European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Main Report

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CONTENTS

S1 AIMS AND APPROACH OF STUDY

The aim of this study was to consider the *economic* implications of environmental liability systems and to examine the *economic* case for action by the EU. A parallel study [(1)] examined the legal aspects.

Environmental liability systems are of interest for a number of potential benefits that they can offer:

- They can provide incentives to prevent or remedy environmental damage not currently covered by other instruments.
- They can directly compensate the victim.
- They give force to the polluter pays principle.
- They are, in some circumstances, more economically efficient than regulatory (command and control) or economic instruments.

The approach taken in this study was to first identify in principle what the expected benefits and costs of a liability system would be, and then to examine the available empirical data and supporting studies. Finally, interviews were carried out with a small number of firms in seven industrial sectors in each of five countries, four from the EU and one from East Europe. Interviews were also carried out with representatives of banks and insurance companies in the five countries.

A significant finding of the study is the surprising lack of previous studies into the economics of environmental liability systems. None of the EU countries studied had carried out empirical economic studies into either the costs, or the benefits, of their existing or future liability systems. A similar lack of empirical analysis is evident among the principal economic actors; firms, insurance companies and banks. The research conducted for this study was unable to find any firm or industrial association which had fully quantified their existing and future environmental liabilities [(2)]. Nor did the research reveal that banks or insurance companies were able to quantify the future costs in any detail.

There are many reasons why the empirical basis for policy making in this area is poor. Two specific reasons are:

- environmental liability systems are novel in Europe and very little experience exists;

[(1)] 'Study of Civil Liability Systems for Remedying Environmental Damage: Legal Study', McKenna & Co, 1996

[(2)] We are aware that a small number of multinational firms have made provisions in their accounts for some or all of their expected future liabilities.

- as with the evaluation of other prevention systems (eg policing, fire services), the target for performance is the *avoidance* of accident or damage; this effect is inherently unobservable.

S1.1 ***Environmental Liability Systems and Other Instruments***

The use of an environmental liability system was compared to alternative types of instruments, ie regulation and economic instruments, using a number of criteria:

- economic efficiency in controlling pollution;
- incentives for prevention, remediation and future technology development;
- transaction costs [(1)];

These criteria were used to provide initial indications of the relative applicability of environmental liability systems to different types of environmental problems.

Environmental liability systems work best where there is clear causation, for example in accidental damage or where a single polluter affects a single victim. Environmental liability systems can be efficient due to their flexibility, since they allow the polluter to choose the least cost actions [(2)], but these choices may be made more difficult due to the uncertainty of the potential size of liability. Uncertainty will be greatest where causation is unclear and the size and value of damage is difficult to assess, eg ecological damage from diffuse pollution.

Regulatory instruments can be relatively effective where the socially optimal pollution level is known, small differences in marginal abatement costs exist, and the regulator has good access to information on abatement costs. Economic instruments can be effective where the underlying markets are not characterised by market failures and where there are large variations in firm's pollution control costs so that giving firms freedom to choose their abatement options can reduce these costs. Both regulation and economic instruments require regular monitoring of the firm's polluting activities.

Taking these characteristics into account leads to the conclusion that an environmental liability system has a comparative advantage in accidental pollution problems to all media, gradual pollution, especially for damage to soil and water, provided causation can be proved at reasonable cost,and possibly also for historic soil contamination (provided that transaction costs can be kept low). Environmental liability systems have comparative disadvantage for diffuse pollution (especially air, possibly water) where there are multiple polluters and multiple injuries, and where causation is difficult to prove.

(1) These costs include legal costs, administration costs, risk assessment procedures, monitoring and enforcement costs.

(2) This is an advantage they share with economic instruments.

There is a complementarity between environmental liability systems and other instruments, since no one instrument is effective for all types of pollution. An example of this is ecological damage to natural habitats and the unowned environment, where the comparative advantage depends on the type of pollution and its sources.

The efficiency of alternative instruments can, in principle, be compared by examining the costs they impose on polluters and regulators in order to achieve a desired environmental objective. In those cases where economic instruments are applicable to pollution problems, a number of empirical studies have found them to be more economically efficient than regulations, ie they can achieve the same environmental objective at lower, sometimes substantially lower, cost. Unfortunately, there are no existing empirical studies of the performance of environmental liability systems, in terms of cost-effectiveness or efficiency compared to other instruments.

S2 *THE COSTS OF ENVIRONMENTAL DAMAGE*

S2.1 *Environmental Damage*

There continues to be considerable unremedied environmental damage in the EU which could, as a starting point, be internalised by an environmental liability system. In attempting to determine just how large, this study again faced enormous deficiencies in the data. No EU country has sufficiently detailed data to be able to produce a comprehensive estimate of this unremedied environmental damage. Partial estimates exist for some types of pollution but the data is very scarce and extremely variable. Using an indicator approach, we have estimated the annual costs of residual damage for EU countries could vary within the range of 4-7% of GDP [(1)]. This range arises through three factors:

- the different levels of polluting activity in Member States;
- the sensitivity and concentration of receptors;
- the different levels of existing environmental protection.

A common EU approach to an environmental liability system has the potential to level out these differences between existing levels of environmental protection, although it would be complex to design a system which achieved the same effect within different jurisdictions, even if there were not variations in the sensitivity of receptors.

The uncertainty in the level and distribution of damage, and the scope for discrepancies in the valuations between different polluters, is clearly unsatisfactory. However, if a European system of environmental liability were introduced, courts would require guidance on the application of damage valuation methods. A first step could be to prepare a set of

(1) Note that if annual damages are as high as this, then it implies that a 'green accounting' estimate of GDP growth would be negative for most countries in most years.

European guidelines for the application of damage valuation techniques, and a framework for assessing damage values.

S2.2 *Current Levels of Environmental Expenditure*

The study has attempted to collate existing data on European industries' expenditure on pollution prevention. This is of interest for two reasons:

- discrepancies in expenditure between EU Member States might already be affecting competition;
- to assess the overall size of current expenditure in relation to the estimated value of residual damage. If residual damage was internalised through an environmental liability system, would this significantly increase the cost burden on firms compared to current environmental expenditure.

The reliability of the data is very uncertain but it tends to indicate that there is a discrepancy between countries in spending by industry on pollution prevention.

The evidence from industry is that, where an environmental liability system exists, firms are unable to separate their environmental costs into those induced by the environmental liability system and those carried out for other reasons, eg compliance with regulations or company environmental policies. Most prevention activities are induced by the combined effects of many factors.

Although firms are not able to identify clearly the extra expenditures which might be induced by stricter liability systems in the future, overall the costs of environmental protection and regulation issues remain a 'top three' concern for industry. In combination with other parts of the environmental protection system, a strict liability framework can be expected to induce a greater level of care towards environmental protection by firms.

It is not possible to measure the extent to which different elements of a stricter liability system would induce further preventative expenditure by industry.

S2.3 *The Impact of an Environmental Liability System*

In relation to the environmental problems for which a liability system may be most effective, what share of environmental damage could be addressed?

Estimates of the share of environmental damage by media suggest that the proportion of damage to land lies in the range 10% - 40% of total damage. Another indicator is the proportion of non-diffuse (ie point source) to diffuse pollution; this is probably around 15%. In relation to soil contamination, accidental releases may cause only around 15% of damage, compared to 85% for on-going releases (see *Section 2.1*).

If an environmental liability system is applied only to those types of problems to which it is most suited, then it might only internalise a small percentage of total environmental damage [1], although it can create wider incentives for prevention.

An environmental liability system might be applicable to some transboundary pollution problems such as accidental water pollution, but probably not for other transboundary problems from many different sources (eg air pollution) where it is difficult to determine and prove which source caused (a share of) the pollution damage

S2.4 *Competitiveness and the Costs of Liability*

Existing Liability Systems

It seems unlikely, based on the results of the interviews, that existing liability systems in EU member states are currently creating any significant distortion of trade. In the interviews, no firms indicated that the environmental liability system on its own was a problem. This is not surprising, since the current cost of environmental liability system is a negligible percentage of the value of output, and so has little influence on current production decisions.

Environmental cost differences would have to persist for the long term, and be expected to continue, to influence decisions about the location of future investments. Furthermore, the approach of multinational firms, who are the most frequent types of firms to view investment location decisions in an international context, is to apply the same environmental standards to all EU countries that they operate in, irrespective of differences in environmental standards and legislation.

Most firms indicated that environmental issues overall were a factor in investment decisions, but not necessarily between countries. Firms are also concerned about transparency in decision making and a predictable regulatory environment.

Future Liability

Without a common approach to environmental liability systems in Europe, the costs of compensation for damage could diverge within the EU.

A trade model of a key competitive industry, the bulk chemical industry, was used to simulate the effects of future liability systems on competitiveness by examining the impact of cost differences up to 2% between countries. The results of simulations showed that in, the long run, this could produce relative changes in market shares of individual EU countries of between -4% and +2%. In an industry like the chemical industry, which is very competitive and where the products of a number of firms are close substitutes for each other, relatively small differences in costs can have quite

[1] This can be compared to the estimate for Germany; the environmental liability system is currently estimated to internalise only about 1% of total environmental damage.

significant effects on loss of market share. However, the trade links and cost differences with countries outside the EU are an important factor, and possibly more important than the environment-related cost differences between EU members and between EU members and third countries, in altering the relative competitive position of EU countries vis-a-vis third countries.

Within the EU, the internal market has levelled out a number of impediments to trade and investment. There is also a greater similarity within the EU in terms of availability of infrastructure and economic policies, than is the case with third countries. Therefore, the impact of environmental cost differences might be expected to be greater within the EU and create problems of internal competition. In the framework of this study, however, it was not possible to find conclusive empirical evidence in this regard.

For other industries examined in this study (leather tanning, pharmaceuticals, electronics, hard coal mining, pulp and paper, wood industries), the impact on competitiveness of future environmental liability systems is likely to be less than for chemicals. This is because these industries are either less competitive than chemicals, are traded less or have a higher share of transport costs in their total costs.

S2.5 *The Benefits of EU Action*

The empirical support for assessing the benefits of EU action has been found to be limited by lack of data. It is nevertheless possible to summarise the general case for EU action.

Environmental liability systems can create effective means to remedy some types of environmental damage, eg accidental damage with clear causation, and incentives for prevention of environmental damage in general. Conversely, it can be argued that in the absence of an environmental liability system damage would be higher, as firms would then not face any potential liability claims. Therefore, a liability system could be a further policy instrument to use as a complement to existing instruments.

There is already a divergence of environmental liability systems, as well as current environmental expenditure, across the EU countries. The differences could increase, for example if those countries who have expressed willingness to sign the Lugano Convention do implement systems of that type and other countries do not.. The competitiveness analysis provided only a general indication of whether the cost differences which might emerge would distort future trade. But environmental issues are a major concern of firms in environmentally sensitive sectors. Firms want certainty across all the EU to promote the single market and facilitate mobility of capital. In this context, the uncertainty of divergent and changing liability systems in different countries could be a more important factor in long term decisions than the direct cost differences.

The issue of including transboundary pollution within the scope of an environmental liability system depends on the type of pollution. Most transboundary pollution is airborne, ie of a diffuse nature and with unclear causation and is not therefore well suited to internalising through an environmental liability system. Other existing cases of transboundary pollution, such as polluted rivers, impaired habitat areas and transport of hazardous waste, may be amenable to being handled through an environmental liability system. However, they may also be capable of being handled through bilateral or international agreements.

S3 THE RESPONSE OF ECONOMIC ACTORS

S3.1 Firms' Responses

Existing liability systems have only had a limited impact on pollution expenditure or compensation payments and have not been, of themselves, a major concern to firms. There has been no clearly identified impact on competition. However, due to the joint effects problem, firms are mostly unable to separate the impact, on their costs, of an environmental liability system from other environmental policies.

It is therefore not surprising that induced prevention costs have appeared to be small and have been hard to detect. Of the firms in the survey, none had made quantitative assessments of their liabilities or quantified the reductions of risk due to preventative expenditure. Similarly, they had not assessed the consequences of future liability systems and were unable to distinguish clearly the potential effects of most policy elements.

SMEs

The flexibility of an environmental liability system, in allowing firms to choose the means of prevention, could be advantageous to SMEs. SMEs may also welcome the transparency and level playing field that a legal system offers. However, most environmental policy instruments, including liability systems, can bear more heavily on SMEs than on large firms in relation to their financial resources.

SMEs are more vulnerable to environmental risks since they are not as diversified as large firms and have limited management capability for prevention. This makes them more exposed to the risks of a large pollution incident. Damage caused by one process may therefore create significant environmental liabilities for a small firm.

The cost of complying with the complex regulations related to an environmental liability system, and the cost and length of possible litigation, will tend to be fixed costs which bear more heavily on SMEs.

Limits on liability, if set in relation to the activities of large firms, would be untenable for small firms; there would need to be a size related element in determining the limit, although this might lead to some damage remaining uncompensated. This potential problem would be exacerbated if large firms created small firms to limit their exposure to risk. It might also be difficult to set an EU wide limit.

Insurability is a crucial issue for SMEs, since they have limited financial resources to cover their own risks. Risk assessment procedures carried out or required by insurance companies (and banks) would be relatively more costly to small than large firms.

Liability risks could lead banks to take a more conservative approach to valuing fixed assets as collateral for loans, particularly if insurance companies place relatively low limits on their cover. This would reduce the borrowing capacity of SMEs and result in lower investment.

Having said that, a SME's impact on the environment can be proportionally greater than its size and SMEs' collective impact can be considerable. Therefore it is hard to justify that they be fully exempt from liability rules. Moreover, there are EU compensatory mechanisms such as the Community Guidelines on State Aid for Environmental Purposes. These provide more favourable conditions for SMEs to help them adapt to environmental standards.

Attitudes of Firms to Future Liability Systems

During the interviews with firms their attitudes to current and possible future liability systems were discussed. The interviews indicated that most firms surveyed accept the polluter pays principle but are not willing to pay for another firm's damage; hence there was a reluctance to consider participation in industry-financed joint compensation funds.

Firms also wanted a fitness-for-use criterion applied to clean up standards.

Firms do not want:
- retroactive liability
- compulsory financial security
- joint (industry financed) compensation funds
- strict liability without limits or defences

The interviews also indicated that firms might possibly under certain conditions accept:
- compulsory insurance
- rights of action by NGOs

S3.2 *Insurance Companies*

Insurance companies expressed two distinct concerns in relation to environmental liability systems. One is the increased vulnerability of insurance companies from old policy exposure for historic pollution, especially under a system of retroactive liability. The other is the need to change insurance policies to cope with stricter environmental liability.

The insurance market's role is considered to be very important for three reasons:

- liabilities will probably need to be insurable for all but the very largest firms, in order that firms can manage their financial risks;
- to ensure that victims will be compensated when the size of compensation exceeds the firm's ability to pay;
- the test of insurability is an indicator of whether the environmental liability system will be able to efficiently internalise the damage costs. Uninsurable risks, unless arising through known ongoing activities of the firm, will either be because the risk is not assessable (in which case the firm will not be able to respond rationally) or because a claim would not be able to succeed because the type of problem makes causation difficult to prove.

The proportion of environmental damage covered by insurance is currently small, estimated on the basis of our discussions with insurance companies at less than 1%. However, retroactive liability would create a long tail of claims for which insurers have not collected a premium, and therefore for which they do not have planned reserves.

If increased insurance coverage is desired for polluting firms then any decisions taken on what will be included in a future stricter environmental liability system must take into account the views and financial interests of the insurance industry.

Insurance companies are beginning to separate environmental risks from general liability policies, or create pools. They now manage the process of offering environmental damage cover more carefully with greater risk assessment. They focus on clearly specified environmental risks where these can be estimated and premia set accordingly. The new policies tend to *reduce* the size of cover and restrict scope, to limit insurers' overall exposure to environmental risks. Site audits are becoming increasingly required before insurance is given to polluter industries. These increase transaction costs (possibly by adding around 10% to premia) and can affect SMEs' capacity to purchase insurance. Although environmental policies are more costly than general liability policies, they are, in principle, available to all sizes of firms.

Compulsory insurance has been proposed as a way of ensuring that all victims will be compensated. The experience of compulsory insurance in Germany has highlighted the practical problems concerning this provision. Insurers that we have spoken to in the context of our study are opposed to the idea, one reason being that they do not wish to be placed in the role of pollution police. There is also a fear that, by intervening in the insurance market in this way, overall costs and premia will rise. Furthermore, because of the immaturity of the environmental liability insurance market, insurers would need to gain considerably more experience before any compulsory scheme can feasibly be introduced.

Compulsory insurance would also prove problematic for potential policyholders, especially SMEs. If individual insurance companies have the right to refuse cover for high risk firms, they would then either have to close or incur a large financial burden to achieve satisfactory pollution prevention standards as judged by the insurer. In the short term costs might rise substantially if insurance companies take a conservative approach to limiting their risks. Insurers would also try to limit the size of cover for high risk firms.

The key difficulties for the effectiveness of insurance in future environmental liability systems, as identified by the insurance industry, include:

- the lack of a claims history (on frequency and size of claims) on which to assess risks;
- the uncertainty in future claims, which will be influenced by a series of unknown risks [1];
- therefore insurers are unable to reliably assess or quantify the scope of cover or the change in the size of premia under stricter liability regimes.

Prevention incentives for firms may be provided by the self-insurance components of policies, but, so far, premium rates have not reflected to any significant extent varying levels of risk in a transparent and objective way. Current rates may vary widely between different insurers and firms (with comparable risks). Therefore, so far, the costs of insurance are unlikely to have provided effective economic signals. However, this market is a fairly recent one and the accumulation of experience by insurers is likely to lead to higher economic efficiency in future, as has been the case with other insurance markets.

Insurers will provide some cover under stricter regimes, but the scope or cost is unknown. In the immediate future, the scope will tend to be limited as follows:

- No cover for damage to natural habitats and the unowned environment.
- No cover if the burden of proof is reversed with no defences.
- Insurers will not cover retroactive liability.
- Insurers will cover accidental damage but hardly any ongoing pollution.
- Insurers do not expect to cover much or any air pollution damage.

Insurance markets may need considerable time to evolve and mature. The environmental liability insurance market is not currently attractive to insurers and they will need considerably more claims experience before they are able to set premia which reflect the real risks of polluters and have the confidence to place a significant proportion of their reserves at risk.

[1] The particular risks involved in environmental liabilities are: the development of scientific knowledge about hazardous substances; the claims consciousness of the public; the valuation of damages and/or the standard of restoration; the litigiousness of the public; and the law court's interpretation of liability and damages.

Due to the circularity of this problem, insurers will need to be encouraged to increase their cover under environmental liability policies in parallel with the development of future environmental liability systems. There is therefore a case for gradual step by step development of this market.

S3.3 *Banks*

Banks were also interviewed in the study countries. They appear to be more uncertain than insurance companies about the implications of current and future liability systems. The discussions focused on the following issues:

- the impact of an environmental liability system on borrowers' access to loans;
- the potential risks to banks of acquiring the environmental liabilities of their borrowers.

Not all banks are yet fully aware of the environmental risks of their borrowers but see the problem mainly in relation to SMEs (who form the bulk of bank's secured lending).

There have begun to be cases where bad debts have occurred as contamination of land reduces the value of the banks' collateral. The need to carry out even a limited assessment of environmental risk raises the transaction cost of lending and disproportionately affects small loans. Therefore small firms may be particularly affected by costs of risk assessment. The availability of finance could be restricted for those sectors which have traditionally borrowed against the value of property, but who are carrying out potentially contaminating activities, since the security value of property will be reduced. This would also affect SMEs particularly badly.

If joint and several liability creates a 'deep pocket' syndrome, the uncertainty of a firm's future liabilities will reduce their credit standing and their borrowing capacity. Banks would be even more cautious if they felt that they could become the 'deep pocket' themselves.

Banks are particularly concerned to limit the liability of the lender in cases where the bank takes a charge over the assets of the firm. Without this protection, banks would not be prepared to lend to many high risk firms.

Compulsory financial security is an area where banks see considerable difficulties. Most financial security instruments have a limited term (eg 5 years) and so would not provide security for damage which has a long term delayed effect. The value of the financial security would directly reduce the borrowing capacity of the firm and this would particularly restrict lending to SMEs.

S3.4 *Compensation Funds*

Compensation funds are under consideration as a complementary mechanism for compensating victims or remedying damage which might otherwise not be covered by a liability system. They may also offer some benefits when remediation is slow or to avoid complicated litigation between multiple polluters and victims.

Funds which have been examined by this study include those in Germany, the Netherlands, France, Japan and the US. Experience shows that the funds have most often been applied to diffuse pollution problems and to orphan contaminated sites for which there is no responsible party liable to pay for the clean up, but the funds have had varying degrees of success. It has proved difficult to predict the level of claims arising and to match the claims met to the availability of funds.

There are two main drawbacks to compensation funds. Firms are resistant to compensation funds where it might result in them paying large amounts for other firms' pollution, including their competitors. It may appear inequitable as well as conflicting with the polluter pays principle. Furthermore, unless financing of funds is proportionate to actual pollution, it fails to create efficient incentives for prevention. But if proportionate financing is possible (ie where there is clear causation) there is less need for a joint compensation fund. Reconciling these two problems requires finding a funding basis which strikes an delicate balance between maintaining equity and efficiency while providing a simple and broad funding base.

There may be a valuable role for a compensation fund to remedy damage or compensate victims where there are many sources of the polluting emissions (eg air pollution) so that assigning liability for each individual source would not be worthwhile under an environmental liability system, and where the emissions could be easily monitored so that taxes on these emissions could finance the fund. This then would combine a compensation fund to remedy the damage with an economic instrument (a pollution tax) to finance it.

The level (local, national or EU) at which funds are organised may differ for administrative and financing purposes. Cost effective administration requires a strong local involvement, while financing may also appear more equitable if locally based so that the benefits of the fund are felt by those who have contributed to it. Using existing national systems for collecting taxes or charges can reduce the costs of administering a fund. While it is possible to argue for economies of scale in large (eg EU level) funds which have a very broad funding base, there is little evidence to support this and the trend is towards more locally or nationally based funds.

S4 SUMMARY OF ECONOMIC STRENGTHS AND WEAKNESSES OF AN EU ENVIRONMENTAL LIABILITY SYSTEM

A key finding of the study has been the lack of economic data on costs and benefits. Analysis of the issues is therefore surrounded by considerable uncertainty [1]. This suggests that a cautious attitude should be taken in the shaping of an environmental liability system.

The size of unremedied environmental damage is highly uncertain but is nonetheless probably quite large. An environmental liability system is a complementary instrument to other policy instruments. Its appropriate use in addressing this damage depends on the type of problem; unclear causation is a key issue in limiting the scope of application of environmental liability. Accidental damage is well suited to liability, but this is only a small part of damage.

Environmental liability is potentially a flexible instrument but introduces a high level of uncertainty for economic actors in assessing their risks. Since insurability of risks would be a supportive factor for the development of a liability system, the shaping of an environmental liability system should also aim to minimise the uncertainty of future liabilities.

Based on the economic issues examined in this study, implications can be drawn on the strengths and the weaknesses of the economic case for several of the elements of a future environmental liability systems. These summary findings are given below (a short explanation is given in brackets after each point):

THE ECONOMIC CASE IS STRONG FOR:

- Accidental pollution. (An environmental liability system is likely to be more effective than other instruments, for damage to all media, in both remedying and compensating damage to the environment, and in creating incentives for prevention.)

- Gradual pollution, provided causation can be proved at reasonable cost. (Liability for accidental pollution will also result in increased care towards preventing gradual pollution.)

- Encouraging the development of the insurance market in specific niche categories of environmental insurance in parallel with the development of the environmental liability system.

- Strict but proportionate liability. (This is consistent with polluter pays principle. Proportionate, rather than joint and several, liability is strongly preferred by firms, banks and insurance companies, although it may be difficult to prove which part of the damage is attributable to each polluter where there are many polluters and causation of damage is not clear.)

[1] There is a need for more economic studies at the national or sectoral level to address this issue.

- Cost-effective restoration standards. (Limits the cost of unnecessary remediation).

- Developing a set of European guidelines for the application of damage valuation techniques and a framework for assessing damage values; this is particularly needed if ecological damage is to be included within the scope of an environmental liability system.

- Providing protection to lenders from the liability of their borrowers (also providing protection to contractors carrying out site remediation to limit their liability).

THE ECONOMIC CASE IS UNCERTAIN FOR:

- Rights of action by NGOs. (More cases of environmental damage could be dealt with if NGOs have a right of action, under control of the judiciary, especially for ecological damage to the unowned environment where normally no individual citizen has an interest to take action. However, even with built in mechanisms to avoid legal procedures as much as possible, it is likely to increase transaction costs.)

- Reversing burden of proof. (The advantage of placing the burden of proof on the operator is that he is more familiar with the possible effects of the emissions from his activities than is the plaintiff. On the other hand, it is always difficult to prove something negative, eg that the emissions have not caused the damage.)

- Limits on firms' liability. (Most risks are small, but risk averse firms may over-invest in prevention with unlimited liability. Banks would also restrict lending under unlimited liability due to a conservative assessment of the worst case large risks. Insurance companies will always limit cover. Limited liability, possibly only for a transitional phase, will still give incentives for prevention, while significantly reducing uncertainty.)

- Special provisions for SMEs. (An environmental liability system can have both advantages and disadvantages for SMEs. It will increase the burden on SMEs disproportionately in relation to their financial resources, but exempting them does not prevent pollution).

- Publicly financed compensation fund. A joint compensation fund financed by industry contributions may not be efficient or fair since the current firms are not responsible for the pollution (as in the case of sites contaminated by past pollution). There is a public good aspect to using public funds to remedy such environmental damages.

THE ECONOMIC CASE IS WEAK FOR:

- Retroactive strict liability with no defences. (Insurers and banks would withdraw from the market, activity on old sites would be inhibited.)

- Industry funded compensation funds. (Firms are not willing to pay for their competitors' pollution; clean firms would pay twice, thereby creating a disincentive for prevention; the size of contributions would be arbitrary and therefore not provide effective economic incentives.)

- Compensation fund organised at the EU level. (Locally or nationally organised funds may be more effective).

- Compulsory insurance. (Insurance companies may only be able to offer comprehensive and cost-effective policies in a very mature liability insurance market where the risks for all firms are well understood. It would be difficult to ensure that insurers do not charge excessive rates) .

- Compulsory financial security. (This could severely reduce lending to SMEs for investment. It would also be limited in duration and not match the timescale of potential liability to long term problems.)

- Extending the scope to diffuse sources of damage, eg ongoing air pollution. (Without clear causation liability is difficult and costly to prove.)

- Joint and several liability. (This is unlikely to produce efficient incentives for prevention and can lead to high transaction costs.)

1 AIMS AND BACKGROUND TO THE STUDY

This *Final Report* has been produced by *ERM Economics* for DG XI of the European Commission. The report summarises the issues and findings resulting from the research carried out during the study:

> *Economic aspects of liability systems and joint compensation systems for remedying environmental damage.*

Environmental Liability System (ELS) is the term used where civil law (and sometimes administrative law) provides a specific opportunity for pollution victims to bring claims for against polluters. If polluters are found to be liable for the damage, they will then be required to compensate the victims or remedy the damage. Special features of an environmental liability systems as an environmental policy instrument include: it is driven by the pollution victims, it provides for direct compensation to victims, it seeks to make polluters fully liable for all the damage caused.

Compensation Funds are usually designed to operate when polluters can not be identified or can not pay to remedy the damage. The compensation fund then either compensates victims or pays to remedy the damage. The fund is financed by a collective group of polluters.

Study Team

ERM Economics' core team was supported in this work by a large team of contributors including Fondazione Eni Enrico Mattei (FEEM) of Italy and by researchers from the Universities of Bonn and Dortmund in Germany. The main inputs to the study of these and other contributors are shown below:

ERM Economics*(Overall project management, UK country analysis, US experience)*
Professor Helmut Karl, University of Bonn *(Germany country analysis)*
Professor Ingo Heinz, University of Dortmund *(Estimates of environmental damage costs).*
Dr Sven Erichsen, Jauch & Hubener *(German insurance industry)*
Dr Roberto Malaman and Dr Domenico Siniscalco, FEEM, *(Italy country analysis, small and medium sized enterprises)*
TAU Consultora Ambiental *(Spain country analysis)*
ERM Hungary *(Hungary country analysis)*
ERM Italy (firm interviews in Italy)
Dr Ted Buijs, Oranjewoud *(Insurance industry, compensation funds and Netherlands country analysis)*
Professor Alistair Ulph *(Simulations of industrial competitiveness)*
Professor David Pearce *(Valuation of environmental damage)*
Dr Anthony Heyes *(Economic analysis of policy instruments, future environmental damage).*

1.1 *AIMS OF THE STUDY*

This study was designed to investigate and analyse the economic effects of civil liability and joint compensation systems for remedying environmental damage, with a view to providing analytical material on the basis of which the European Commission can develop its policy in this field. It focuses on the economic issues. A parallel study was undertaken by other consultants to examine the legal issues.

The economic analysis aimed to examine whether environmental liability systems have the potential to be a more efficient tool than other environmental policy instruments, particularly for the prevention of pollution. The study addresses the following:

- What are the economic implications of extending the use of environmental liability systems and/or compensation funds?
- What are the main economic effects of action and non-action of the EU regarding civil liability for environmental damage?
- What are the economic costs and benefits of alternative types of liability systems and compensation funds?

1.1.1 *Background to Environmental Liability in the EC*

The European Commission issued a *Green Paper* [1] in 1993 to initiate discussion in this field. This study was commissioned by the European Commission in the context of the preparatory work it felt was required to appraise the need and desirability of further EU initiatives on this subject.

Environmental policy has been implemented, up till now, mainly through the use of regulatory instruments (command and control). More recently, there has been a growing interest in the use of economic instruments although their application has so far been limited.

Civil liability systems for remedying environmental damage are a complementary set of instruments which offer a third approach.

Civil liability [2] is a legal tool to make those responsible for causing damage, pay compensation for the costs of remedying that damage. The *Green Paper* set out various options for the elements of an environmental liability system.

Many different types of environmental liability system are possible, covering some or all of the following aspects:

(1) 'Green Paper on the repair of damage caused to the environment', European Commission, March 1993 (COM (93) 47)

(2) Civil liability arises under private law, whereas criminal and administrative liability arise under public law.

* fault-based or strict liability;
* joint and several or proportionate liability;
* types of environmental damage to be covered;
* limitations of liability and financial security;
* the right to bring a legal action.

Section 1.2 discussed the economic implications of these and other issues regarding the different types of environmental liability systems.

Also in 1993 the Council of Europe proposed a convention on civil environmental liability, known as the *Lugano Convention* [1]. So far this convention has been signed by eight countries of which five are EU Member States (Finland, Greece, Italy, Luxembourg and the Netherlands). Although there has been no ratification of the convention to date, several Member States are in the process of ratifying the convention. This situation raises the possibility that there could be a growing divergence of environmental liability systems within the EU.

These two documents stimulated discussion about the overall case for implementing environmental liability systems and, in particular, whether action at the EU level was justified by the following particular European dimensions of the issue:

* the impact of environmental costs on competition in the single market and the distortion of trade within and outside the EU;

* transboundary pollution issues;

* the subsidiarity principle and Member States' development of their own liability systems within their diverse jurisdictions.

This study, and the parallel legal study, provide a further and more detailed examination of the issues related to environmental liability systems in the EU.

1.1.2 *Why have an Environmental Liability System?*

No one environmental policy instrument can achieve all the environmental objectives on its own. Each type of instrument has different strengths and weaknesses (these are discussed in *Section 1.3* below). The particular characteristics of a liability system are that it has the potential to compensate directly the victims of pollution, is driven by the actions of the victim or their representatives as in some cases for NGOs regarding ecological damage to the unowned environment. In some circumstances, it may also be more economically efficient than other instruments. The benefits of including a liability instrument within the panoply of environmental instruments may

(1) Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment', Council of Europe, June 1993.

therefore be seen, in the context of a number of principles and criteria which guide EU environmental policy, to:

- provide incentives to prevent environmental damage (the prevention principle);
- provide a more efficient instrument for certain types of pollution problems, compared to regulatory or economic instruments (the cost-effectiveness and economic efficiency criteria);
- ensure that polluters become liable for the damage they cause (the polluter pays principle);
- create a mechanism to provide compensation for the victims of pollution (the equity principle);
- remove or reduce the distortion of competition due to differing environmental costs within the single market;
- provide improved rules and mechanisms for dealing with transboundary pollution problems.

The study has examined the extent to which these benefits are likely to be realised, together with the costs and other economic problems associated with implementing environmental liability systems within the EU.

1.1.3 Research Methods

The study has been carried by a multi-disciplinary team drawn from several countries, and has followed four principle lines of research:

- *Existing studies;* reviewing existing economic studies and experience in selected EU (and some non-EU) countries.
- *Interviews and country analyses;* undertaking interviews with key economic actors (firms, insurance companies and banks) in selected countries.
- *Topic papers; five key topics were examined in greater detail: valuation of environmental damage; impacts on industries' competitiveness; insurance; implications for small and medium sized enterprises; and compensation funds.*
- *Industrial competitiveness simulations; carrying out simulations of the impact on trade competitiveness of possible future costs due to divergent liability systems.*

Existing Studies

An early step in this study was to attempt to collate information, at the national level, from similar economic studies to this one. It had been expected that the costs and benefits of liability systems would have been researched elsewhere, especially in those countries which have introduced some form of environmental liability systems of their own (eg Germany, UK, Netherlands, Denmark).

Surprisingly, it was found that almost no substantive studies had been carried out in the EU countries either by Governments or industry. *Table 1.1a* indicates the paucity of studies and lack of existing economic information within the EU countries selected for this study and three other countries with a strong interest in liability systems. Most analyses refer back to the US data on Superfund where the costs, and also to a very limited extent, the benefits have been examined in some studies (eg Probst et al [1]).

Table 1.1a ***National Empirical Studies on the Economics of Liability Systems and Compensation Funds***

	Existing Economic Studies Covering:		
Country	***Costs of liability systems***	***Benefits of liability systems***	***Compensation Funds***
Germany	None	None	Some
Hungary	None	None	None
Italy	None	None	None
Spain	None	None	None
UK	None	None	None
Netherlands	None	None	Yes
Denmark	None	None	None
Japan	None identified	None identified	None identified
US	Yes	Limited	Yes

Interviews and Country Studies

In order to maximise the usefulness of the study while keeping its costs and duration within acceptable boundaries, the research focused on five countries selected to be representative of the range of approaches to environmental protection and stages of development of liability systems in Europe. These countries were:

- Germany;
- Italy;
- Spain;
- UK;
- Hungary.

[1] 'Footing the Bill for Superfund Clean Up: Who pays and how?', Probst et al, The Brookings Institute and Resources For the Future, 1995.

An in-depth analysis was carried out for Germany, as their experience of liability systems since 1991 is the most extensive in Europe. Shorter comparative country case studies were carried out for the other four countries. Hungary was included as an example of an East European country with more limited experience in environmental liability. A summary of the current legal framework for environmental liability in these countries appears in *Annex B.*

Specific research was also carried out in the Netherlands, Denmark, Sweden, France and Japan, and the US experience of Superfund was also reviewed.

The country studies collated the available information on past economic studies, estimates of the valuation of environmental damage and current expenditure on environmental protection. Interviews with industry, insurance companies, banks and relevant Government departments were carried out to assess the costs and implications of existing environmental liability systems and to seek views on current and possible future liability systems and compensation funds. Interviews were carried out with 16 insurance companies and 7 banks in the UK, Germany, Italy, Spain and Hungary. The main industrial interviews were carried out with 63 firms and focused on firms and industrial associations in the following major sectors:

- chemicals, petrochemicals, oil production and refining;
- pulp and paper;
- pharmaceuticals;
- leather tanning;
- electronics;
- wood treatment;
- mining;
- iron and metals.

Topic Papers

Six topics were identified as being of particular concern for their economic implications. In addition to industrial competitiveness (see below), the topics covered were the insurance industry, valuation of environmental damage, compensation funds, implications for SMEs. In addition experience with Superfund in the US was reviewed.

Industrial Competitiveness Simulations

A trade simulation model of the basic chemicals industry was used to simulate the possible competitiveness implications of cost differences between EU countries and its main trading partners, if environmental liability systems were to diverge in the future. US Superfund costs were used as indicative of the maximum likely cost impacts. The implications for a number of other industries (wood products, pharmaceuticals, electronics, leather tanning, pulp and paper, mining) were also assessed by comparison with the chemical industry simulations.

1.1.4 *Limitations*

It became evident early in the study that there were serous limitations to the availability of empirical economic data. There are a number of reasons why this problem was faced.

- *Prediction difficulties.* A liability regime is more difficult to model than other policy regimes. The response of economic actors is highly sensitive to the context (legal and market structure), to the precise design of the liability system, and to the interpretation of the courts. Furthermore, the elements of the liability system can be linked with each other and it is difficult to assess the effects of the separate elements of a liability system.

- *Joint effects problem.* The impact of a liability system is difficult to separate from the simultaneous impact of other environmental policy instruments. Firms carry out pollution prevention measures in response to the combined effect of all the pressures they face (eg environmental regulations, liability and public pressure) and are unable to associate a particular expenditure activity with a particular policy instrument (the joint costs/joint effects problem).

- *Speculative and uncertain effects.* There is very little actual experience of liability systems in Europe. Even in the US, where the Superfund system has been operating since 1980, the transferability of experience is limited and the criticism of the approach has now led to a number of very different proposals for radical reform. Thus even within the US domain past experience is still leaving considerable uncertainty over future directions.

- *Poor data.* There is a severe lack of reliable data with which to characterise the problem, ie on environmental damage (that might be captured by a liability system), on current and future costs of preventative measures, and on the potential liabilities faced by different firms and industries.

- *Uncertain damage values.* Reliable valuation of damage is required by all economic actors in order to make rational decisions (eg on preventative expenditure, insurance premia, bank lending). However, the size of faced by a firm are dependent on a series of unquantifiable risks:

  - the public's attitude to pursuing litigation and the likelihood of the victims taking legal action;
  - the uncertainty of legal proofs of liability;
  - the uncertainty of valuation methods;
  - the uncertainty of interpretation by the courts.

This study has therefore had to test theoretical arguments against very restricted empirical data in order to draw inferences on the economic implications of future environmental liability systems.

1.1.5 *Layout of Report*

This *Volume I* comprises the *Main Report*. The remainder of *Section 1* introduces the economic issues in liability systems, compares this instrument to other environmental policy instruments, and briefly characterises the environmental liability systems in the selected countries.

Section 2 presents the findings from the empirical analyses to assess the costs of environmental liability systems in relation to the estimated total cost of environmental damage and also in relation to current expenditure on pollution control.

Section 3 discusses the results and summarises the findings on the economic issues arising out of the interviews with the main economic actors (firms, banks and insurance companies) and the analysis of the potential impacts on industries' competitiveness.

Section 4 provides a short review of compensation funds.

Volume II comprises a series of discrete topic papers elaborating on the issues in the *Main Report*. These topic papers cover:

- Valuation of environmental damage: review of methods;
- Impacts on industries' competitiveness;
- Implications for the insurance sector;
- Implications for small and medium sized enterprises;
- Compensation funds;
- Economic review of the US experience with Superfund.

1.2 *THE ECONOMIC ISSUES IN ENVIRONMENTAL LIABILITY SYSTEMS*

Environmental liability systems can differ enormously in their design and implementation. Each main element of the liability system can have varying economic implications. The purpose of this section is therefore to discuss the main economic issues related to the various elements of liability systems and to highlight those issues which are analysed more fully in *Sections 2-4*. Key economic impacts, which are used to assess the issues, include:

- the effect of the type of system on *transaction costs;*

- the efficiency of incentives for pollution prevention expenditure;

- the degree of uncertainty in quantifying risks and the effect of this on decisions taken by economic actors.

1.2.1 *Uncertainty*

In contrast to regulatory instruments, which tend to have predictable and certain effects, a liability instrument involves a considerable amount of uncertainty regarding the level of prevention that will occur, the damage that will occur, and the financial liabilities that will result from the damage. There are several sources of this uncertainty since many economic actors are involved and they are not always able to foresee the risks. Sources of uncertainty include:

- The probability that unforeseen or unexpected damage will occur.
- The likelihood that victims will make a claim.
- The difficulty of proving who caused the damage. Proof involves several steps linking the emissions of the polluter to the damage caused. Proof becomes more difficult where there are time lags between emissions and damage occurring or being detected. Establishing individual liability is also complicated where multiple polluters have contributed to the damage and more costly under a *joint and several* liability regime.
- The size of the . A number of factors contribute to this uncertainty, including the methods of economic valuation of damage, the size of liability under a *fault based* regime, the restoration standards and speed of restoration required, the subjectivity of Courts' interpretation.

The difficulties and uncertainties of proving who caused the damage and of valuing the damage are particularly pronounced for diffuse sources of ecological damage.

The effect of uncertainty is likely to be to impose higher costs on various economic actors. These costs may appear in a number of ways.

Banks may respond by limiting the size of loans they offer, raising the interest rate, or raising the amount of collateral they require. Insurance companies may similarly respond by lowering the amount of cover they offer or raising the premium rates. Both banks and insurance companies are likely to incur higher risk assessment costs and these will ultimately be passed on to firms. The consequences of this could be disproportionately higher on SMEs.

The response of risk averse firms who are faced with uncertain future costs may be either to over-invest in pollution prevention [(1)] or, in some cases, to withdraw from risky activities altogether. This may particularly affect SMEs. A possible alternative response, particularly by SMEs, might be to under-

[(1)] Over-investment may occur because firms will be strongly averse to the possible costs of a large accident or damages claim, even if it has a very low probability of occurring. This will lead them to invest an uneconomically large amount (ie more than is socially optimal for the sector as a whole) in avoiding low probability damages. This type of risk averse behaviour is sometimes referred to as the *lottery effect*.

invest where the size of the potential liability is greater than the firm's total resources

Although uncertainty is a disadvantage for environmental liability as an instrument, the size of the effects may be small and may diminish over time as experience grows. Many of the implications are discussed more fully in later sections.

1.2.2 *Scope of System*

The scope of the system determines the extent of coverage of different types of environmental damage and is also important in relation to the costs involved in proving causation. At the simplest level of categorisation, environmental problems may be characterised by the affected medium:

- human health;
- materials and buildings;
- land/soil;
- water;
- air;
- ecological damage [1];

and by type of causation:

- accidental damage or damage triggered by a unique event;
- gradual or ongoing pollution.

The economic impacts of the scope of the system are influenced by media and types of damage covered, as these affect how easy or difficult it is to prove causation. If causation is not clear, the main economic impacts will be twofold. Firstly, it will raise the costs of bringing a claim (administrative costs, scientific investigations, legal costs of both parties etc - these costs are collectively referred to as *transaction costs*). Secondly, it will introduce uncertainty to all the economic actors (firms, insurance companies, banks) about the size of their potential liabilities. A risk averse actor will tend to act cautiously when faced with uncertainty which may lead to uneconomic outcomes, eg under (or over) investment in pollution prevention, high insurance premia, restricted availability of bank finance.

One criterion for determining scope is to focus on the largest areas of unremedied damage and/or those which are unlikely to be satisfactorily controlled by other policy instruments, eg ecological damage.

This criterion would orient liability towards achieving overall environmental objectives but could lead to high transaction costs and considerable uncertainty concerning the size of future liabilities.

[1] In this study the term *ecological damage* is used to refer to damage to natural habitats, natural resources or species which are either publicly owned or unowned, sometimes referred to as the *unowned environment*. An example is the loss of habitat of an endangered bird species.

The criterion of *clear causality* is important in order to establish certainty of effects and rationality of actions by the economic actors. For example, insurers are more likely to be willing to provide cover for a potential liability for which a claim could be pursued through the Courts. If this is not possible, it may well be an uninsurable risk since insurers might refuse to accept the claim.

Causation is easiest to prove when:

- there is a single polluter with scientifically established effects;
- there is no, or a short, time lag between releases of pollutants and damage occurring;
- damage can be traced to a unique incident or event; and
- there is an injured party who can sue.

Under these circumstances, transaction costs would be relatively low and liability could be reasonably assessed. Conversely, proof is more difficult when the damage is caused by multiple polluters through gradual pollution and when the effects are revealed after a long delay. This situation can lead to high transaction costs and unquantifiable risks.

Environmental problems where causation could be more easily established include:

- accidental releases to soil and water;
- some accidental releases to air;
- possibly gradual releases to soil; and
- possibly some gradual releases to water.

1.2.3 *Historic and Future Pollution*

Historic damage, especially the problem of soil contamination of old industrial sites, has created a large legacy of remediation costs raising a number of issues.

Some damage was created by firms who were either complying with existing requirements at the time or were not able to know of later discovered toxic effects. These firms have not therefore included the unanticipated costs of clean up in their production costs and have not set aside financial reserves for the purpose [(1)]. The same problem applies to insurance companies who were unwittingly providing cover for unanticipated without building up reserves. A further problem is that many sites have passed through multiple ownership and uses. Liability is difficult to apportion equitably and some polluters may no longer exist, creating the problem of *orphan sites.*

[(1)] We are aware of a small number of multinational companies who have made provisions in their accounts for future liabilities.

There is no incentive effect in making existing firms retrospectively liable for historic damage. However, if they knowingly polluted with hazardous substances or contravened the then existing regulations, it is nevertheless justifiable to make them pay for the remediation of such damage. The problem of paying for remedying the remaining damage is primarily a question of creating a funding mechanism to pay for cleaning up pollution caused by past activities. This raises the question of what share should be borne by industry, consumers and public funds?

Retrospective liability may frequently also involve unclear causation, raising the problems of high transaction costs and large uncertainty concerning the level and attribution of the liabilities.

Future liabilities can be considered in four cases.

- Releases in contravention of existing regulations. A liability system would strengthen the economic incentive for compliance.

- Releases at levels in compliance with current permitted standards, but which later turn out to cause damage. If these are covered it would create incentives for firms to continue researching into acceptable release levels of both controlled and uncontrolled substances, since they have the best information about their actual releases.

- Accidental releases. A liability system covering these could create incentives for due care in continuing operations and the installation of appropriate preventive measures.

- Development risks. The discovery, through scientific advance, of hazardous substances which were previously thought to be safe. Making firms liable for development risk creates incentives for research and development into new pollution problems and control methods. This is likely to be efficient since polluting firms are also the ones who have the greatest access to information on the release of substances, and therefore the most efficient research and development possibilities.

1.2.4 *Restoration Standards*

The standards applied to the remediation of damage are a major cost factor. The alternative approaches are:

- restoration to original condition;

- restoration to a standard based on cost-effectiveness or fitness-for-use for the planned use.

The first approach was originally used by Superfund. It resulted in remediation costs estimated to be about 35% greater than those likely under the second approach [(1)].

Due to the criticisms of high costs in Superfund, there is now a strong pressure [(2)] for more flexible approaches to be taken to restoration standards and speed (ie the second approach) even though this may result in a gradual degradation of the environment in relation to its original condition.

1.2.5 *Strict Versus Fault Based Liability*

Strict liability makes the polluter liable so long as it can be shown that he caused the damage. Fault based liability requires the additional proof that the polluter was negligent in relation to some duty to behave according to a certain standard. Strict liability therefore eases the burden of establishing liability which will tend to incur *lower transaction* costs than a fault based system.

Both strict and fault liability create prevention incentives, but to different extents. Strict liability extends the scope of the system and hence leads to more remediation and/or more damage prevented with greater compensation for victims. Potentially liable parties need to be able to assess the costs they would face if damage occurs, and this may be clearer under strict liability since under fault liability there is the additional uncertainty of establishing fault. If polluters can assess their risks, they can then determine their optimal level of prevention expenditure.

Fault liability may also be economically optimal but this depends on whether the court's negligence criteria reflects the economically optimal level of prevention.

There are a number of economic consequences which may be anticipated from a strict liability system in comparison to a fault based system, although their individual and collective significance is difficult to assess. Strict liability:

- could increase the incentive for prevention to reduce environmental risks since the polluter is liable for any damage that he causes;

- increases the demand for insurance, while insurers may be expected to impose lower financial limits;

- may have higher damage costs since where the victim may influence the level of damage costs (eg if the victim fails to take precautions to minimise the damage to his property);

(1) Brattle/IRI (1995) Assessment of Costs Savings Resulting from Implementation of the CMA Remedy Selection Approach. Report prepared for Chemical Manufacturers Association, USA

(2) Including in proposals for revision of Superfund.

- raises the level of insurers and banks' transaction costs in setting up policies/loans, since they may need to carry out more comprehensive risk assessments;

- increases the frequency of claims [1] while the costs for proof decrease since there is no need to prove faulty behaviour.

Defences

The impact of strict liability may be moderated by allowing certain defences on the part of the polluter. For example, defences include:

- Acts of war or a natural phenomenon of an exceptional, inevitable and irresistible character;
- Where damage resulted necessarily from compliance with a specific or compulsory measure of a public authority;
- Where the victim contributed to or caused the damage due to a negligent or deliberate act [2] ;
- Where it was not scientifically known at the time that the activity would create adverse environmental impacts.

Allowing the possibility of defences has two effects. It reduces the amount and cost of remediation but raises the transaction costs in proving and defending the liability.

1.2.6 *Joint and Several or Proportionate Liability*

Where multiple polluters have contributed to damage, the issue arises whether liability should be proportionate to their contribution to damage or whether any polluter should be joint and severally liable for the whole damage and then have to recoup contributions from the other polluters.

Proportionate liability conforms with the polluter pays principle since it places responsibility for damage in relation to cause. It creates a regime of reasonable certainty for economic actors to assess risks and undertake prevention.

However, there are two problems with proportionate liability where multiple polluters are concerned. Firstly, victims may need to bring multiple claims and may not easily be able to identify the responsible parties. This will create a disincentive to bring a case and will raise the victim's transaction costs. Secondly, it may be difficult to prove which party caused the damage.

Joint and several liability, on the other hand, increases the transaction costs of the polluters. The costs of litigation increase since it encourages multiple litigations between firms and between insurance companies (this can also be

(1) But note that in the case of product liability the claims frequency has not increased since there has been a trend towards settlement rather than litigation.

(2) The first three defences outlined above are set out in the Lugano convention (Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment, Council of Europe, June 1993).

a problem under proportionate liability - unless the share of liability is decided by administrative body).

Joint and several liability can encourage two phenomena, the deep pocket syndrome and forum shopping. The *deep pocket* syndrome is where the victim seeks redress from one of the polluters with the greatest financial resources to pay, irrespective of the size of the contribution to the damage. This can create considerable uncertainty among firms and other economic actors about their possible liabilities. Faced with this uncertainty, firms may withdraw altogether from risky activities. It also creates reduced incentives for prevention, since the liability for damage does not reflect the actual level of care [(1)]. Finally, it may also temporarily distort competition since some firms may be forced to pay for their competitors' damage.

Forum shopping occurs where the victim chooses the jurisdiction in which he brings the claim, and may search around different countries to find the most favourable regime. This may arise were the multiple parties are based in different countries.

Joint and several liability arises as an issue principally where multiple polluters contribute to the damage and clear causation for individual polluters would otherwise be difficult to prove. It has already been noted in *Section 1.2.1* that this type of problem is not well suited to an environmental liability system.

1.2.7 Rights of Standing for Interest Groups

A number of rights of standing may be granted to public interest groups (eg NGOs). These include the rights to intervene in administrative decisions, the rights to be granted a judicial review, or the rights to bring actions on their own account. The advantages of granting a right of standing to interest groups are:

- an increased commitment of the public with respect to environmental protection;
- public bodies may not be able to deal with all cases of ecological damage;
- in some cases, NGOs may have more expertise than small local public authorities where ecological damage is concerned;
- decisions by public bodies may be influenced by short term political or economic interests rather than long term environmental interests.

[(1)] On the other hand, joint and several liability is likely to increase prevention activity, since more cases are likely to be brought and the risks of a large size of claim increase. Without joint and several liability the victim may not be able to prove the share of causation.

If rights to bring an action are only granted to private individuals, two types of environmental damage may not be easily pursued. One is where there are multiple victims and each individual victim only suffers a small damage. In this case the transaction costs of pursuing many individual claims would be too high. They could be lowered by granting rights to an interest group to bring a class action.

The second is the question of who would bring claims to get restoration or compensation for ecological damage to the unowned environment. The issue for this problem is whether to grant rights of action to NGOs and/or individual citizens rather than leaving it entirely to a public body.

The problems associated with granting a right of standing are:

- Too many false or weak claims may be pursued (especially with reversed burden of proof - see below) [1]. However, so far there is no experience to support this in the countries where NGOs do have a right of standing.
- Some NGOs may pursue claims for political purposes, eg by bringing a claim against a high profile company.
- NGOs are strongly represented in some EU countries, but not in others.

Information Rights

Since firms have a near monopoly of information relating to the production, prevention and release of pollutants, they may be required to reveal that information at some point during the legal process.

If firms are not required to provide information prior to a court case, then the costs for plaintiffs in establishing their case may be very high and create a disincentive to pursue their claim. On the other hand, there could be excessive costs to the firm if they were required to release information to any party before they had established the basis for a reasonable claim.

1.2.8 *Burden of Proof*

The burden of proof normally rests with the plaintiff. Under certain liability systems the burden may be reversed to the defendant. This encourages plaintiffs to bring claims and increases the claims frequency. On the other hand, since most information rests with the firm, it is overall economically efficient for the firm to produce the relevant knowledge about causation at the lowest cost. It also creates increased prevention incentives.

There are degrees of facilitation of the burden of proof for the plaintiff. Proof involves three steps. These are proving that:

[1] *Fishing trips* is the term that has been given to the possible situation where a victim with a weak case nevertheless makes a claim at very little expense, but where the costs of proof are all reversed to the defendant.

- specific substances were emitted;
- the emissions were capable of causing the damage; and
- damage must be shown to have been a result of the emissions.

A limited degree of facilitation of the burden of proof for the plaintiff may relate only to one or two steps, eg the first step, establishing that the firm could have emitted the substance because the firm falls in an industrial category or type of process that tends to emit the substance due to the raw materials or technologies used.

1.2.9 Financial Limits

The issue of financial limits arises where there is a potential risk of damage which exceeds the financial resources of the firm. In order for economic actors to take rational decisions, they expect to be able to quantify their risk. If firms are exposed to excessively large potential liabilities there could be a number of impacts.

Insurance companies will always impose financial limits on their cover; any risk to the firm greater than this would go uninsured. Banks may not lend if liability could exceed the firm's reserves. Firms, especially small firms, may therefore withdraw from risky activities. Another possibility is that firms may ring fence their risky activities into limited liability firms with minimal assets. They would not be able to compensate the victims out of their assets if large occurred.

Unlimited liability risks are hard to calculate and may create uncertainty, particularly for small firms [(1)]. On the other hand, if financial limits on liability were imposed, it would lead to some unremedied damage. However, most current claims for are small and therefore a level of financial limits could be found which would contain the majority of .

1.2.10 Compulsory Insurance or Financial Security

Compulsory financial insurance or some other form of financial security is a means of ensuring that each firm has a minimum level of resources to compensate victims if they cause damage. The issues associated with this option is whether this is an effective way to ensure victims are compensated, whether it will encourage the growth of the insurance market, and whether it will impose unreasonable costs on the insured.

Insurer's costs of risk assessment are likely to rise if they have to carry out risk assessments on firms that are high risk and might otherwise not have received insurance cover. Although firms can be required to have cover, it is more difficult to ensure that insurance companies provide that cover. Potentially, this places insurance companies in the position of deciding

(1) However, the Product Liability Directive has been implemented by most Member States with unlimited liability, without any reported adverse effects.

whether or not to sanction a firm's polluting activities. Insurers are unwilling to act as pollution regulators.

Firms are also likely to be concerned that they may become captive to high insurance premium rates or that insurance may not be available to them.

1.2.11 *Joint Compensation Funds*

The principle of a compensation fund is that damage is remedied or victims compensated from a fund which is financed by a collective group of polluters. The need may arise where no liable party can be identified or no longer exists, where a large number of polluters is involved, or in emergency cases where there is an urgent need to restore damage quickly. In practice, most funds are focused on diffuse pollution problems (eg air pollution) or orphan sites [1].

The operation of compensation funds raises the issues of economic incentives and the polluter pays principle. The conflict in the application of compensation funds lies between the desire to target the financing of funds at the actual polluters, whereas the compensation is directed towards pollution without a clearly responsible party. Firms will have economic incentives for prevention only if the costs they face relate to their actual pollution and if increased prevention lowers their contribution to the fund. However, if polluters can be clearly identified for the purposes of financing, do not need to be compensated through a fund. If the fund is financed through a common charge on all polluters, it raises the possibility that clean firms may be contributing to the pollution costs of heavy polluters and firms who may be their competitors. A similar conflict arises if the fund is financed by a charge on current polluters in order to pay for the remediation of past pollution [2].

A further issue relates to the question of whether a fund should be administered locally, nationally or at the EU level. The benefits of local administration are likely to be that the benefit is felt locally by those who have contributed to the fund and no transfer of income is involved, while national or EU level funds have the greatest possibility of spreading the financial burden and applying a common approach to compensation.

1.3 *ENVIRONMENTAL LIABILITY AND OTHER INSTRUMENTS*

A variety of policy instruments are available for use in the control of polluting activities. These instruments include the broad classes of regulation (eg emissions standards, technology-based standards), economic instruments (eg taxes, charges or tradeable permits) and liability systems.

[1] An orphan site is a contaminated site where the responsible party can not be found.

[2] This problem may potentially be avoided if the charge is levied as a surcharge on insurance premia.

These instruments can be complementary. They have different strengths and weaknesses when applied to different pollution problems. Regulatory instruments are likely to perform well where the control costs for firms are known or similar and the socially optimal level of emissions is known. Regulatory instruments will be reasonably certain about achieving a target level of environmental emissions.

Economic instruments are likely to perform well where the marginal value of damage is known and where there are large variations amongst firms' pollution control costs so that efficiency savings can be obtained by enabling firms to choose their own level of abatement to minimise the sum of their costs of control and the costs of damage.

A liability system has potentially even more flexibility since it is driven by the victim's claims and does not require any prior knowledge about standards, costs or damage values. It leaves to the firm the choice about the extent and type of pollution prevention and abatement measures - a feature that it shares with economic instruments

In comparing policy instruments, a number of criteria can be considered (each of these five criteria relate to one column in *tables 1.3a and 1.3b* below):

- how great is the incentive for preventative action?
- how great is the incentive for clean up and remediation?
- how great is the incentive for R & D into pollution prevention techniques?
- how cost-effective is the instrument in prevention and clean up?
- how large are the transaction costs likely to be?

Applying these criteria to the types of pollution problems in *Section 1.2.2* enables an indicative picture to be drawn of the relative strengths and weaknesses of environmental liability systems for various types of environmental problems, as shown in *Table 1.3a*.

The applicability of each instrument in relation to a damage type has been subjectively assessed against each one of the above criteria which is applicable. The instrument has been rated as either having a relative strength (✓), a relative weakness (✗), or neither (?) (balance of strengths and weaknesses, or uncertain). Not all the criteria are relevant to each case, and not all the instruments may be realistically applied to each damage type.

The first category covers environmental damage caused by accidental discharges to air or water bodies where the damage is clearly identifiable (eg evidence of fish kill from a water pollution spill) and fairly readily traceable to a single source. These cases are examined in *Tables 1.3a* and *1.3b*.

The second category covers gradual pollution (eg leakages of polluting substances to soil and water bodies) from one or more identifiable sources where the causation regarding the damage can be established, although not always easily. In this category transaction costs may be higher than with accidental pollution since gradual pollution can involve a long time period between the pollutants being gradually discharged and the damage becoming evident, which can raise the costs of proving that the polluter is responsible for the damage. Where there are many sources of gradual pollution and the causation is even more unclear, then the transaction costs of liability systems would be higher still and liability systems are less applicable.

This category also has a ? for the effect on incentives for R&D regarding air pollution since it may be more difficult to determine that a single polluter caused the gradual air pollution. This lowers the incentive for such polluters to invest in R&D to reduce the risks of becoming liable for the damage.

The third category relates to ongoing pollution [1] involving diffuse damage from many sources where there is no clear causation. Where the ongoing pollution can be clearly traced to a single or many sources (clear causation), this category would entail similar entries to the gradual pollution category above.

Under the criterion of cost-effective clean-up, all the entries are ? since the position on this criterion depends on how the standards defining the clean up of the damaged asset are determined (see *Section 1.2.3* above).

Liability systems cannot have an incentive effect to prevent past land contamination since the contamination has already occurred. Nevertheless, they might create an incentive for firms to carry out R&D to improve (technologies for) the clean up of contaminated land and prevent future contamination.

[1] Such ongoing pollution is the residual environmental damages from a firm's ongoing level of pollution emissions that are permitted under the existing regulations because it would be excessively costly to require that the emissions are eliminated.

Table 1.3a *Advantages and Disadvantages of Environmental Liability Systems for Different Environmental Problems*

		Criteria				
		Incentive for:				
Medium	Damage type	Prevention	Clean up	R&D	Cost-effective clean up	Low Transaction Costs
Water	Accidental releases, clearly identifiable damage, single or multiple sources with clear causation	✓	✓	✓	?	✓
	Gradual pollution, single or multiple sources, causation may be difficult to prove	✓	✓	✓	?	?
	Ongoing pollution, diffuse damage, many sources, no clear causation	✗	✗	✗	?	✗
Air	Accidental releases, single or multiple sources with clear causation	✓	✓	✓	?	✓
	Gradual pollution, single or multiple sources, causation may be difficult to prove	✓	✓	?	?	?
	Ongoing pollution, diffuse damage, many sources, no clear causation	✗	✗	✗	?	✗
Land	Cumulative historical contamination: single or multiple sources, with clear causation	✗	✓	?	?	✓
	Cumulative historical contamination: many sources, no clear causation	✗	?	?	?	✗
	Future contamination, accidental releases, single or multiple sources with clear causation	✓	✓	✓	?	✓
	Future contamination, gradual pollution, single or multiple sources, causation may be difficult to prove	✓	✓	✓	?	?
	Future contamination, ongoing pollution, many sources, no clear causation	✗	✗	✗	?	✗

Key: ✓ = strength ✗ = weakness ? = balanced or uncertain

The applicability of environmental liability systems to ecological damage depends in part on the type of pollution involved. Environmental liability systems may be applicable to damage to ecological assets where the damage can be readily traced to a single or multiple source (eg from accidental discharges or gradual pollution) and where reasonable costs for the restoration of the damage can be readily derived. But environmental liability systems are unlikely to be applicable for damage to ecological assets due to ongoing diffuse pollution from many sources since there are the following three areas where ecological damage raises greater difficulties for the application of environmental liability systems than is the case of damage to other receptors such as damage to buildings or humans.

- It can be more difficult to prove causation, ie that a polluter caused the ecological damage, where there are many possible sources of the damage, long time lags in the impact mechanisms and a variety of other possible factors affecting the condition of the ecological asset and the incidence of the damage.

- Ecological damage raises greater difficulties and uncertainties concerning the valuation of the damage than is the case of damage to more tangible assets such as human health and property. In some cases (eg restocking a river following a pollution incident) restoration costs can be fairly readily estimated. However, in other cases, restoration of the damage may not be feasible. In such cases, and also when restoration of the damage would be very expensive, it may be necessary to value the damaged assets to determine compensation or compare restoration costs to benefits. Valuation involves difficult and subjective issues (see *section 2.1*).

- In addition, ecological assets are generally not owned by an individual or, if they are owned by an individual, the owner may not be interested in the restoration of the ecological damage. This raises issues of who can bring a claim for such - the public authorities or NGOs or individual citizens - and who should receive the compensation for ecological damage? In some other cases there may be relevant property rights involved (eg rights of fishing on a river). In such cases damage can be fairly readily assessed and liability systems may be appropriate.

Table 1.3b presents a comparison of the strengths and weaknesses of environmental liability systems compared with the other main environmental policy instruments for tackling these major different types of environmental problems. Each entry (eg ✓ or ✗) in *Table 1.3b* presents an indicative assessment of each instrument in respect of each of the criteria detailed above and in *Table 1.3a*.

Table 1.3b *Comparison of Environmental Policy Instruments*

Medium	Damage type	Liability System	Regulations	Economic Instruments
		Advantages and Disadvantages of Alternative Instruments for Different Environmental Problems[1]		
Water	**Accidental releases, clearly identifiable damage, single or multiple sources, with clear causation**	✓ ✓ ✓ ? ✓	✓ ✗ ✗ ? ✓	-
	Gradual pollution, single or multiple sources, causation may be difficult to prove	✓ ✓ ✓ ? ?	✓ ✗ ✗ ? ?	-
	Ongoing pollution, diffuse damage, many sources, no clear causation	✗ ✗ ✗ ? ✗	✓ - ✓ ✗ ?	✓ ✓ ✓ ✓ ✓
Air	**Accidental releases, clearly identifiable damage, single or multiple sources, with clear causation**	✓ ✓ ✓ ? ✓	✓ ✗ ✗ ? ✓	-
	Gradual pollution, single or multiple sources, causation may be difficult to prove	✓ ✓ ? ? ?	✓ ✓ ✗ ? ?	-
	Ongoing pollution, diffuse damage, many sources, no clear causation	✗ ✗ ✗ ? ✗	✓ - ✓ ✗ ?	✓ ✓ ✓ ✓ ✓
Land	**Cumulative historical contamination: single or multiple sources, with clear causation**	✗ ✓ ? ? ✓	-	-
	Cumulative historical contamination: many sources, no clear causation	✗ ? ? ? ✗	-	-
	Future contamination: accidental releases, single or multiple sources, with clear causation	✓ ✓ ✓ ? ✓	✓ ✗ ✗ ? ✓	-[2]
	Future contamination: gradual pollution, single or multiple sources, causation may be difficult to prove	✓ ✓ ✓ ? ?	✓ ✓ ✗ ? ?	-[2]
	Future contamination: ongoing pollution, many sources, no clear causation	✗ ✗ ✗ ? ✗	✓ ? ✓ ? ?	✓ ✓ ✓ ✓ ✓

(1) Each symbol (eg ✓, ? or ✗) refers to the criteria set out at the start of this sub-section and in *Table 1.3a*

(2) Economic instruments (eg landfill waste charges) may provide incentives to reduce waste generation and disposal or reduce emissions of other pollutants and also provide resources for clean up as part of a programme of public expenditures or financial assistance to clean up contaminated sites. Such charges might form part of the contributions to a compensation fund.

Key: ✓ = strength ✗ = weakness ? = balanced or uncertain - = not applicable

The table illustrates the potential complementarity between the instruments so that in most cases the best result may be achieved by a combination of the alternative instruments rather than relying on a single instrument. For example, environmental liability systems may be most appropriate for ensuring that the polluters pay the victims for any damage from accidental releases, for preventing future land contamination and paying for the clean up of future land contamination. Such environmental liability systems might effectively complement the traditional environmental regulations and economic instruments - the latter have potential merits for promoting further reductions in ongoing pollution below the existing levels where it is easier to measure emissions than damage and where valuation of the environmental damage costs can be more easily determined by the public agencies. Environmental liability systems have merits where it is easier for the damage costs to be valued by the victims.

Drawing together the assessments indicated in *Tables 1.3a* and *1.3b*, a preliminary indication of the relative strengths and weaknesses of a liability system in comparison to other policy instruments is that:

an environmental liability system has a comparative advantage for tackling future environmental damage:

- accidental releases to all media;
- gradual pollution, especially for damage to water and soil contamination especially non-historical (and other than from diffuse sources), provided that causation can be proved at reasonable cost;

an environmental liability system has a comparative disadvantage for:

- diffuse pollution (air, water, land), multiple polluters;
- multiple injuries with unclear causation.

2 EXISTING ENVIRONMENTAL DAMAGE COSTS AND POLLUTION CONTROL COSTS

This section (*Section 2.1)* first reviews existing techniques that are currently being applied in Europe for valuing environmental damage costs to see how well they could underpin an environmental liability system. It also defines the types of environmental damage costs and the techniques for their valuation that are referred to in *Section 2.2*

Section 2.2 then reviews some available estimates of environmental damage costs so as to indicate the scale and nature of the existing residual environmental damage costs and how they may evolve in the future. It also highlights differences in these environmental damage costs between EU countries.

Section 2.3 reviews briefly the available estimates of the expenditures in different European countries on existing pollution controls.

The analysis in *Section 2.2 and 2.3* of the differences between individual Member States' environmental damage costs and their existing expenditures on pollution controls is designed to help inform discussions of any possible scope for the development of an environmental liability system at an EU wide level.

2.1 TECHNIQUES FOR VALUING ENVIRONMENTAL DAMAGE

2.1.1 *Introduction*

Sound and uncontroversial environmental valuation techniques are ideally desired to support the implementation of an environmental liability system. An environmental liability system involves actual financial payments so that doubts about the robustness of the underpinning valuation techniques creates the potential for costly disputes [(1)], although the implementation of an environmental liability system could itself significantly increase the application and robustness of damage valuation techniques - as has occurred in the US.

Uncertainties about the valuation of environmental damage both for individual cases and at the aggregate level could create difficulties for the main parties involved in making key decisions concerning an environmental liability system:

- the Courts who would have to determine the appropriate level for the damage costs;
- the authorities who would have to determine the appropriate level for the environmental damage costs to be recovered from polluters (in administrative liability cases);

[(1)] Navrud, S., Pruckner, G.J., (1996), Environmental Valuation - To Use or Not to Use? A Comprehensive Study of the US and Europe. To be published in **Environmental and Resource Economics**

- the firms who would have to determine the level of their environmental liabilities and the extent to which they should implement pollution prevention measures to reduce these liabilities;

- the insurers who would have to determine the extent of their possible exposure for environmental liabilities so as to determine whether it is worthwhile for them to offer insurance and, if so, the appropriate level of premia to set for such policies;

- the banks who would have to determine the extent of environmental liabilities for firms to whom they provide loans and their effect on the bank's bad debts and also whether the banks would provide bonds for the environmental liabilities of firms.

- the victims who need to know the level of environmental damage costs to press for.

This section therefore aims to examine the existing techniques for valuing various types of environmental damage costs with respect to their adequacy for the implementation of environmental liability systems.

In addition, this section examines briefly any variations in the valuation techniques that are commonly applied in different European countries so as to indicate whether an EU wide environmental liability system could be consistently applied across the EU.

Criteria for Assessing Valuation Techniques

A key issue for the effective and efficient operation of liability and compensation system for remedying environmental damage is how adequate are the existing available techniques for determining a monetary valuation for the environmental damage costs in question.

Criteria for assessing the adequacy of existing valuation techniques to fulfil this role include:

- Robustness and the scope for disputes about the valuations. This concerns the following issues:

    - The validity of the assumptions that have to be made concerning key variables on which data are lacking.
    - The extent to which different valuations have been or can be produced by the plaintiffs and victims due to differences in approaches, methodologies, data and assumptions; and hence what is the incentive for both parties to incur transaction costs in commissioning separate studies and critiques of each other's studies.
    - The extent of possible disputes or consensus about the appropriate approach and methodology for valuing the environmental damage costs.

- Public acceptance of the valuations.

- Acceptance of the techniques by the courts.

- Practicability in terms of availability of data.

- Costs of acquiring data and applying the techniques to determine the valuations.

Whereas some valuation techniques may be appropriate for determining approximately the significance of environmental damage to input into the environmental policy making process, their application for an environmental liability system entails much stricter tests in respect of the criteria outlined above.

2.1.2 *Review of Techniques for Valuing Environmental Damage Costs*

Major types of environmental damage costs are impacts on use values which include:

- Losses of economic outputs such as reduction in yields in agriculture or forestry due to air pollution.

- Extra defensive expenditures incurred by individuals or firms such as increased expenditures on repainting or replacing materials damaged by air pollution or expenditures incurred to prevent damage arising (eg moving stock animals away from polluted site).

- User damage costs such as lower or impaired recreation benefits due to water pollution or damage to forests caused by air pollution or destruction of natural habitats.

In addition, there can be impacts on non-use values which include:

- Welfare losses to individuals who do not currently use the affected environment but derive welfare benefits from having the option of doing so or from knowing about the quality of the environmental assets (existence values).

- Intrinsic valuations of to the natural environment for its own sake rather than the above valuations which concern losses of human welfare arising from damage to the environmental assets.

The uncertainties and difficulties of valuation become progressively greater as one moves down the above list of possible types of environmental damage costs.

The main steps involved in the valuation of environmental damage costs include:

- identifying and estimating the level of the discharges of the pollutants that caused the damage, and converting the discharges into ambient concentration levels of the pollutants;

- assessing the physical impacts of these discharges and ambient concentrations of the pollutants through, for example, the use of dose response relationships [(1)];

[(1)] Dose response relationship give estimates of the effects of a pollutant on physical parameters such as incidence of an illness, yield losses of agricultural crops etc.

- assessing the economic valuation (and significance) of these impacts.

The lack of information, uncertainties and scope for controversy are more pronounced as one moves towards the last step.

The techniques for the economic valuation of environmental damage costs include:

- Estimating the costs of restoring the damaged environmental asset. It is relatively easy to obtain such cost estimates. However, this technique does not represent the value of the damaged asset as such. Moreover, it raises important and difficult issues concerning definition of the standards to which the asset should be restored since using a cost-effective fitness for use standard entails much lower costs than restoring the environment to its original condition [(1)], which can be difficult to specify.

- Market based approaches which apply existing market prices to the physical impacts estimated through dose response relationships (eg changes in yields of agricultural crops or timber due to air pollution).

- Estimating the defensive expenditure incurred as a result of the pollutants (eg the costs of protecting, cleaning, repairing or replacing the affected asset, such as materials and buildings).

These valuation techniques can be fairly readily applied to derive directly tangible estimates of damage costs for certain types of environmental damage, although considerable uncertainties and potential for disputes still remain concerning the estimates. These environmental damage costs are termed type I environmental damage costs in this study and in the analysis of available data on damage costs in *Section* 2.2.2 and *Annex* C.

In addition, there are the following types of techniques for valuing environmental damage costs which involve greater uncertainties and difficulties - these are termed type II environmental damage costs in this study and in *Section* 2.2.2 and *Annex* C.

- Travel costs methods which have been used to assess impacts on recreation where the extra travel costs that consumers pay to visit a recreation site, instead of an alternative, are used to estimate the value of to this site (eg water pollution at a lake).

- Hedonic pricing methods where the differences in prices or rents for properties and land in areas with different environmental pollution levels (eg noise or air pollution) are analysed to indicate the value of damage costs from these pollutants.

- Surveys where users and non-users are asked either directly for their willingness to pay for the changes in the quality of an environmental asset (eg loss of a natural habitat, damage to a lake or river) (contingent valuation methods) or their willingness to pay estimates are derived from their responses to questions about their relative preferences for the environmental impacts (eg noise or air pollution emissions from traffic)

(1) Brattle/IRI (1995) **Assessment of Cost Savings Resulting from Implementation of the CMA Remedy Selection Approach.** Report prepared for the Chemical Manufacturers Association, USA.

compared with an item involving a monetary payment (eg fares) (stated preference techniques).

- Benefit transfer methods where the valuations derived from any of the above studies for other situations are applied to a particular case.

Navrud and Pruckner (1996) [(1)] review the existing studies involving the above valuation techniques and found that some hedonic pricing studies were carried out in Europe and the US in the 70s and early 80s, but that there has since been a move away from hedonic pricing and travel cost techniques towards contingent valuation methods.

They also state that benefit transfer methods can involve greater uncertainties due to potential for disputes about the valuations made in the original study and its applicability to the case in question. They conclude that benefit transfer is best suited for deriving ball park estimates to guide policy development, but that their use is not defensible for environmental liability cases (Navrud and Pruckner (1996, p9). Consequently, original damage valuation studies are likely to be needed for environmental liability cases entailing considerable transaction costs.

Table 2.1a identifies some possible techniques for valuing the environmental damage cost categories examined in *Section* 2.2 and highlights some issues regarding their adequacy.

- The valuation techniques have been most extensively applied for the traditional pollutants (eg acid rain) on which there is a body of experience and data on their applications;

- The least knowledge, experience and data are available on the main emerging pollution problems (such as health impacts of chronic toxic water and air pollutants) about which there is the greatest uncertainty and concern.

- The long time lags before many current pollutants create perceived (eg increased deaths or illnesses) increases the uncertainties and disputes about damage costs and the difficulties of valuing them.

- Lack of baseline data, especially on environmental conditions before the incident may make it difficult to assess the damage caused by an incident.

There are some uncertainties concerning the survey techniques, such as contingent valuation methods (CVM), to determine individuals' willingness to pay for the remediation of intangible environmental damage costs such as ecological damage. These uncertainties concern:

- whether the respondents can adequately comprehend the changes in environmental conditions;
- whether the questioner providing information on the environmental conditions biases the respondents' views;
- the specific manner in which the questions are posed;
- how respondents have interpreted these questions;

(1) Navrud, S, Pruckner, G J (1996) **Environmental Valuation - To use or not to use? A comparative study of the United States and Europe.** Forthcoming in Environmental and Resources Economics.

- which specific aspects of the environmental conditions that respondents are valuing;
- how respondents have interpreted the questions;
- possible biases in respondents' valuation such as over estimating the value where they think they will not in fact have to pay (free rider issues);
- whether the sample is representative and how the findings should be interpreted and grossed up.

There have recently been attempts to provide guidelines in the US for carrying out CVM to overcome these limitations [1].

The value of these intangible environmental damage costs are essentially determined by the public preferences which are difficult to anticipate. Public concern about environmental damage, especially for damage to natural habitats, is likely to keep rising in the future as incomes rise and with increasing pressures on a declining stock of natural habitats.

As a result, it would be difficult for insurers to anticipate and predict what the public's preferences and valuations will be and hence what could be their liabilities for ecological due to a pollution incident that might arise some time in the future.

Navrud and Pruckner (1996) review the experience in Europe with environmental valuation and suggest that there are large differences across Europe in people's preferences towards environmental protection. This is due in part to differences in income levels and environmental conditions. Differences in people's environmental preferences and valuations due to these factors would not affect the efficiency and effectiveness of environmental liability systems. One potential advantage of an environmental liability system is that it could provide a mechanism for raising environmental standards in those locations where the individuals concerned are most concerned about the environmental .

However, the differences across Europe in people's preferences and valuations are also fundamentally due to differences in the availability of information on the state of the environment and their knowledge and perceptions of the environmental . Therefore better information on environmental conditions is needed. Differences in individual's knowledge and perception mean that an environmental liability system based on civil liability would lead to greater clean up and pollution prevention in countries where the individuals are more aware of the and also where the individuals (or the environmental groups) are more likely to take legal action. These countries are likely to be those with already higher environmental standards (eg Germany, UK). Hence there is unlikely to be an even application of environmental liability systems across Europe, especially if there are differences in the acceptance of valuation techniques across Europe (see below).

[1] Arrow, K Solow, R, Portney, P R Leamer, E,E, Radner, R, Schuman, H, (1993). Report of the National Oceanic and Atmospheric Administration Panel on Contingent Valuation. Resources for the Future, Washington DC.

Table 2.1a ***Valuation Techniques for Specific Environmental Damage Costs***

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
Human health	Mortality impacts	Dose response functions plus: standard value of statistical life estimates- ie WTP to reduce risk faced by individuals medical costs of treatment paid by rest of society some forgone output and productivity	Health Costs of Particulate Matter, Pearce and Crowards (1996). Health Costs of SO_2, NO_x, and Particulates, Landrieu (1995).	Dose response relationships for some pollutants (PM_{10}, NO_x,SO_2 and Lead), but great uncertainties for other pollutants(CO, dioxins, VOCs, Ozone); chronic effects of pollutants much less understood than acute effects; Will courts accept economic values of life?
	Morbidity impacts:	Dose response functions plus: Surveys of individuals' WTP to avoid morbidity estimates, or medical treatment costs.	Health Costs of Particulate Matter, Pearce and Crowards (1996)	As above Uncertainties and disputes over survey methodology and findings; costs of surveys
Buildings	Material replacement/restoration costs	Analysis of incremental replacement/repainting costs	Benefit of Reducing SO_2 emissions, ECOTEC (1994).	Fairly well established; need inventory of materials affected; uncertainties about dose response relationships for specific pollutants
	Loss of historic buildings	WTP surveys	Durham Cathedral Study, Willis (1994)	Uncertainties and disputes over survey methodology and findings; costs of survey
		Travel costs methods		Problems of interpreting results.
Agriculture	Loss of crop output	Dose response relationships plus market value of loss output	Effect of Ozone on Wheat, Brown et al., (1996).	Fairly well established; Uncertainties about dose response relationships and specific effects of pollutants
Industry/commerce	Loss of tourist profits	Changes in tourism profits	Costs of Amoco Cadiz oil spill (Bonnieux and Rainelli (1991, 1993)	Lack of data on tourism (visitor numbers and profits) so that surrogate indicators needed (bread consumption); Problems of determining baseline of position in absence of oil spill.
	Increased industrial costs (eg water treatment, repair of buildings)	Estimates of extra costs (market based techniques)		Determining extent extra costs due to pollution; Definition of extra costs - whether just incremental expenditures or short or long run marginal costs of additional resources used.
Land	Costs of treating contaminated soil	Estimate of costs of techniques	Costs of treating contaminated sites (Carrera and Robertiello (1993))	Definition of standard for treatment (?use of cost-effective and fitness for use criteria); Variations in definition of sites needing treatment; lack of consistent data on sites and their costs.

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
	Contamination of aquifers	WTP surveys	Nitrate Pollution, Hanley 1989.	Usual concerns over CVM applies.
			Milan study, Press 1995.	
		Costs of treating aquifer or alternative water supply source	Cambridge Water Co vs Eastern Counties Leather	No dispute over level of claim and estimate costs of remedying contaminated aquifer
			Study for Chemical Manufacturers Association of cost-effectiveness of treating Superfund sites	Whether alternative more cost-effective options are available (eg alternative supplies); determination of the opportunity costs of these supplies.
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution	Dose response relationships, plus valuation by Market based studies of extra costs and foregone profits	Damage to Forests in Europe	Fairly well established; but problem of determining baseline of costs and profits without air pollution; long lags before pollutants affect trees; disputes about dose response relationships.
	Reduced recreational benefits	Surveys of visitors' views on impacts and WTP to prevent them	Recreational Value of Forests, Willis and Benson (1991)	See above for surveys re historic buildings
		Travel cost methods		Ditto
		Hedonic Property Price Method	Garrod and Willis (1991) Merlo and Signorelli (1990)	
		Costs of remedying damage (eg replant trees) or recreating a forest or habitat elsewhere		Fairly easy to estimate; but possible disputes about whether costs reasonable and most cost-effective options; Are replaced trees an adequate substitute? lack of baseline data on original conditions of forest
	Non-user and option value benefits	Surveys of general population	Norfolk Forest (forthcoming) Bateman.	See above for surveys of historic buildings;
Fishing industry	Lost yields/catch and extra costs	Market based studies	ECOTEC (1994).	Fairly straight forward, but problems of determining baseline position without pollution; Problem of previous position of overfishing
Water supply	Extra water treatment costs	Estimates of extra costs		Fairly straightforward
Natural habitats and biodiversity loss	Loss of biodiversity from acid deposition	WTP survey	MacMillan et al., 1994.	See above for surveys re historic buildings
	Costs of remedying damage to water courses from water pollution incident	Costs of restocking river; Costs of remedial operations	Section 16 of Water Resources Act in UK; NRA's guidance on standard costings	NRA's guidance facilitates cost recovery; but lack of baseline data on environmental conditions before pollution incident; disputes about mortality rates for restocked fish and number of new fish needed

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
	Residual damage that cannot be restored	Surveys of users/visitors to natural habitats		Definition of residual damage; problems with surveys even more marked due to intangible nature of damage to irreplaceable assets; increasing importance of damage due to rising pressures on natural habitats and increasing public concern
	Option values and non-users' values			Ditto; plus problems of defining sample
	Loss of Tourism and user benefits	Economic impacts on tourism	Impacts of Amoco Cadiz (Bonnieux and Rainnelli (1991)	Difficulties of defining baseline of tourism levels in absence of environmental impacts; how allow for changes in quality as well as number of visits
		Surveys of users		See above for problems of surveys, especially how users perceive the environmental damage

Footnote: WTP = what individuals are willing to pay to secure or prevent an environmental change - WTP usually estimated by surveys of individuals.
CVM = Contingent valuation method for valuing the environmental good

2.1.3 *Current Practice with Valuation Techniques in Europe*

Valuation techniques have been much less extensively applied in Europe than is the case in the USA [(1)]. Experience with applying valuation techniques is currently more limited in Europe, especially in Cohesion countries, although some valuation studies have been carried out over the last few years in Spain and Portugal

There is a lack of scientific and economic data in Europe concerning emissions levels, ambient environmental conditions, scientific dose response relationships and the economic valuation of (marginal) changes in the levels of these impacts. CORINE provides data on air emissions [(2)], but there is a lack of consistent data on water pollution, wastes and contaminated sites.

A number of valuation studies have been carried out in Germany, Netherlands, Sweden, UK and France on, for example, the impacts of air pollutants such as SO2 on human health, forests, agriculture and buildings. Most of this work has built on scientific analysis of dose response relationships. Many of the existing studies have applied market based techniques such as estimates of additional costs of repairing damage to buildings.

Interest and application of contingent valuation methods has occurred later in Europe than in the US, but the number of CVM studies has increased significantly over the last few years - mostly in the UK, Norway and Sweden although some CVM studies are now being carried out in Central and Southern Europe. More than 200 valuations of environmental in Europe have been carried out using contingent valuation, travel costs or hedonic pricing valuation techniques.

There are some differences between European countries as to the extent to which the various valuation techniques have been applied. Valuation techniques, especially contingent valuation studies, have been more extensively applied in the UK, Norway, Sweden and Finland than in Germany and the Netherlands. Few valuation studies have been carried out in Southern European countries. These differences are largely due to the lack of expertise in the latter group of countries to carry out valuation studies.

In Germany and the Netherlands, there have been studies of type I environmental damage costs based on dose response relationships and market based valuation of the resulting physical impacts in terms of output

(1) For a review of valuation studies in Europe see:
Georgiou, S (1994), **UK Studies of the Economic Valuation of Environmental Impacts.** Review prepared for the Department of the Environment.
Navrud, S, Pruckner, G J (1996) **Environmental Valuation - To use or not to use? A comparative study of the United States and Europe.** Forthcoming in Environmental and Resources Economics.
Navrud, S (ed) (1992) **Pricing the European Environment.** Oxford University Press, Oxford.
Merlo, M, Della Puppa, F, (1994), **Public Benefit Valuation in Italy. A review of forestry and farming applications.** In Budgaard, A, Bateman, I, Merlo, M, (eds) **Identification and Valuation of Public Benefits from Farming and Countryside Stewardship.**
For a review of contingent valuation studies see:
Carson N, Wright R T J, Alberini A, Flores N, (1995): **A bibliography of Contingent Valuation Studies and Papers.** Natural Resource Damage Assessment Inc.

(2) Eurostat (1995) **Europe's Environment: Statistical Compendium for the Dobris Assessment.**

losses and financial expenditures for cleaning, repair and replacement of the damaged assets rather than use of the more uncertain and controversial consumer survey techniques such as contingent valuation methods (CVM).

Greater application of valuation techniques in European countries would be needed to develop the greater experience and data needed to underpin an environmental liability system.

The European Community's Fifth Environmental Action Programme [1] recommends that a community cost-benefit methodology should be drawn up for application to all projects and policies with an environmental dimension. There are differences in Member States' current practices and expertise regarding the alternative valuation techniques. Adoption of best practice appears necessary to achieve a consistent application of the techniques across member states. However, under the prevailing situation it would probably not be effective to *require* simply the adoption of best practice.

Therefore as a first step it appears fruitful to *encourage* the adoption of best practice by collating and sharing available experience on the application of valuation techniques in European countries, developing and promulgating guidelines for the performance of valuation studies and promoting the development of expertise to carry out such studies (eg training and technical and financial assistance).

2.1.4 *Application of Valuation Techniques in Environmental Liability Cases*

US Experience

Valuation techniques have for many years been much more extensively applied in the US than in Europe. The greater expertise in the US is related to the greater interest in environmental valuation in the US. Thus Executive order 12291 of 1981, for example, required that a formal regulatory impact analysis be carried out of the costs and benefits of policies or regulations imposing significant costs.

Interest and experience in valuing environmental impacts in the US has been increased by the passage of CERCLA. More importantly, in tandem with the implementation of CERCLA, considerable efforts were made in the US to develop and promulgate best practice guidance on valuation methodologies. This included the work of the National Oceanic and Atmospheric Administration (NOAA)[1]. A specific Government Department - the Department of Interior - was responsible for promoting the assessment of environmental damage costs and promulgating regulations for the assessment of natural resource under CERCLA.

The US Department of Interior expressed a preference for use of market prices to value the losses or, where market prices are not appropriate, then to use the uniform appraisal methodology used for federal land acquisition. Only for those types of environmental damage costs such as non-use and option values, then contingent valuation methods (CVM) should be applied.

[1] European Commission (1993) **Towards Sustainability: A European Community Programme of Policy and Action in Relation to the Environment and Sustainable Development.**

The DOI's hierarchy of techniques led to a dispute as to the suitability of CVM.

Consequently a panel headed by Professors Arrow and Solow was set up to advise NOAA on the use of CVM. This panel concluded that CVM studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment [1]. The Panel drew up guidelines for carrying out reliable CVM studies that should be followed as closely as possible.

NOAA published in January 1994 proposed regulations on natural resource damage assessment [2], which reiterate the Panel's recommendations, but also proposed that the willingness to pay estimates from a CVM should be reduced by 50% because the hypothetical WTP estimates reported by CVM surveys overstate what individuals would actually be willing to pay in practice. NOAA is still seeking comments on this proposal.

Existing Liability Cases

Recent environmental liability cases have revealed substantial differences between the damage costs estimates made by the plaintiffs and those by the defendants. The size of these differences gives each party a strong incentive to carry out their own damage valuations and scrutinise those of the other parties, which can entail significant transaction costs.

The differences in the valuations were largely due to differences in the assumptions used in the analysis rather than disagreements regarding the basic valuation techniques and methodologies.

2.1.5 *Conclusions*

Implementing an effective and efficient environmental liability system would expose the techniques used for valuing environmental to considerable scrutiny. This scrutiny is much more demanding than occurs in general environmental policy making since actual financial payments are at stake in the liability cases.

The existing liability cases reveal wide divergences between the damage valuations made by the opposing parties. These are due to differences in the assumptions made in estimating the costs (eg whether the most cost-effective remediation option has been costed). Such assumptions often have to be made due to the lack of data on the appropriate variables such as baseline economic and environmental conditions.

The difficulties surrounding the valuation of environmental damage costs are particularly marked in respect of:

- chronic pollutants (eg gradual releases of toxic air or water pollutants);
- ecological damage and other intangible environmental damage;

(1) Arrow, K Solow, R, Portney, P R, Leamer, E,E, Radner, R, Schuman, H, (1993). Report of the National Oceanic and Atmospheric Administration Panel on Contingent Valuation. 58 Federal Register, 4601-4614.

(2) National Oceanic and Atmospheric Administration (1994) Notice of Proposed Rule-Making: Natural Resource Damage Assessments. 59 Federal Register 1062, January 7 1994.

The following types of environmental have the greatest potential of being able to be valued:

- acute pollution incidents such as water pollution accidents, rather than chronic pollution;
- expenditures resulting from the environmental damage (eg costs of replacing or repainting damaged assets);
- costs of restoring ecological assets damaged by the pollution incidents (eg restocking a river after a fish kill as in Section 161 of the Water Resources Act in the UK).

In the last case, the techniques do not measure the value of the damaged asset. Moreover, if this approach is used, it raises issues concerning the definition of the standard to which the damaged asset should be restored since restoration of the damaged asset to its natural state may not be worthwhile and could entail high costs.

Current experience with the practical application of valuation techniques in European countries is more limited than that in the USA, where CERCLA was introduced in tandem with great efforts to promulgate best practice regarding valuation techniques and where the implementation of CERCLA has led to an increased use of techniques to value the environmental impacts.

It is unlikely that an efficient environmental liability system in Europe, and the sufficiently reliable valuations that it requires, could rely on the current experience with valuation techniques in Europe. Disputes concerning the valuations could result in considerable transaction costs being incurred by each party.

The uncertainties concerning the valuation of environmental liabilities are a barrier to the effective and efficient development at present of an environmental liability system. Due to these uncertainties, firms, insurers and banks would be unlikely to undertake an efficient level of prevention measures under an environmental liability system. Partly due to these uncertainties, insurers are not currently willing to provide insurance cover for ecological damage.

There are some differences in the extent and manner in which environmental valuation techniques are currently applied in practice in EU countries. Such differences could limit the extent to which an environmental liability system could be evenly applied throughout the EU. In some countries (eg Germany and the Netherlands), market based valuation techniques are applied. Annex C indicates that such valuation techniques could only cover about one third of the total environmental damage costs. Contingent valuation methods to value the other more intangible environmental (eg loss of recreation and non-user benefits) raise considerable uncertainties and methodological and empirical difficulties. They are less accepted and are less extensively applied in some European countries (eg Germany, the Netherlands) than in others (eg UK).

Increased use of valuation techniques in European countries is needed to develop the greater experience with environmental valuation techniques and data needed to underpin an environmental liability system.

Developing a common approach to environmental valuations would seem worthwhile given the advances in the theory and practice of valuing environmental damage costs in the last decade, although it does raise issues concerning the differences in views within and between Member States regarding the appropriateness of alternative valuation techniques.

For all the difficulties, though, an even application of an environmental liability system in the EU does require the development of common guidelines for the assessment of environmental damage and the applicability of the different techniques in their appropriate circumstances [1].

Therefore it would appear fruitful to encourage the adoption of best practice by:

- collating and sharing available experience on the application of valuation techniques in European countries and elsewhere;
- developing and promulgating a framework for the assessment of environmental damage costs with guidelines for the applicability of different valuation techniques in their appropriate contexts; and
- promoting the development of expertise to carry out such studies (eg training and technical and financial assistance).

2.2 COSTS OF ENVIRONMENTAL DAMAGE

2.2.1 *Introduction*

This section reviews the available information and uncertainties about the level of environmental damage costs in a selected EU country in order to indicate the scale of these environmental damage costs as compared with GDP and the level of existing pollution control expenditures, and also to highlight differences in pollution levels and hence possibly environmental damage costs between EU countries.

2.2.2 *Main Categories of Environmental Damage Costs*

Approach

Our original intention was to prepare a complete set of environmental damage costs for all EU countries. However, consistent data on environmental damage costs do not exist for all EU countries. Consequently, an investigation was made of one EU country - the former West Germany - for which some environmental damage cost data could be obtained. These data are presented in *Annex C*.

[1] This appears to be worthwhile for other reasons such as the promotion of efficient environmental protection and financial reporting.

Table 2.2a ***Environmental Damage Costs in (former) West Germany for Each Medium***

Medium	% of GDP	Accidents as % of damage costs for medium	Accidents as % of total environmental damage costs
Air	0.8 - 1.0	5%	1%
Noise	1.0	0%	0%
Soil	0.4 - 0.7	30%	3 - 6%
Water	0.4	30%	4 - 5%
Wastes	0.3 - 0.7	0%	0%
Others (excluding global damage)	>0.1	0%	0%
Total	>3.0 - 3.9	N/A	8 - 12%

Note: N/A = Not available
Source: Annex C; and estimates from insurance brokers in Germany on proportion of environmental claims accounted for by accidents.

Table 2.2a summarises the cost estimates from the review of cost data in the former West Germany. The review of the data highlighted the uncertainties, gaps and inconsistencies in the available cost estimates. For example, estimates were not available for ecological damage nor for environmental damage costs caused by waste disposal. We have assumed that the latter amount to about 0.3-0.7% of GDP, on the grounds that they are likely to be of a similar order of magnitude to the costs for contaminated soil and water.

Schulz [(1)] (1986) estimated that environmental damage costs in the former West Germany amounted to about 6% of GDP in 1986. Wicke (1993) [(2)] updated Schulz's results to allow for the reduction in air pollution emissions since 1986 due to recent pollution controls. The updated results suggest that environmental damage costs in the former West Germany amount to about 133 bn DM (1992 prices) which represents 4.7% of GDP.

It is difficult to reconcile the estimates from the different studies due to, amongst other things, differences in their definitions, assumptions and coverage. Wicke's estimates differ from the figures given in *Table 2.2a* and *Annex* C because Wicke has applied different valuation techniques to cover more types of environmental damage. In particular, Wicke has included the costs of environmental protection measures at waste disposal sites (16.8 - 33.6 bn DM), the costs of incinerating sewage sludge and the costs to agriculture of ground water protection and controls on the use of treated sewage sludge and manure and the costs of CO2 control to prevent global pollution. These were excluded from *Table 2.2a and Annex* C on the grounds that they represent the existing costs of pollution controls rather than the costs of environmental damage.

(1) Schulz W (1986) **A survey on the Status of Research concerning the Valuation of Benefits of Environmental Policy in the Federal Republic of Germany.** Paper presented at an OECD workshop in Avignon.

(2) Wicke, L. (1993) **Umweltokonomie**, Munchen 1993

Notwithstanding the limitations of the available estimates, these environmental damage costs are significant in relation to GDP. The damage costs are larger than the total private and public current expenditures on pollution control measures, which amount to about 1.5% of GDP. Consequently, if the environmental damage costs were fully internalised (through an environmental liability system or pollution charges), then this would significantly increase the financial costs to industry of environmental policies.

The differences between Wicke's estimates and those shown in *Table 2.2a* highlight the limitations and uncertainties surrounding the available estimates and the possible wide range of damage cost estimates.

Table C1 (in *Annex C*) also highlights the wide range of the cost estimates given by different studies for individual damage components. For example, the estimates for costs of foregone recreation benefits due to forest damage caused by air pollutants vary by almost a factor of two. The estimates for the costs of restoring contaminated sites and the costs of contaminated aquifers vary by a factor of more than two. This variation in the available estimates is due to differences in the scope of pollutants and environmental covered, differences in the valuation methodologies and assumptions for key variables (eg stock at risk, dose response relationships, value of the) and how the specific studies have been extrapolated to give nationwide estimates. The estimates for the costs of restoring contaminated sites depend on estimates of the number of sites requiring clean up, the standard to which these sites have to be restored and the time period over which the programme for restoring the contaminated sites will be carried out - the figures in *Annex C* assume a ten year programme.

Moreover, there are considerable uncertainties and gaps concerning the available damage cost estimates.

Annex C distinguishes between two types of environmental damage costs in respect of the extent of techniques that have been commonly applied for valuing the different types of environmental damage costs. These are defined as follows:

- Type I are the environmental damage costs that have been valued using estimates of restoration costs or defensive expenditures or values of marketable outputs where the changes in the outputs have been estimated from, for example, dose response relationships.

- Type II are the environmental damage costs that have been valued by other techniques such as consumer surveys and contingent valuation methods. These techniques are more subjective and are subject to greater uncertainties than the type I environmental damage costs. There are also greater gaps in the available data for type II environmental damage costs.

The type I damage costs represent a small fraction of the total environmental damage costs. *Annex C* indicates that the less uncertain type I damage cost estimates amount to about one third of the available estimates of total environmental damage costs, although even for these damage types considerable uncertainties exist. Allowing for the omitted environmental damage costs not included in *Annex C*, the type I damage costs probably less than one third of the total environmental damage costs.

These type I damage cost estimates include the following types of damage:

- air pollution damage to human health, buildings, forests, the timber industry and the fishing industry;
- costs of restoring contaminated soil [1];
- impacts of contaminated soil on groundwater (eg increased water treatment or extra costs of alternative supplies);
- impacts of water pollutants on water supply (eg increased water treatment or extra costs of alternative supplies);
- impacts of mining on agricultural land and outputs and subsidence damage to buildings.

Extrapolation of data on environmental compensation claims from insurance brokers in Germany indicates that accidents account for about 30% of total soil contamination and water pollution and about 5% of air pollution cases. Hence, accidents account for about 10% of the total environmental damage costs (see *Table 2.2a*). Gradual and ongoing pollution accounts for the remaining 90% of environmental damage costs.

Future Environmental Damage Costs

Table 2.2b presents some approximate estimates of possible trends in the various categories of environmental damage costs in the former West Germany. The assessments of likely future trends for each category of environmental damage costs (in the third column of *Table 2.2b)* are based on the emissions projections by DRI [2]. This analysis assumes that environmental damage cost unit values will rise in line with GDP growth.

[1] This category is not actually an environmental damage cost, but rather an estimate of the costs likely to be needed to clean up contaminated sites in Germany.

[2] DRI (1994) Potential Benefits of Integration of Environmental and Economic Policies: Report prepared for the European Commission.

Table 2.2b ***Present and Future Environmental Damage Costs in (former) West Germany for Each Medium***

Medium	Damage costs in 1992 (% of GDP)	Likely Future Trends in Pollution	Assumed Approximate Damage Costs in 2010 (% of GDP)
Air	0.8-1.0	growth	1.0 - 1.2
Noise	1.0	N/A	N/A
Soil	0.4 - 0.7	decline	0.2-0.4
Water	0.4	decline	0.3
Wastes	0.3 - 0.7	growth	0.6 - 1.0
Others	>0.1	growth	0.2
Total	>3 - 3.9		N/A

Note: N/A = Not Available
Source: Table 2.2a. Estimates of future changes in pollution emissions for each medium are derived from the business as usual (reference) emissions projections given in: DRI (1994) **Potential Benefits of Integration of Environmental and Economic Policies** (Report prepared for the European Commission). Estimates of assumed damage costs in 2010 are ERM's judgements based on DRI's projections for likely future trends in emissions.

The costs of restoring contaminated sites largely relate to cleaning up the backlog of sites contaminated by pollution generated by past industrial activity. The present estimates assume that this backlog of sites will be cleaned up over the ten year period (1990 - 2000). Looking to the future (ie 2000 - 2010), these costs should fall to less than half of the present estimates because existing pollution control regulations are leading firms to implement pollution prevention measures which will reduce the extent to which new contaminated sites are generated.

A recent study for the European Environment Agency [1] concluded that the priority environmental problems that are likely to increase in the near future (up to 2010) include:

- climate change;
- photochemical oxidants (mainly from increasing transport emissions);
- deterioration of natural habitats and biodiversity due, in part, to pressures from transport projects and tourism;
- contamination of groundwater (eg by nitrates)
- water pollution from industry;
- generation and disposal of hazardous waste;
- chronic effects of air pollutants, especially from transport;
- urban environment pollution;
- environmental impacts from accidents and accidental releases;
- conservation and protection of biodiversity.

[1] European Environment Agency (1995) **Environment in the European Union 1995: Report for the Review of the Fifth Environmental Action Programme.**

Most of the air pollution , including greenhouse gas emissions causing climate change, are caused by many emissions sources, including transport. Similarly, noise pollution is caused by many diffuse sources. Some water pollution is caused by diffuse sources (eg agriculture).

Increasing importance is likely to be attached to natural habitats due to their increasing scarcity and the rising values consumers attach to natural habitats as incomes rise. However, there are considerable uncertainties concerning their valuation.

The proportion and level of environmental for which type II valuation techniques are needed is likely to rise in the future. Consequently, the uncertainties concerning the values of the environmental (eg impacts on natural habitats) are likely to rise in the future. There are also considerable uncertainties surrounding the chronic effects of low levels of air and water pollutants emitted over a long period, about which there is increasing concern.

2.2.3 *Differences Between Countries' Pollution Levels*

The lack of data is even more marked in other European countries. This reflects the limited extent to which valuations of environmental damage costs have currently been made. Moreover, there are considerable difficulties in comparing the estimates of environmental damage costs that are available for different countries since they are based on different methodologies and assumptions.

Due to these problems of compiling consistent and comparable estimates of environmental damage costs across the various EU countries, Tables 2.2c and 2.2d compare Eurostat [1] estimates for the relative emissions of three major air pollutants from stationary sources, and the level of industrial solid waste generated in 1990 as a proportion of manufacturing output, for various European countries to highlight potential differences in countries' pollution levels and hence pollution damage costs. SO_2 was selected because it contributes to acid deposition. NO_x plays an important role in the formation of photochemical oxidants and contribute to acid deposition. Both SO_2 and NO_x emissions come mainly from electricity generation, while NO_x emissions come from electricity generation and industrial processes and from transport and VOCs are emitted by a wide range of industrial processes and by vehicles. Therefore these three air pollutants and the generation of solid wastes by industries cover a wide range of the main sources of the major environmental problems in Member States.

Tables 2.2c and 2.2d show that there are considerable variations in relative pollution levels between european countries. It indicates the relatively high pollution emissions in the UK, Italy and Netherlands. However, it should be noted that the Eurostat estimates for 1990 do not allow for the recent pollution control measures, such as integrated pollution control in the UK, which could be expected to lead to reductions in emissions and damage costs.

(1) The data on emissions are taken from Eurostat (1995) **Europe's Environment: Statistical Compendium for the Dobris Assessment**. They are based on submissions to the Corinair 1990 inventory project.

Table 2.2c **Estimates of Relative Air Pollution Levels in 1990 in Various European Countries (Emissions Per Unit of Industrial Output - 1000 t/bn ECU)**

Country	SO_2 *(Emissions Per Unit of Industrial Output - 1000t/bn ECU)*	Indexed to Germany	NO_x *(Emissions Per Unit of Industrial Output - 1000t/bn ECU)*	Indexed to Germany	VOCs *(Emissions Per Unit of Industrial Output - 1000t/bnECU)*	Indexed to Germany
France	4.2	0.5	1.5	0.9	4	1.5
Germany	7.9	1	1.6	1	2.65	1
Italy	5.3	0.7	2.9	1.8	4.5	1.7
Netherlands	2.6	0.8	3.7	2.2	3.8	1.4
Spain	15.6	2	3.7	2.2	4.7	1.8
UK	15.4	1.9	5.2	3.1	6.7	2.5

Source: Eurostat (1995), Europe's Environment: Statistical Compendium

Table 2.2d **Estimates of Relative Industrial Waste Generation Levels in Various Countries**

Country	Manufacturing Solid Waste Output Intensity (1000t per bn ECU)	Indexed to Germany
France	247	1.5
Germany	162	1
Italy	179	1.1
Netherlands	179	1.1
Spain	158	0.9
UK	351	2.2

Source: Eurostat (1995), Europe's Environment: Statistical Compendium

Conclusion

Tables 2.2c and 2.2d indicate that the relative pollution levels in different Member States vary by about a factor of 1 to 3.1 for the specific air pollutants and solid wastes examined. Taking the various pollutants broadly together would suggest that relative pollution levels in different Member States might vary by a factor of about one to two [(1)]. Applying these relative pollution indices to the estimates given for total environmental damage costs in Germany indicates that environmental damage costs across EU countries could vary within a range of between four and at least seven % of GDP. Environmental damage costs are likely to be even higher for Eastern European countries. [(2)]

(1) The data in *Tables 2.2c and 2.2d* may in fact underestimate these differences since they include emissions for both the former East and West Germany. The relative pollution levels for just West Germany might be even lower than those given in *Tables 2.2c and 2.2d*

(2) Wicke (1993) estimates that environmental damage costs for the former East Germany are substantially higher (as a % of GDP) than those for the former West Germany.

2.3 COSTS OF POLLUTION CONTROL

2.3.1 *Introduction*

This section presents estimates of expenditures on existing pollution controls in European countries in order to identify whether there are divergences between industries' existing expenditures on pollution control in different Member States which might negatively affect the conditions of competition in the EU, and to indicate how the estimates of environmental damage costs (presented in *Section* 2.2) compare with industries' existing expenditures on pollution control.

2.3.2 *Data Sources*

The analysis is based on data collated by ERECO for DG XI of the European Commission (1) (2) (3). It is acknowledged that this study is subject to a number of important limitations regarding the availability of data and the approximate nature of some estimates especially on industries' expenditures in some countries (eg Spain, Greece, Ireland, Belgium and Luxembourg). Nevertheless, this major study did collate the best available statistics in as consistent a manner as possible.

2.3.3 *Analysis of Data on Total Expenditures on Pollution Control*

Table 2.3a presents data on total public sector and private sector expenditures on environmental protection measures. This shows that these expenditure levels range from between 1.5% of GDP in Germany and UK to 0.5% of GDP in the cases of Portugal and Greece (4). The divergence is even more marked - up to a factor of 8 to 9 - when the expenditures are considered on a per capita basis and when expenditures are divided by an environmental pressure indicator that allows for the relative industrial structures and levels of output of polluting activities in the various countries. Thus Germany, France, UK, Denmark and the Netherlands spend much more per unit of polluting output than Greece, Portugal, Ireland, Belgium, Luxembourg and Italy.

Water pollution control accounts for the largest share of environmental expenditures (largely due to expenditures on sewage treatment plants) followed by waste management and air pollution control.

(1) ERECO (1993) **Environmental Expenditures in the European Community**, Final report prepared for DG XI of the European Commission

(2) The findings of this study were cross checked with estimates from other studies (eg OECD) and the firm investigations carried out for this study. However, it is difficult to compare results from different studies for different countries due to differences in coverage, definition, methodology and assumptions. Consequently the comparative analysis focuses on the ERECO study since this is the most consistent data available.

(3) *Definitions.* The ERECO study covered industries' current and capital expenditures on end of pipe techniques for waste management, air and water pollution control. The estimates do not include industries' expenditures on process changes and pollution prevention measures that are integrated in firms' investments (eg clean technologies) because of the difficulties of identifying the portion of these expenditures that can be allocated to pollution control purposes and the problems of obtaining reliable and consistent estimates of these expenditures in the various European countries. The estimates are presented for 1992 (the latest year in which the best available estimates are produced for the various European countries), and in ECU at 1992 prices.

(4) OECD (1993) shows a similar picture for UK, Germany, France, Netherlands and Portugal.

Table 2.3a ***Total Environmental Expenditures in EU12 in 1992***[1]

		%Breakdown by Media					Total Environmental Expenditures		
	Total ECU (bill)	Wastes	Air	Water [2]	Noise [3]	Nature Protection [3]	% of GDP	Per cap.	Per env pressure Indicator [4]
Belgium/ Luxembourg	1.2	40	17	30	5	8	0.7	120	42
Denmark	1.2	33	10	53	1	3	1.1	225	112
Germany	20.5	24	23	50	2	1	1.5	255	139
Greece	0.3	22	2	72	1	3	0.5	29	16
Spain	3.9	35	2	46	1	16	0.8	100	63
France	12.9	34	8	54	2	2	1.3	226	128
Ireland	0.3	52	11	33	3	1	0.7	73	36
Italy	6.8	47	4	47	1	1	0.7	119	63
Netherlands	3.5	33	13	43	4	7	1.4	232	108
Portugal	0.3	30	4	52	1	13	0.5	34	20
UK	12.4	35	12	46	3	4	1.5	214	115
Total EU12	63.3	33	13	49	2	3	1.2	183	100

(1) Total public and private sector (industry) expenditures on environmental protection excluding R & D, water supply management, environmental improvement schemes (eg in urban areas), household expenditures, renewable energy and energy efficiency.
(2) Waste water collection and treatment; excludes protection of aquifers for certain countries.
(3) Definitions vary between countries; care needed in interpreting data.
(4) This environmental pressure indicator reflects the environmental pressures caused by the relative industrial structures and output of polluting industries in the different countries.

Source: ERECO (1993) **Environmental Expenditures in the European Community.** Final report prepared for DG XI of the European Commission.

2.3.4 *Analysis of Data on Industries' Expenditures on Pollution Control*

This section focuses on industries' existing expenditures on pollution controls so as to indicate whether any differences in industries' expenditures on pollution controls might affect the competitiveness of industries in the EU.

Table 2.3b indicates that industries' total capital and current expenditures on pollution control are substantially higher in certain European countries (eg Germany, Netherlands and France) than others (eg Spain, Greece and Ireland). The estimates are particularly poor for the latter group of countries. Nevertheless, even allowing for the data limitations, this still suggests that there is an uneven playing field between various European countries in respect of their present pollution control expenditures and measures.

Table 2.3b indicates that industries' current and capital expenditures on waste management, air and water pollution control range from between 0.2% (for Greece and Ireland to about 2.5% for Germany. The 12-15 fold difference in industries' expenditures in Germany compared with Greece and Ireland is greater than the difference for total public and private expenditures.

Interviews carried out for this study of firms in Italy and UK found that the firms' expenditures on pollution control account for between 0.6 - 4% of turnover.

Water pollution control accounts for the largest share (at about 45%) of industries' total expenditures. This is partly accounted for by the high level of industries' expenditures on water pollution control in the UK, which includes expenditures by the privatised water companies. Air pollution control accounts for the next largest share (at about 30%) followed by waste management (at about 25%). Noise control accounts for about 3% of industries' total expenditures. Industries' expenditures on air pollution control are particularly high in Germany.

2.3.5 *Sectors' Expenditures*

Table 2.3c reports OECD [1] data on the allocation of the pollution control expenditures between various specific industries for Germany, Netherlands, Austria and the UK. This shows that the chemicals industry accounts for the largest share of total industries' expenditures, especially in the Netherlands and Austria. However, for the UK, the expenditures are more significant in terms of turnover for the leather tanning (about 3.5%) and pulp and paper industries (about 3.6%).

2.3.6 *Conclusion*

This short review of available estimates of industries' environmental expenditures indicates that there may be significant differences between the level of industries' existing environmental expenditures.

[1] OECD (1993) **Pollution Abatement and Control Expenditure in OECD Countries.** OECD Monograph No 75.

Table 2.3b ***Industries' Pollution Control Expenditures in Selected European Countries (in M ECU at 1992 prices)***

	Environmental Media							
Country (1)	Air	% of Total	Water	% of Total	Waste	% of Total	Total	Total (% of manufacture output) (2)
Germany	4535	50	3118	35	1372	15	9025	2.52
Netherlands	394	46	306	35	135	16	864	2.03
France	1013	30	1217	36	1112	33	3342	1.76
UK	1514	19	4760	60	2014	25	7948	na
Italy	280	23	552	45	384	32	1215	0.70
Denmark	19	16	73	62	25	21	117	0.74
Spain	6	1	231	40	339	59	575	0.79
Portugal	na	na	na	na	na	na	na	na
Belgium/Luxembourg	na	na	na	na	na	na	na	na
Greece	6	9	37	53	27	39	70	0.16
Ireland	32	47	8	12	29	43	68	0.21
Total EU 12	7767	33	10302	44	5437	23	23224	

Source: ERECO (1993) **Environmental Expenditures in the European Community**, Final report.
na = not available

(1) The EU 12 countries are listed in ERECO's ordering of their accuracy of the available data, with the most accurate (Germany and Netherlands) presented first.

(2) Manufacturing output obtained from 1993 data in the World Bank Development Report 1994

Table 2.3c ***Pollution Abatement and Control Expenditures by Specific Industries***

	Netherlands		Germany [1]		UK		Austria
Industry	% of total mfr exp	% of industry turnover	% of total industrial pollution control investment [1]	% of industry turnover	% of total mfr exp	% of industry turnover	% of total mfr ind exp
Chemicals	60	2.9	47	1.7	23	1.5	40
Textiles and leather	1		2	1.7	3	3.5	2
Pulp and paper	3	1.6	8	1.5	12	3.6	16
Food and tobacco	15		5		14		5
Iron and steel	10		10		18		20
Machinery	7		21		13		11
Wood and wood products	1	0.3	2	0.2	3	0.3	2
Non-metallic mineral products	2		5		4		6

Source: OECD (1993) **Pollution Abatement and Control Expenditure in OECD Countries**

[1] The data for Germany only covers industries' expenditures on pollution control investments (not both current and investments expenditures as in the data for the other countries).

3 ECONOMIC IMPLICATIONS OF ENVIRONMENTAL LIABILITY SYSTEMS

3.1 BENEFITS OF ENVIRONMENTAL LIABILITY SYSTEMS

This section identifies the types of benefits that can result from the implementation of environmental liability systems so that these benefits can be viewed alongside the costs of environmental liability systems which are discussed in *Section 3.2.*

The benefits of environmental liability systems are that they:

- Lead to greater restoration of environmental damage arising from environmental incidents. This can be particularly important for accidents which can lead to significant acute environmental damage and where the existing regulations do not provide a ready mechanism for the restoration of environmental damage and for compensation of the victims.

- Increase compensation of victims and increased security for the public that might be affected by (industrial) activities with potential to pollute.

- Make it easier for victims to secure compensation and the restoration of the environmental damage. This lowers their transaction costs of making claims.

- Lead firms to implement better assessments of their environmental risks and liabilities which enables and prompts them to implement more efficient risk management measures. This can also identify opportunities for other economically beneficial improvements in their operations such as better process control and reduced spillages and wastage leading to savings in raw materials and energy and improvements in workers' safety and working conditions.

- Induce firms to implement greater pollution prevention and control and risk management measures to reduce the risks of environmental pollution arising.

For example, in the UK, the National Rivers Authority's recently increased enforcement of their powers under Section 161 of the Water Resources Act to recover the costs of pollution incidents from polluters. This has led to greater pollution prevention and care being taken by the firms and has helped reduce the number of substantiated pollution incidents significantly by 31% in 1994 compared with 1993.

There is little other information currently available documenting the benefits of existing environmental liability systems. This is partly due to: the difficulties of documenting environmental accidents that do not actually take place; the lack of baseline information on environmental liabilities - few of the firms interviewed had carried out a systematic assessment of their liabilities and none had carried out a monetary valuation of these liabilities; and the difficulties of disentangling the effects of an environmental liability systems from the other factors affecting the changes in the number and level of environmental incidents (eg changes in technology, industrial structures etc).

3.2 COSTS OF ENVIRONMENTAL LIABILITY SYSTEMS

3.2.1 *Introduction*

This section identifies the types of costs of an environmental liability system. It then reports available data on these costs to indicate their level and the key components of the costs of environmental liability systems for tackling specific types of environmental problems. The section also identifies which industries are likely to be most significantly affected by these costs.

Section 3.2.3 reports on experience in the USA with Superfund, for which some data are available. *Section 3.2.4* then reports the available data on the costs of liability systems in Europe based on the findings from interviews with firms regarding existing and alternative environmental liability systems.

3.2.2 *Types of Costs of Environmental Liability Systems*

The costs of an environmental liability system can be split into:

- the additional *economic costs* arising from the environmental liability systems;
- *transfer payments* in terms of compensation payments from the polluter to victims.

Economic costs of environmental liability systems include:

- Transaction costs are defined as expenditures incurred by responsible parties and their insurers that do not directly contribute to site cleanup. Transaction costs are incurred by the government (eg to assess and value the damage costs), responsible parties and their insurers and the victims. The transaction costs include:
    - The costs directly relating to the assignment of financial responsibility - most of the discussion about transaction costs has focused on this aspect. This includes the costs of negotiation and litigation between responsible parties and the government and between responsible parties to determine who is liable for which portion of the costs, and then between responsible parties and their insurers.
    - Costs of assessing the environmental liabilities, valuing the damage costs and estimating the level of costs that the responsible parties have to pay.
    - The insurers' and banks' costs of assessing a firm's environmental liabilities/risks to determine their insurance premia and for their decisions on loans to the firm. These costs will be incorporated in their premia or financing charges they levy regarding environmental risks.
    - Administrative costs of processing claims (eg by insurers).
- Costs of additional pollution prevention measures that the environmental liability system induces the firm to undertake. These includes the costs of finding out about appropriate control measures and implementing them and any additional R&D into pollution prevention measures by the firms.

- Wider economic implications from:
  - impacts of the costs on industries' international competitiveness (this aspect is examined in *Section 3.3);*
  - impacts on the level of industrial investment due to the effects of the liability system on availability and costs of finance and insurance (see *Sections 3.4 and 3.5),* especially for SMEs (see *Section 3.6);*
  - the impacts of a liability system on industrial confidence.

Transfer payments include:

- Costs of remedying or restoring environmental .
- Compensation costs paid by the polluters to the victims.
- Industries' contributions to any fund to cover these compensation payments and costs of remedying the . Compensation funds may also involve some additional the costs of administering the compensation fund and raising the revenue.
- Insurers' premia will be designed to cover the expected costs of compensation claims to be paid out of an insurance contract plus the insurers' transaction costs.

Environmental liability systems can entail higher transaction costs than other environmental policy instruments.

3.2.3 *Costs of Superfund (CERCLA) in the US*

This section reports briefly some available estimates of the costs of Superfund - the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) - to indicate the scale, nature and key determinants of the costs that have arisen as a result of a major piece of environmental liability legislation that has actually been implemented and to identify specific industries particularly affected by this legislation.

The Superfund was established in 1980. It gives the US Environmental Protection Agency (EPA) the power to identify and compel those responsible to clean up the nation's worst hazardous waste sites.

Under the Superfund program the costs to industry are borne partly by direct recovery of costs from responsible parties (about 70% of the total) and partly by a Trust Fund (about 30% of the total) set up to cover the costs of orphan sites for which no responsible or liable party can be found. The Superfund clean up programme had very high transaction costs, which are one of its most highly criticised components.

Clean Up Costs

Estimates of the annual total clean up costs of Superfund for remedying or restoring environmental , including transaction costs, are approximately $2 billion pa [1]. This annual cost represents about 0.03% of the GDP of the US. It also represents only 1.5% of total public and private sector expendit ır\ s to comply with federal environmental regulations.

Compensation Costs

The only compensation costs are for land restoration which is included in the figures above.

Transaction Costs

Transaction costs for industry (the responsible parties), on average, account for about 20% of these total clean up costs - or approximately about $0.4bn pa.

Table 3.2a shows that the transaction costs rise substantially with increases in the number of parties that are potentially liable for the . Probst et al suggest that transaction costs' share of the total costs rises from 5% where one polluter caused the damage to 25% where between 11 and 50 polluters were potentially liable for the damage [2].

Most of the responsible parties' transaction costs were for legal expenses. Other transaction costs include assessing the liabilities and drawing up clean up plans for sites. Transaction costs accounted for about 88% of the costs incurred by insurers, with these transaction costs split fairly evenly between the costs of settling disputes between insurers and the firms as to whether the insurance policy covers the clean up costs (42% of the total) and the insured firms' legal costs of disputing their liability to pay for the clean up of the site (37% of the total) [3].

However, transaction costs as a percentage of total clean up costs appear to fall as sites move through the remedial process. This is because the initial litigation processes between parties over responsibility are concluded at the beginning of the remediation actions. This suggests that as more of the nation's sites move to the later stages of the clean up process, transaction cost shares will fall.

[1] American Academy of Actuaries (1995), **Studies of Superfund Costs and Reform.**

[2] Probst et al, (1995), **Footing the Bill for Superfund Clean up: Who pays and how?** The Brookings Institution and Resources for the Future

[3] RAND (p 22 and 61), Superfund and Transaction Costs, The Experiences of Insurers and Very Large Industrial Firms, 1992

Table 3.2a *Effects of Number of Potentially Liable Parties on Transaction Costs*

Number of responsible parties	Transaction costs as % of total costs
1	5%
2 - 10	20%
11 - 50	25%
>50	30%

Source: Probst, K N, Fullerton, D, Litan, Portney, P,R, (1995) **Footing the Bill for Superfund Clean ups: Who pays and how?.** Brookings Institute and Resources for the Future, Washington D.C.

Contributions to Compensation Funds

The Trust Fund is financed by the following taxes:

- a tax on domestically produced or imported oil, which raises about 37% of the total funds. In 1989, this tax was set at 9.7 Cts per barrel;
- a tax on domestic and imported organic and inorganic chemical feedstock, which raises about 16% of the total funds;
- A corporate environmental tax of 0.12% on every corporation's taxable income in excess of $2m (in all sectors of the economy).

Probst et al (1995, p 79) use input-output models to estimate that the direct and indirect increase in all industries' costs and prices due to these taxes are a small fraction (less than 0.004%) of all industries' production costs [1].

Probst et al (1995, p 89) state that the administrative and compliance costs for the authorities and the firms of these three taxes form a much higher proportion of the revenue raised than is the case with other taxes administered by the Internal Revenue Service. The complications and costs of administering the corporate environmental income tax are particularly high.

Costs of Additional Pollution Prevention Measures

There is no specific data available for this cost because it is extremely difficult for industry to separate out additional expenditure for pollution prevention measures, resulting from the Superfund program, from general environmental pollution prevention expenditure.

Costs for Specific Sectors

There are concerns that an environmental liability system will impose particularly significant costs on specific sectors and that their competitiveness might be affected. This section therefore presents US information on the costs for specific industrial sectors. This information provides the basis for the competitiveness analysis in *Section* 3.3.

[1] The costs and price increases due to the taxes are less than 0.001% of production cost for almost all industries and slightly higher for petroleum refining (0.003%) and petroleum related products.

Chemicals industry

Table 3.2b presents estimates of the costs of Superfund for the chemicals industry broken down between:

- clean up costs for which the chemicals industry has been assigned liability as a responsible party plus the chemical industry's transaction costs associated with these liability cases;
- the chemicals industry's contributions to the Trust Fund through the taxes on chemicals feedstock, petroleum tax and the corporate environmental income tax.

Table 3.2b *Costs of Superfund for the Chemicals Industry*

Cost Elements for Chemical Industry	Annual costs ($M pa 1990 prices)	Annual costs as % of Chemical Industry's Value Added
Responsible party costs for clean up plus chemical industry's transaction costs	492	0.4%
Contributions to Trust Fund through chemical feedstock tax	286	0.2%
Contributions to the trust fund through petroleum tax, corporate environmental income tax [1].	150	0.1%
Total costs	928	0.7%

Source: Probst, K N, Fullerton, D, Litan, Portney, P,R, (1995) **Footing the Bill for Superfund Clean ups: Who pays and how?.** Brookings Institution and Resources for the Future, Washington D.C.

Other Industries

Table 3.3c presents estimates of the responsible party clean up and transaction costs under Superfund for various other industries compared with the chemicals industry. This shows that the chemicals industry accounts for the largest share of the costs of clean up under Superfund, but the clean up costs represent a larger proportion of value added for the mining and lumber industries.

Difficulties in obtaining consistent and comparable data on profits across industries and the considerable annual fluctuations in industries' profits limits the extent to which the clean up costs can be presented and analysed as a percentage of the industries' net profits. *Table 3.2c* reports estimates given in Probst et al (1995). The figure for costs as a percentage of profit can vary depending on the year selected due to variations in the industries' profits in different years. The figure for the primary metals industry was derived by dividing this industry's annual clean up and transaction costs by its annual profits over the more recent period 1988 - 1992, when profits were higher than in the early 80s. This is the more relevant time period for assessing the ability of industry to support the annual clean up costs which

(1) This is based on the figures in Probst (1995, Figure 4.2 (p 76)) which indicate that the direct and indirect costs for the inorganic and organic chemicals, chemicals and allied chemicals industries of the petroleum and corporate environmental income tax represent slightly more than half of the chemical feedstock liabilities.

this industry is expected to incur over the period 1990 to 2000. The clean up costs are a significant proportion of the profits and burden for the mining industry, which actually made losses in 1991.

Table 3.2c *Superfund Costs for Various Selected Industries Compared with Chemicals*

Industry	Clean up and Transaction Costs ($m 1990 prices)	% of total costs for Superfund	Costs as % of value added	Costs as % of net (after tax) profits	Index of Relative costs (% of value added) vs chemicals
Chemicals	492	25%	0.4% (1)	2.3% (2)	1
Mining	220.5	11%	0.7%	>22% (3)	1.75
Lumber and wood products (excluding furniture)	119.9	6%	0.5%	<1%	1.25
Petroleum	97.4	5%	0.3%	0.7% (4)	0.75
Primary metals	148.8	7.5%	0.3%	4.5% (5)	0.75
Fabricated metal products (except machinery and transportation equipment)	98.7	5%	0.1%		0.25
Electronics	70.1	3.5%	0.1%		0.25

Source: Probst, K N, Fullerton, D, Litan, Portney, P,R, (1995) **Footing the Bill for Superfund Clean ups: Who pays and how?.** Brookings Institution and Resources for the Future, Washington D.C.

3.2.4 *Costs of Environmental Liability Systems in Europe*

Findings from Interviews with Firms

Interviews were carried out with 63 firms in the iron, metal, leather tanning, pulp and paper, wood preserving, pharmaceuticals, mining, electronics, chemicals, petroleum, oil production and refinery industries in Germany, UK, Italy, Spain and Hungary to assess the costs and economic implications for these firms of existing and possible future environmental liability systems.

(1) *Table* 3.2c presents the estimates for just the clean up of contaminated sites by responsible parties (ie it does not include contributions to the Trust Fund)

(2) This is based on the chemicals industry's profits in 1991.

(3) Mining industry's annual clean up and transaction costs as % of profits in 1990. The mining industry made a loss in 1991.

(4) This is based on the petroleum industry's profits in 1991.

(5) This is based on the primary metals industry's profits over period 1988 - 1992

Costs of Existing Environmental Liability Systems

The research and firm interviews indicated that the costs cf existing liabilit, systems in Europe are low and much lower than those of the Superfund in the USA.

A further survey of 30 firms in the iron and metals industry in Germany indicated that the law on environmental damage in Germany (UmweltHG) in 1991 increased firms' pollution control investments and pollution control operating costs by about 3 and 11%, respectively, which represents less than 0.2% of these firms' turnover. The increase in operating costs mainly reflects increased transaction costs, such as documentation costs and the costs of assessing the firms' environmental liabilities and risks. The iron and metals industry comprises mostly small and medium sized firms. Prior to the introduction of the UmweltHG, these small firms did not have as extensive procedures for assessing, documenting and managing their environmental liabilities as large major firms. Therefore it is possible that the UmweltHG led to greater increases in these small firms' transaction costs and pollution control operating costs than was the case for the larger firms.

In Germany, experts in the Chemicals Industry Association (VCI) commented that the German Environmental Liability Act in 1991 (UmweltHG) has led to little or no significant increase in pollution prevention costs in these industries. This is due to the limited scope of the UmweltHG and the greater effect of the environmental regulations in Germany.

Interviews with firms in the UK, Italy and Hungary similarly indicated that firms' costs of existing environmental liability policies represent a small proportion of their turnover.

Other key conclusions from the interviews with the firms include:

- Firms' awareness of the existing environmental liability policies varied from very high in Germany and the UK to fairly good in Italy and Spain to not at all in Hungary.
- No firms interviewed have made any quantitative and monetary assessment of the potential costs of their existing environmental liabilities. They were unsure to what extent compensation would be sought for their environmental liabilities.
- Firms have not assessed the reduction of risk due to preventative expenditure.
- Most firms across the countries considered that the environmental liability system did not have a significant impact on their competitive position.
- Most prevention activities carried out by the firms are induced by existing command and control policies and not environmental liability policies.

These results imply that at this stage current environmental liability systems are, in general, not affecting firm behaviour or entailing significant costs.

However, there are few data or estimates available of the costs to industries of the existing or proposed environmental liability system. This is partly because the existing liability systems in Europe are less strict than Superfund and partly because it has proved difficult for industry to cost hypothetical and imprecise proposals for future environmental liability systems.

Moreover, it is also difficult to estimate firms' costs due to the environmental liability system as distinct from, and additional to, the costs they incur for environmental regulations since the firm's prevention measures are designed both to comply with the environmental regulations as well as reducing the firm's environmental liabilities.

Costs of Possible Future Environmental Liability Policies

In the interviews, firms were asked how specific elements of alternative future environmental liability systems might affect them.

In respect of the consequences for industries of possible future environmental liability policies, the firm interviews found that most firms are willing to pay for the environmental damage costs they cause, but not for the damage caused by others. Moreover they argue strongly that the costs of remedying environmental damage must be reasonable and based on cost-effective treatment methods and a fitness for use criteria in setting the restoration standards.

Firms, on the whole, had not evaluated consequences of future liability and were unable to clearly distinguish effects of most elements.

Some firms might accept rights of action by NGOs, although some large firms stated that this would result in increased litigation of large firms who may not necessarily be the most polluting.

Some firms expressed considerable concern and opposition over the following elements of possible future environmental liability policies:

- *Retroactive liability.* Most firms are opposed to proposals for retroactive liability, claiming it was unfair if firms had originally complied with prevailing laws in the past. Retroactive liability provisions would have led to the closure of one small leather tanning firm that caused a major pollution incident.

- *Joint and several liability.* Some firms expressed concern over the likely high litigation costs due to the deep pocket syndrome of claimants focusing on larger firms with better financial resources.

- *Strict Liability.* Firms claimed this would increase their litigation costs and were particularly opposed to strict liability without limits or defences.

- *Ecological damage.* On the whole widening the scope of environmental to include ecological damage of the unowned environment was not viewed as a significant problem for most firms. However, some suggested that it would increase uncertainty about the level of a firm's environmental liability and the amount of provisions to make.

- *Compensation funds.* The cleaner firms (eg those with certification under BS 7750) were opposed to a joint compensation fund since they are unwilling to subsidise the costs of cleaning up environmental damage caused by more polluting industries and their more polluting competitors within their own industry. Some firms believed in a fund's necessity but felt it should be funded by the state.

Conclusion

Existing liability systems in Europe have not significantly increased costs for European industries. In relation to possible future environmental liability systems, the firms interviewed suggested that they would be willing to pay for the damage they cause but not for damage caused by others, and provided that the costs of remedying the damage are reasonable and cost-effective and that it allows them a degree of certainty as to who is or will be liable for what sort of damage costs.

3.3 IMPLICATIONS FOR COMPETITIVENESS OF INDUSTRY

3.3.1 Introduction

This section assesses the impacts of differences between existing or likely future environmental liability systems in European countries on the competitiveness of European industries both with respect to trade within and outside the EU. The analysis is based on the findings of simulations of a set of scenarios of possible differences in the costs of environmental liability systems for the chemicals industry that might arise if different European countries adopted environmental liability systems of differing stringency (see *Section 3.3.2*). In addition, *Section 3.3.3* provides a qualitative analysis of the relative costs of liability systems for some other industries which include the wood products, electronics, pharmaceuticals, leather tanning, pulp and paper and mining industries. This takes account of the degree of trade and international competition in these industries' markets.

Section 3.2.4 reported that the existing environmental liability systems in the European countries studied have not entailed significant costs for the firms and industries investigated and that, on their own, the environmental liability systems had not significantly affected the firms' competitiveness. This limited impact of existing liability systems in EU countries on European industries' competitiveness is due to the following factors:

- Any differences in the environmental liability systems must be expected to persist for a long time (say about 10 years) to influence firms' decisions on the location of plants.

- In decisions on new plants, multinational companies tend to apply common standards based on the latest environmental standards.

- Most firms interviewed indicated that environmental issues overall were an important factor that firms take into account in their investment decisions, but that differences between countries' environmental liability policies, taken on their own, had little effect on these decisions. One multinational firm reported that greater confidence and certainty about environmental liability policies in the UK contributed to their decisions to locate all its manufacturing plants in the UK. However, this was essentially due to greater confidence that the authorities in the UK would implement the environmental liability policies more flexibly and pragmatically than any differences in the stringency of the policies per se.

Without a common approach to environmental liability systems in Europe, there could be some divergences between the environmental liability systems and their associated costs between different individual European countries. Thus some EU countries have signed the Lugano Convention (eg Netherlands, Luxembourg, Austria, Finland, Italy) or have said they will soon do so (eg Belgium, Sweden); while other European countries are not willing to sign up to the Convention (Germany, UK, France).

Consequently this section focuses on the potential impacts on European industries' competitiveness of such possible differences between EU countries' **future** environmental liability systems.

3.3.2 *Impacts of Future Environmental Liability Systems on the Competitiveness of the Chemicals Industry*

Methodology

A trade model for the basic chemicals industry (NACE codes 251 & 255) was used to simulate the impacts of policy scenarios with differences between countries' environmental liability on the numbers of plants and market shares for the main European and OECD groups of countries [1]. This trade model allows for the direct effect of the cost differences on demand and market shares between the competing countries. In addition, it allows for the long run effects of changes in the profitability of chemicals production on decisions on plant locations between the different countries - where long run is defined as about 10 - 15 years in line with a normal time horizon for decisions on new plants. The model allows for trade linkages between countries such as where one country's industry provides basic chemical inputs into the chemicals industry of another country.

The chemicals industry was selected for the model simulations since it could be significantly affected by environmental liability systems, its products are highly traded and it is subject to considerable international competitive pressures from both within and outside the EU.

Scenarios of Possible Future Environmental Liability Systems

The trade model simulations examine the effects of a hypothetical set of different levels of stringency (and costs) of environmental liability between the following five groups of countries:

- *Group I* comprises US and Canada, which are assumed to be subject to the strict environmental liability systems set out under CERCLA (Superfund) in the US concerning contaminated sites. This approach to a strict liability system is assumed to cover all environmental damage. The cost assumptions used in the simulations are based on an analysis of the costs of Superfund for the chemicals industry in the US.

[1] This trade model of the chemicals industry was developed (in the early 90s) by Professor Tony Venables and Professor Alistair Ulph (University of Southampton). It was based on published data on trade, production and input-output relationships for the chemicals industry for all countries in the world for 1985 - the most recent date for which consistent data were available at that time. Inevitably, the model has a number of limitations which are highlighted in this report. Most notably, the changes that have occurred since 1985 are highlighted and an indication is given of how they might alter the findings of the model simulations.

- *Group II* comprises Italy and EC North (BENELUX, Denmark) [1]. This includes countries who have signed up to the Lugano Convention and is designed to simulate the effects of some European countries adopting this convention while others do not. The costs of environmental liability systems for these group II countries are assumed to be half of those for the strict CERCLA based system analysed for Group I countries.

- *Group III* comprises Germany, France, UK and Ireland, Japan, Australia and New Zealand. These countries are adopting their own national environmental liability policies at an assumed moderate level of costs. The costs of environmental liability systems for these group III countries are assumed to be half of those for Group II countries.

- *Group IV* comprises EC South (Spain, Portugal and Greece). These countries have fairly limited environmental liability systems that are less stringent than those currently implemented by Group III countries. The costs of environmental liability systems for these group IV countries are assumed to be half of those for Group III countries.

- *Group V* comprises the rest of the world. These countries are assumed to have no environmental liability policies and incur no additional costs over their baseline positions.

Table 3.3a presents the main **assumptions** [2] for the costs of environmental liability systems for the chemicals industry in the above groups of countries. They are based on the costs of Superfund for the chemicals industry in the US. The cost estimates are derived for the other countries on the basis of the assumptions for the country groupings given above. Discussions with the chemicals industry suggested that the cost assumptions depicted in these scenarios provide a reasonable basis for analysis in this study.

(1) The above country grouping is based on the existing groupings already specified in the trade model with the groups combined to take account of whether they have signed up to the Lugano Convention. However, the existing trade model's data do not provide separate analysis for Denmark so this country has had to be included in the EC North group of countries even though it appears that Denmark might in fact be in Group III. The existing trade model's data also do not provide separate analysis for Sweden, Finland and Austria which are included in the rest of the world block.

(2) *Table 3.3a* and *Table 3.3b* presents the findings for the main simulations H and L. Scenario H is based on an estimate that the costs of strict environmental liability systems for the chemical industry in Group I countries (eg USA) amount to 2.4% of the turnover of this industry in the Group I countries. The cost estimates for the countries in Groups II - V are reduced using the factors described earlier. In scenario L, the costs of strict environmental liability systems for the chemical industry in Group I countries (eg USA) are slightly lower - at 2% of the turnover of this industry in the Group I countries. In addition, 7 other simulations were carried out. The points from these other simulations are highlighted in the text.

Table 3.3a ***Cost Assumptions (as % of value added) for Chemicals Industry in Model Simulations***

Group	Country	Simulation Case	
		H	L
I	US & Canada	2.4	2
II	EC North	1.2	1
II	Italy	1.2	1
III	Germany	0.6	0.5
III	France	0.6	0.5
III	UK & Ireland	0.6	0.5
IV	EC South	0.3	0.25
III	Japan	0.6	0.5
III	Australia & New Zealand	0.6	0.5
V	Rest of the World	0	0

Table 3.3b ***% Change in Market Shares for Chemicals Industry in Model Simulations***

Country	Simulation Case	
	H	L
US & Canada	-9.0	-5.0
EC North	0	-5.0
Italy	0	0
Germany	+3.6	+2.0
France	-7.0	-4.0
UK & Ireland	0	0
EC South	+4.0	+2.0
Japan	+2.6	+2.9
Australia & New Zealand	+3.0	+0.4
Rest of the World	c[1]	c[1]

Footnote 1: c = constant market shares assumed in analysis for the rest of the world.

Findings of the Model Simulations of the Impacts on the Chemicals Industry

Table 3.3b presents the findings of the simulations detailed in *Table 3.3a*. Case L shows that cost differences of up to 2% between countries lead in the long run to a (relative) fall of 5% in the market share of the highest cost countries (US and EC North) - this represents a reduction in share of world trade for the US and Canada from 2% of the world trade to about 1.9% or an absolute fall in 0.1% percentage points. Case L leads to a 2% rise in market share for the European countries with the lowest costs (EC South) - a rise in their share of world trade from 2% to 2.04% or an absolute increase of 0.04% - as indicated in *Table 3.3b*. This shows that, in an industry like chemicals, which is very competitive and where the products of the industries in the various countries are close substitutes for each other, relatively small differences in cos s can have quite significant effects on percentage changes in market share.

Comparing the findings for case L with those for H shows that a change in the costs of the environmental liability has a more than proportionate effect on their impacts on market shares. This is due to the scale economies in the chemicals industry.

The changes in market shares, shown in *Table 3.3.3b*, are small compared with recent changes in the market shares experienced by the European chemicals industry. Thus the market shares of the chemicals industry in the UK and US declined by about 20% and 4%, respectively, between 1979 - 1994. The market share of Western Europe (excluding UK) declined by about 12% over this period.

However, the changes in market shares arising from the costs of environmental liability systems in these simulations are much greater than in other studies of the impacts of environmental costs on competitiveness. These have generally found little direct evidence that the stringency of environmental regulations has had significant effects on plant location and choice and on industries' international competitiveness [1].

Limitations of the Simulations

Table 3.3.3b presents the long run impacts of the cost differences on the assumption that these cost differences would have to be perceived to be likely to persist for a sufficiently long time (ie more than 10 - 15 years) to influence plant location decisions. If this assumption does not hold, then the model simulations may exaggerate the impacts likely to arise in practice.

Discussions with chemical industry economists suggested that the model simulations overstate the likely impacts on plant location decisions. This suggests that there are trade barriers and other factors affecting relocations of plants, such as links with other industries, availability of industrial, financial and social infrastructures and inertia, which are not costed and reflected in the model so that the model simulations may exaggerate the impacts on the relocation of plants and market shares.

The model does not allow for the effects of increasing competition from the rest of the world, about which the chemicals industry is most concerned although the market share of the rest of the world has currently only increased by 0.4% between 1979 - 1994 and imports to the EU from the rest of the world have not increased significantly recently.

The model simulations had to be calibrated on 1985 data, which does not allow for the recent freer movement of goods and capital with the EU, especially since the Single Market. This effect may have led the model to underestimate the impacts on competitiveness of differences in costs.

(1) For a review of these studies see Jaffe A B, Peterson, S R, Stavins R N, (1995) Environmental Regulations and the Competitiveness of US Manufacturing: What does the evidence tell us? Journal of Economic Literature, Vol 33, March 1995 pp 132 - 163.

It is evident that the model simulations have a number of limitations - most notably the model simulates the long run effects of cost differences which are assumed to be perceived to persist over a long time period (of say 10 -15 years) and the model does not reflect barriers to trade and other factors affecting firms' decisions on the relocation of plants.

In view of these limitations, the findings should best be seen as useful indications of the likely direction of the changes rather than accurate predictions of quantitative effects. Attention should not be focused on the numerical findings, but rather on the following insights - that in an industry which is very competitive, with products which are close substitutes for each other, then relatively small differences in costs can lead to a more than proportional loss of market share.

3.3.3 *Impacts on Competitiveness of Other Industries*

Methodology

This section presents a qualitative analysis of the impacts of possible differences in environmental liability systems' costs on the competitiveness of other industries. It covers the following industries:

- semi-finished wood products;
- electronics;
- pharmaceuticals;
- leather tanning;
- pulp, paper and board;
- mining.

The analysis is based on:

- Data presented in Probst et al (1995) [1] on the costs of Superfund for the mining, lumber and electronics industries in comparison with Superfund's costs for the chemicals industry (see *Table 3.2c*).

- Assumptions as to whether the costs of environmental liability systems for the leather tanning, pulp, paper and board industries are likely to be greater, less than or similar to the costs for the chemicals industry. These assumptions were based on discussions with environmental insurance experts.

- Analysis of the degree of trade and international competition in the markets for these industries to indicate the possible impacts of any differences in the costs of environmental liability systems on the competitiveness of these industries in Europe.

Wood Processing and Semi-Finished Wood Products Industry

The costs of the environmental liability provisions concerning contaminated sites in Superfund in the USA are estimated to be higher for the lumber and wood products industries than the chemicals (when represented as a % of

(1) Probst et al (1995) Footing the Bill for the Superfund Clean up: Who pays and how? The Brookings Institution and Resources for the Future.

value added) [1]. However, the impacts of these costs on the competitiveness of European products industry are likely to be lower than is the case for chemicals since the scope for specialised products reduces the competitiveness and elasticity of demand for this industry. In addition, the main sources of imports of wood products to the EU (EFTA and US) are likely to face environmental liability systems that are as strict or stricter than is likely to be the case for Europe. However, European producers are likely to face increasing competition from South East Asian countries where environmental liability systems are expected to be less strict.

Electronics

The electronics industry has many similar characteristics to the chemicals industry. Thus trade in electronics products is high and very competitive. There is a high degree of substitution between products of the industry in different countries and the price elasticity of demand is high. In addition, the electronics industry is currently undertaking a high level of investment in new plants. Hence any differences in costs of environmental liability systems for European countries might significantly affect their competitiveness and trade.

However, the costs of the environmental liability provisions concerning contaminated sites in Superfund in the USA are estimated to be low for the electronics industry - representing only 0.1% of value added. This reflects the relatively clean and mature nature of this industry. Consequently environmental liability systems are unlikely to have any significant impacts on the competitiveness of the European electronics industry.

Pharmaceuticals

The costs of environmental liability systems for the pharmaceuticals industry are assumed to be similar to or lower than those for the chemicals industry. However, the impacts on the competitiveness of the European pharmaceuticals industry is likely to be lower because international competition and elasticity of demand in this market is lower due to the following reasons:

- the high R&D intensity in this industry acts as a barrier to entry to new firms;
- the high R&D levels required to compete in this industry means that most of the competition in this high tech market comes from developed countries (eg USA, Japan) who are likely to face strict environmental liability systems;
- product differentiation;
- the influence of the Governments in the domestic markets in European countries.

[1] The wood processing and semi-finished wood products industry (NACE classifications 461 and 462) is taken here as being the closest industry category to the 'lumber and wood products' industry for which Probst provide estimates of the costs of Superfund. Probst' data excludes furniture.

Leather Tanning

The costs of environmental liability systems might be higher (as a % of value added) for the leather tanning industry than the basic chemicals industry because the leather tanning industry has been less subject to environmental regulations than the chemicals industry in the past and has not established as extensive environmental risk assessment and management programmes as the chemicals industry. However, these costs are unlikely to affect significantly the competitiveness and market shares of this industry since trade in leather tanning products is lower and the level of international competition (and elasticity of demand) is lower for the leather tanning market. The economies of scale are less marked in the leather tanning industry and there are greater links between leather tanning and final users of leather, especially for the increasing high quality products.

Pulp, Paper and Board

The costs of environmental liability systems for the pulp, paper and board industries might be of a roughly similar level to those for the basic chemicals industry (when presented as a % of value added). However, the impacts of these costs on the competitiveness of the European pulp, paper and board industry is likely to be lower than that shown above for chemicals since the major competitors to European producers (US and Canada, Sweden and Finland) are likely to face environmental liability systems that are as strict or stricter than those likely for European countries.

Mining

The costs of the environmental liability provisions concerning contaminated sites in Superfund in the USA are estimated to be higher for the mining industry than the chemicals industry (when represented as a % of value added). However, in the case of coal mining, these costs are relatively low compared to the existing difference between production costs for EU countries compared with imports so that, in practice, they are unlikely to affect significantly the competitiveness and market shares for this industry which are driven by other more important factors.

3.3.4 *Conclusions*

Existing liability systems in European countries are unlikely to have significant impacts on the competitiveness of European industries.

In the absence of a common approach to environmental liability systems across Europe, there might in the future be further divergence between the environmental liability systems and their associated costs for different EU Member States. In industries such as chemicals, which are very competitive and where the products of the industries in the various countries are close substitutes for each other, then relatively small differences in costs could lead to a more than proportional loss of market share. However, the differences in costs due to environmental liability systems would have to be perceived to persist for a sufficiently long time (ie more than 10 - 15 years) to influence plant location decisions.

The impacts of environmental liability systems on competitiveness are likely to be lower for other industries compared with chemicals either because they are less subject to strong international competition (eg pharmaceuticals) or because the main competing countries are likely to be subject to strict environmental liability systems (eg pulp and paper and lumber and wood producıs although the latter industry may face increasing competition from South East Asia) or because the costs of environmental liability systems are low compared to value added (eg electronics).

However, the above analysis and conclusions assumes that the costs of the environmental liability system for a major polluting industry, such as chemicals, amount to a maximum of 2.4% of value added in the strictest environmental liability system. *If* certain European countries implement more extensive and stricter environmental liability systems to internalise all environmental damage costs, then the resulting cost differences between countries would be higher and the impacts on the competitiveness of European industries might be larger.

3.4 *Implications for the Insurance Sector*

3.4.1 *Introduction*

The insurance sector is extremely important in developing a successful environmental liability system. It has three main potential roles. It guarantees financial cover for environmental damage costs. It spreads the risk of compensation payments through pooling so that individual industrial companies will not face excessive financial burdens from a liability claim. Furthermore, through offering a specialised service related to the environmental management of the policyholder, insurance companies could provide incentives to policyholders to adopt pollution prevention measures to reduce future damage.

The aims of this section are to assess:

- the implications for the insurance industry of an environmental liability system;
- the problems encountered in issuing such insurance cover and how insurers might react to an environmental liability system;
- the role that the insurance industry could play in instituting an effective environmental liability system.

3.4.2 *Environmental Liability Policies and Contract Components*

This section defines the main types of insurance policies concerning environmental liabilities and the mains terms of these policies that are used in the subsequent discussion of the implications of environmental liability systems for the insurance market.

There are two types of insurance policy which include provisions for covering environmental liability. They are *General Liability (GL)* and *Environmental Impairment Liability (EIL)*. GL is a liability insurance policy which covers employers liability, public liability and product liability as a 'package'. An EIL policy is an individual environmental insurance policy which is written and adopted specifically in relation to potential environmental problems as opposed to general cover provided under GL policies which, in some cases, can also include environmental liabilities.

Within these policies insurers have options regarding the exact specification of the insurance policies they offer.

Triggers

Triggers are contract components which specify when an incident gives rise to a claim. The type of trigger determines the length of time under which insurers are liable to meet claims. The two most commonly used types of triggers are termed *occurrence* and *claims made*. An *occurrence* trigger specifies that a claim can be made at any time for an incident as long as the incident occurred under a policy. A *claims made* trigger specifies that a claim must be made during the time a policy is held by the insured. In general there has been a distinct move away from *occurrence* based to *claims made* triggers since *occurrence* based policies can expose insurers to a long-tail of claims relating to incidents arising in a period covered by past policies but which become evident and are the subject of claims later due to the lag times in the manifestation of pollution problems. These claims were unpredictable and insurers are trying to reduce these uncertainties by moving to *claims made* triggers. *Claims made*, in limiting the time period for making a claim, allows insurers to estimate better the frequency of claims' incidents as all claims have to come from a known number of existing policy holders. However, *claims made* policies sometimes considered unlawful by the courts in some countries (eg France).

Scope of cover

Scope is usually restricted to third party, with the cause of the damage coming from specifically insured sites. This is based on general civil liability practices. Cause of damage is also defined and limited. Causes of damage are divided into sudden and accidental or gradual. Another distinction is whether the incident was unexpected or part of the course of normal operations.

Financial limits

Insurers usually put financial limits on the sums covered either as a limit for an individual claim or for the total financial sums that can be claimed under the policy. Limits will vary depending on the type of policy formulated and premium paid and the extent of risk. Insurers will put lower limits on firms with high risk.

3.4.3 *Current Relationship Between General and Environmental Liability Policy.*

The GL and EIL policies presently overlap and the margins of difference between them vary between countries. *Table 3.4a* compares the two policies and presents the areas of difference between them. Most insurers in the UK and Germany will insist that a firm has its GL policy and its EIL policy with the same insurer, to avoid double-counting and disputes as to who is responsible for the environmental liabilities and to lower transaction costs of issuing the policy. So when considering the insurance industry policies and contracts both general and environmental policies should be considered, especially as in most countries the latter is still extremely limited in demand.

The overall trend in light of stricter environmental policies is to reduce GL obligations and move coverage of environmental liabilities into EILs. In most countries, insurance companies' GLs cover only sudden and accidental pollution. Therefore, if a manufacturer wants gradual pollution covered it needs to take out an EIL policy for named and audited sites. Insurers are now seeking to go one step further than offering additional environmental coverage in EILs by isolating and excluding pollution insurance from their general policies.

In attempting to reduce the potential environmental compensation obligations from GL policies many insurers may seek to deny coverage under previously issued GL policies. To be able to successfully make a claim the insured will have to prove that the loss/liability arose during the period of the policy and that the contract wording covered the specific type of event. Insurers will look very closely at the policy terms, conditions and exclusions and will deny coverage if the insured: failed to take all reasonable precautions; deliberately caused the pollution; failed to disclose material facts and; are late in notifying the claim. (1)

Markets across Europe are now at different stages of offering cover for environmental damage. The Comite Europeen Des Assurances (CEA) identifies four existing situations in EU countries.

- total pollution exclusion from general liability with an optional surcharge for sudden and accidental damage;
- old general liability policies which did not make a distinction between sudden & accidental pollution and gradual pollution;
- general liability insurance covering sudden and accidental pollution but not gradual pollution damage;
- in addition to the above, environmental impairment liability policies are offered which pertain specifically to environmental risk and include gradual pollution damage (which is often offered through an insurance pool operated by a collective group of insurers in some countries).

The demand for EIL policies to date in most European countries has been limited. EIL premium income is very small in relation to the GL market. EIL premium income accounts for less than 1% of GL premium income in the UK, Italy and Spain, less than 2% in the Netherlands and about 4% of GL premium income in Germany.

The main trends identified across the countries are that:

- Under both GL and EIL policies insurers usually limit their liability to third party .
- Cover for ecological to the unowned environment is not available.
- A transition has occurred from 'occurrence' to 'claims made' policies. This is to resolve the long tail liability problem.
- Gradual pollution may now be covered in an EIL policy.

(1) Brian Street, An Insurer's View of the 1995 Environment Act, Fifth Environmental Insurance Conference, List of Lloyds Press.

Table 3.4a ***Comparison of Major Characteristics of Liability Policies in the European Countries Investigated***

	General Liability (GL)	Environmental Impairment Liability (EIL)	Key Differences of EIL
Types of covered	sudden and unintended; damage to property, bodily injury and the natural environment	as GL but also gradual pollution and all discharges, including unforeseen from permitted discharges	wider scope but specifically for pollution and contamination. Air pollution damage will be difficult to prove. Past damage excluded (therefore requires audit)
Claims basis	occurrence, during period of insurance	claims made	no retroactivity; avoids long tail of claims since, if policy lapses, claim cannot be brought after a short expiry period (30 days after the policy has expired in one case). This is a crucial change to make EIL more robust
Whose damage can be covered	third party (1)	third party	provides specific cover previously available in GL
Extent of cover, exclusions, limitation		only cover firms with good environmental management	no retrospectivity, applies to named and audited sites
How risks are assessed	no assessment	audit; desk study for small risks, site visit for large risks	expertise in risk assessment is required
Transaction costs as % of premium	10-30% of premium	25-40% of premium	higher cost due to risk assessment of named sites

3.4.4 *Evolution of Environmental Insurance Cover*

Insurance policy systems evolve based on past policy and claims experience and changing external forces. The external forces are legal, jurisdictional and public consciousness. Claims experience and external developments have made insurers reassess their initial service for covering environmental damage and rearrange the scope and price of such policies.

Insurance companies are responding to two distinct concerns. One is the increased vulnerability of insurance companies from old policy exposure for historic pollution. The other is how insurance policies need to change to cope with stricter environmental liability.

Historic Pollution Problems

The insurance industry in Europe for a long time did not explicitly consider environmental liability. Insurance companies, under general liability provisions, may be potentially liable for a series of claims for old pollution problems. General Liability, due to its non-specific nature, made no special provisions or restrictions for irresponsible actions by firms regarding their

(1) However, first party damage is covered under GL policies in Germany.

ensuing pollution damage. Wording was not careful enough to restrict the scope of responsibility of the insurers. Original cover was based on *'occurrence'* based triggers with no time limit, exposing insurers to a long-tail of claims. Due to the *'occurrence'* claims trigger insurers may become liable for past pollution of the insured. Therefore where retroactive liability is established insurers now fear that they will face an onslaught of lawsuits and possible compensation payments directed at the insured companies for past contamination which the insurers unwittingly covered at no extra premium. This historical experience has led insurers to be cautious about providing cover on environmental liabilities.

Future Pollution Cover

Increasing awareness of environmental liabilities, accompanied by the development of stricter environmental legislations are part of the set of influential factors now altering insurers' coverage of environmental damage. This situation has led to some insurance companies developing specific environmental insurance provisions.

Insurers now manage the process of offering environmental damage cover more carefully with greater risk assessment and focusing on clearly specified environmental risks where they can estimate the level of their potential liabilities and set premia accordingly. Insurers offer this cover in Environmental Impairment Liability (EIL) policies. EIL policies require individual environmental risk assessments and modify the elements of the policies, such as triggers, to restrict liability for insurers in the future. They are not yet well established and still do not have a wide market base or standardized premia levels. The number of EIL policies so far in place is low at present. Discussions with the insurance industry indicated that insurers are, in general terms, unable to quantify the scope of the cover or the change in the size of premia under stricter liability regimes.

Site audits are increasingly required before insurance is given to polluting industries. These increased transaction costs are proportionally higher for small firms and might affect SMEs' capacity to purchase insurance.

Insurance Pools

In countries where the insurance industry is dominated by small insurance firms lacking resources to build new markets by themselves, insurers have come together and formed insurance pools specifically for environmental liability. Through acting together the companies can share financial resources, environmental expertise and reduce risk. Insurance contracts are developed by the companies under the supervision of the pool, which provides technical assistance, a reference contact and provides advice on special conditions to impose and assessment of the risks and costs related to specific sites. The pool covers nearly all environmental insurance contracts though a few are still carried out by individual companies and are reinsured outside the pool.

3.4.5 *The Size and Maturity of the Insurance Industry*

Table 3.4b shows a clear difference in the size of insurance markets with Germany and UK being significantly larger and more developed than the others. Spain and the Netherlands have a particularly large number of insurance companies, considering the size of their markets. This indicates that insurance companies in Spain and the Netherlands have, on average, smaller financial resources and thus will be more wary of taking financial risks. Therefore insurance pools for environmental insurance are being developed in these two countries and also Italy, where the insurance industry is smaller and less developed than in Germany and the UK.

Table 3.4b *Size of Insurance Markets in Countries Investigated*

Country	Number of Insurance Companies	Total General Liability Premium Income (M ECU)
Germany	800	5,500
UK	830	2,070
Italy	270	1,105
Spain	410	850
Netherlands	490	540

Source: FEEM

3.4.6 *Economic Issues for Insurers*

This section provides a framework to understand the situation currently faced by the insurance companies with the new environmental liability insurance market.

The insurer provides a commercial service to private enterprises by pooling their individual risks. These risks would otherwise cause excessive financial hardship in the event of a pollution incident, if the costs of the incident had been borne by an individual firm. The provision of this service depends on:

- risk spreading;
- risk assessment.

Risk Spreading

Sufficient amounts of policy holders taking up the cover are needed to spread risks. This needs the ability to find a sufficiently large number of candidate firms. The time, cost and uncertainty of gaining a sufficiently large pool of policyholders makes insurers cautious about venturing into new markets. This holds particularly true for environmental liability insurance markets which in many countries is a very new market about which the insurers have little experience and expertise.

Risk Assessment

Premium rates need to be high enough to build up financial resources to cover potential compensation payment. It is crucial to set appropriate premia for the insurance policies to be sustainable. Insurers need to be able to predict compensation payments (amount and frequency) to calculate the appropriate premium level. This requires case experience and clear valuation criteria. Without these, future premium rates cannot be reliably calculated. Risk assessment requires questionnaires and site audits. Risk assessments are key tools for insurers to filter out 'bad' risks and determine suitable premia levels for those companies with sound enough environmental management to be covered.

Expertise is required when a policy is to be taken out and when a claim is made: to assess and value (environmental) risk and remediation possibilities; for verification of ; and to establish causation and responsibility to determine the levels of compensation. There are organisational costs associated with building up such expertise and carrying out site investigations for risk assessment. The costs of this expertise will significantly add to transaction costs. However, these transaction costs could be expected to decrease over time as expertise builds up. The need for technical expertise in this area is very important for environmental liability insurance as environmental damage is not a traditional area of insurers' expertise.

Summary

The main problems faced by insurers in developing environmental liability insurance are:

- risk assessment;
  - need for technical expertise;
  - uncertainty of future claims;
- defining and selecting triggers;
- uncertainty concerning future cumulative risk;
- potentially high litigation costs in apportioning responsibility;
- high costs leading to high premia and tight margins which impede market growth.

3.4.7 *Potential EIL Market*

There has so far been limited uptake of new policies designed to insure future pollution. This is reflected in the limited growth of the EIL market, although Germany is an exception where almost all policyholders of general liability also have an EIL policy. Germany, UK, Italy, Spain and the Netherlands all have EIL markets which are substantially smaller than their GL markets; EIL premium income in all countries is less than 5% of their GL income.

One of the reasons that insurers have been slow to expand their exposure in this market is that they are reluctant to cover unknown risks. Insurance companies are also greatly influenced by the uncertainties still remaining in potential losses to be covered. Uncertainty makes insurers' plans for covering environmental damage more conservative. There is still a large degree of uncertainty regarding the cost of covering environmental damage. The uncertainty arises from:

- lack of a claims history;
- legislative changes;
- difficulties in predicting likely future public concern;
  - level of restoration demanded;
  - number of cases taken to court;

- lack of technical expertise to underwrite risks;
- problems of valuing environmental damage.

However, even when insurance companies offer environmental liability cover under EIL policies, there is little demand for such EIL policies on the part of firms. This is partly because some firms do not recognise the magnitude of their environmental liabilities that require cover and because cover is not compulsory under existing laws. Moreover, the premia for the EIL policies being offered are high and much higher than the premium rates for GL policies so that firms often prefer to stay under GL cover.

Transaction costs also influence the potential policyholder's decision whether or not it is economic to take out specific environmental cover when a choice is available. This includes the transaction costs incurred by the insurer, which are included in the premia, and the transaction costs paid by the firms on, for example, the assessment of environmental liabilities. The transaction costs as a percentage of premium will vary in proportion to the size of the plant or company being insured. Smaller firms with lower premium needs will still have to carry out audits and thus have higher relative transaction costs. In general, administration costs for GL range from 10 to 30% of premium. In comparison, administration costs for EIL range from 25-40% of premium.

The perspective of the industry is that good business opportunities do not exist in this market and will not for at least the short to medium term yet. Therefore a rapid expansion of the market cannot be expected in the short term. The EIL insurance market will need considerable time to evolve and mature.

3.4.8 *Insurance Industry Views on Alternative Liability Systems*

At the moment in the UK, Germany and Spain, EIL insurance is not seen to be very attractive due to the difficulty in attaining profitability and existing scientific and other uncertainties concerning environmental liabilities. Insurers would be cautious about offering policies under stricter regimes. If increased insurance coverage is desired for polluting firms then any decisions taken on what will be included in a future stricter environmental liability system must take into account the views and financial interests of the insurance industry.

The main elements considered are:

- retroactive liability;
- joint and several liability;
- compulsory insurance;
- covering ecological damage.

Retroactive Liability

Insurers are very concerned about the imposition of retroactive liability. Old policies might leave insurers responsible for compensating past damage, which they had previously not considered and allowed for in setting past premia so that insurers have not built up reserves to cover these damage costs. Therefore, if retroactive liability is imposed and old policyholders are held liable for past the insurers will be left paying the bill unless they find supportable defences. The potential liabilities for insurers regarding CERCLA in the US are large compared with their reserves.

If insurance companies are made to pay for exposed historic liability they may experience a significant drain on resources, such as in the US. Their ability to pay claims may decrease which would adversely affect them through a drop in credit rating.

To protect against retroactive liability they now will not cover historic damage in new policies. This will not help them with old policies but will limit their responsibility for pollution occurring from now but which is not found for years to come. However, in order to prove what pollution has occurred before and after the initiation of a policy contract a detailed site audit needs to be carried out.

Joint and Several Liability

Joint and several liability means that a polluter may be liable for more than the damage the polluter caused. This difference in the value of damage caused and the amount for which an individual firm would be liable would differ case by case depending on the situation of the other responsible parties and the extent to which the firm can recoup the costs of the environmental liabilities from other responsible parties.. Therefore it will not be possible for the insurance company to estimate the actual amount a company may be liable on the basis of a site audit and risk assessment of this company's environmental liabilities.

Insurers would find it very difficult to price a policy under a liability regime in which financial liability could not be clearly related to the pollution risk of an individual firm or plant for which they are providing cover (and for which they receive premia). The uncertainty would mean that insurers would therefore have to increase the premia set.

Compulsory Insurance

Compulsory insurance might increase the number of firms requiring environmental insurance policies, which would give greater experience with such policies and thereby lead to the development of an extensive EIL market. However, compulsory insurance provisions would raise many practical problems, which are exacerbated by the existing difficulties that constrain the development of EIL policies.

Compulsory insurance is asymmetric. Firms can be required to have insurance but individual insurers cannot be forced to provide cover. Given the various types of damage and the many types of cover and the wide range of premia and conditions for policies that insurers may offer concerning such damage, it will be very difficult to specify in the regulations how the compulsory insurance provisions would apply to all these diverse cases. Moreover, given the potential rise in total damage costs to be covered, insurers would need many years until claims experience and risk assessment were developed to be able to calculate appropriate premia levels and to cover all firms for the various types of environmental damage. Cover might therefore be very restrictive. Furthermore, firms not being able to obtain insurance would be legally forced out of business.

The experience of compulsory insurance in Germany exemplifies these specific difficulties. The arrangements, initiated in 1991/2, to deal with compulsory insurance are still not complete. It is estimated that it will take several more years before compulsory insurance comes into force. This delay is because of the as yet unresolved problems concerning how to set legal requirements to prevent insurers offering insufficient financial limits and narrow scopes of damage for high risk firms.

Covering Ecological Damage

Insurers do not usually cover ecological damage due to the uncertainties concerning the valuation of environmental damage where there is no specific injured party whose property rights have been damaged and who can seek compensation and pursue a claim. If the public bodies pursue the claims for ecological damage, then the insurers may argue that such ecological damage has not been suffered by a readily identifiable third party and therefore are not covered under some insurance policies. The possibility of claims from NGOs might make it difficult for insurers to set appropriate premia rates because ecological damage is not covered under most existing legal systems in Europe so that insurers in Europe do not have much experience regarding claims from action groups for ecological damage on which to set premia. Insurers consider that rights of action for NGOs might increase litigation for insurers which would be passed on to industry through higher premia.

Thus ecological damage raises significant problems concerning the valuation of the damage and determining what should be done with the compensation payments (since there are no identifiable victims that could receive the compensation). Instead of covering compensation for such unquantifiable damage, it might be more feasible to cover restoration of ecological damage in cases where the ecological losses can be readily identified and quantified (eg level of fish kill) and estimates can be readily agreed for cost-effective and reasonable measures to restore the damaged ecological asset. . An example of this is Section 161 of the Water Resources Act in the UK.

3.4.9 Potential Role of the Insurance Sector

Insurers take the initiative and control the direction and scope of the new policies they offer. They have the option to offer cover of a restrictive nature and thus leave companies without insurance and vulnerable to liability actions, to be self-financed.

A tension exists between the insurers' reluctance to insure environmental risk and the need for financial resources to support environmental liability. Insurers will need to be encouraged to increase their cover under EIL policies in parallel with the development of future environmental liability systems.

Compensation of

Many companies (particularly SMEs) have restricted financial resources to cope with liability and thus need insurance. Areas which lack insurance are not necessarily financially covered because firms can become insolvent and leave contaminated sites as orphan sites.

Once a firm is insured, compensation is guaranteed for any environmental caused by the firm which fall under an insurers' responsibility. This reduces the chances of victims going uncompensated.

At present, little data are available on the level of environmental damage currently covered by insurance policies. Nevertheless, estimates from insurance brokers of payments made by insurers for environmental in Germany suggest that environmental insurance policies in Germany currently cover less than 1% of total environmental damage costs.

The insurance sector has a financial system which pools resources from potential polluters which can be used if pollution eventually occurs. This reduces the need for individual firms to save sufficient resources in case of pollution incidents and thus have to divert resources from other areas of investment. However, a disadvantage of involving insurers is that they become another player which can become involved in litigation in determining responsibility for compensation payments.

Promoting Prevention

Environmental insurance premia can provide signals to the market on costs of environmental damage. At present risk assessments for environmental insurance policies cannot be sufficiently detailed to indicate accurately the potential damage costs. Due to this problem, and lack of systematic methods of assessing risk, there are no systematic discounts offered in premia levels for policyholders that manage to lower their environmental risks. Where offered, discounts are limited to no more than 10% of premia for well managed firms. Therefore, policyholders do not have a cost-effective incentive to adopt pollution prevention measures to obtain lower premia. The self-insurance components of insurance contracts offer more incentive for firms to reduce environmental risk.

Compulsory Insurance

Compulsory insurance would prove problematic for potential industrial policyholders. Insurance companies would have the right to turn down high risk companies which would then either have to close or incur high costs to achieve a satisfactory pollution prevention standards to be considered for insurance cover.

Insurers would try to limit cover for high risk firms through narrowing scope of insurance offered (eg by imposing financial limits on the level of claims that can be made). To ensure adequate cover was being offered to all firms the governing body would have to intervene with guidelines. In Germany, where compulsory insurance was introduced on a limited scale, it is proving difficult to reach agreement over these guidelines.

3.4.10 Conclusion

Insurance companies could play a potentially very important part in the application of an environmental liability system since they can spread the costs of environmental risks over a large number of firms. This risk spreading role is particularly important for small firms, for whom the costs of an environmental incident could be very high if it were to arise. Therefore it will be important to take account of the views and interests of the insurance sector to ensure the sustainable development of a wider environmental liability system.

Insurance companies are concerned about their exposure to past pollution problems which they have inadvertently covered under General Liability insurance policies. Insurance companies are therefore trying to limit their liability for environmental and develop more focused Environmental Impairment Liability (EIL) policies. However, the demand for EIL policies is currently limited. Considerable time is required for EIL markets to mature. Insurance companies need greater experience with handling environmental liabilities in order to be able to assess the risks better and set premia accordingly. Consequently, this suggests that any development of environmental liability policies and systems needs to be gradual and incremental rather than radical so as to expand gradually the insurers' experience and expertise concerning environmental liabilities.

3.5 *IMPLICATIONS FOR BANKS*

3.5.1 *Introduction*

This section examines the implications of environmental liability systems for the banks to show how environmental liability might affect the level and cost of lending to firms, especially SMEs, and to indicate how the banks might respond to possible alternative environmental liability systems, including in particular proposals for compulsory financial security measures.

3.5.2 *Potential Implications of Environmental Liability Systems on Banks*

Banks have the following concerns about the potential implications of environmental liability systems, especially concerning contaminated sites, for their lending operations:

- Contamination problems may reduce the value of the collateral assets that the bank has taken as security for their loan.
- The banks are concerned that they might be held liable for environmental liabilities of a firm to which they lent money on the grounds that either they knowingly permitted the polluting activities in that they advised the firm on its environmental risk management and provided a loan to the firm or because the bank takes over and exercises a charge over the firm's property assets.
- The high transaction costs of the diligence procedures that the banks would have to carry out for their lending operations so as to reduce these potential liabilities.
- The extra effects on SMEs of the environmental liability provisions and the costs of the due diligence procedures.
- The practical difficulties of compulsory financial security measures and their particular implications for SMEs.

Environmental contamination of a property could reduce its value or render it unsaleable so that, where the loan was secured against the value of the property, the bank cannot recover its loan if the firm becomes bankrupt. In the UK, there is a further problem that, if a borrower is bankrupt, the bank may not be able to investigate the potential environmental liability, in order to ensure that the liability was less than the value of the property, without first taking possession of the site. This action might render the bank liable for the environmental which could exceed the bank's collateral value of the property.

Consequently, in the UK, the banks will respond cautiously and write off the debt rather than risk taking on the environmental liabilities. This could increase the bank's bad debts.

Implications for SMEs

Nearly all loans for small firms (with turnover of less than about 1m ECU) are secured on the firms' assets - usually the property. The loan often amounts to around two thirds of the value of the secured asset, but the value of the asset could be reduced by potential environmental liabilities. Consequently the environmental liability provisions could have greater impact on small firms since they could reduce small firms' capability to borrow.

Loans for medium sized firms are normally secured on either the firm's property or debenture assets. Loans for large firms are often unsecured. Hence environmental liabilities will have less impact on borrowing by large firms.

3.5.3 *Banks' Response to Existing Environmental Liability Systems*

There is currently limited awareness of the existing environmental liability systems on the part of banks in Southern European countries such as Italy. One bank interviewed in Spain does not carry out environmental audits for loans. Another bank in Spain, though, does require site inspection of high risk companies (eg chemicals) and, in deciding on loans for a firm, this bank takes account of what risks are covered under the firm's insurance policy. Banks in the UK are to some extent more aware of the implications of existing environmental liability policies - most notably concerning the provisions concerning contaminated land recently debated and enacted in the Environment Act in 1995.

The European Bank for Reconstruction and Development (EBRD) requires that financial intermediaries in Eastern European countries, such as Hungary, develop and implement procedures to assess the environmental risks and liabilities of a firm requiring an EBRD loan. This is prompting the banks in these countries to develop simplified procedures for assessing environmental risks for their own loans to small industrial firms.

Effects of Uncertainties Concerning Environmental Liability Systems

It is difficult to quantify the impacts for the banks of environmental liability systems since this depends on the detailed design of the liability policies and how they will be implemented and interpreted in practice.

Even where the banks are aware of the general environmental liability systems, they are highly uncertain as to how specific provisions will be interpreted and implemented in practice and therefore how these provisions will affect them. These uncertainties are particularly pronounced where the courts will determine how the provisions will be interpreted.

The banks are uncertain about the likely incidence of environmental arising and the cost of these environmental liabilities due to their limited experience so far concerning the assessment and valuation of environmental liabilities.

These uncertainties concerning environmental liability systems are likely to increase banks' caution in lending to firms in major polluting industries, especially SMEs.

For example, the impacts of the contaminated land provisions enacted in 1995 in the UK depend fundamentally on how the forthcoming guidance notes will spell out the way in which the provisions should be interpreted, especially whether the banks can be deemed to be liable for a firm's pollution because they 'knowingly permit' an act of pollution by lending money to the firm concerned and where they have assessed a firm's environmental risks and advised the firm on pollution measures. The banks have been given assurances that they will not be liable. But if there is remaining uncertainty about whether banks could become liable, then this could discourage banks from assessing the environmental risks of firms and from suggesting that the firms implement pollution prevention measures.

UK banks are concerned that they have to take on ownership of a collateral asset in order to be able to carry out a site investigation to determine the scale and nature of environmental liabilities at a firm to whom they previously gave a loan secured on this asset. This can then discourage them from carrying out such investigations since the potential liabilities could exceed the value of the loan (see above). Consequently there is considerable interest in recent initiatives such as that between the banks in Canada and the Ontario Ministry of Environment and Energy, under which the banks would be allowed to investigate a site without incurring liability for the asset provided that they alert the authorities about the environmental risks of a property that they do not take on ownership [1].

Due Diligence Procedures by Banks

In response to environmental liability policies, it is possible that the banks may carry out a desk based simple screening of firms. This could include a search of a register of past uses of the site and a simple short questionnaire to the firm about its environmental problems and management systems. The banks interviewed suggested that this might cost about 300 - 500 ECU, which represents an increase of 30% over the bank's current costs of processing a loan. However, it is possible that these additional costs could be reduced as environmental risk rating services are developed and applied more extensively.

3.5.4 *Banks' Responses to Future Environmental Liability Systems*

A stricter environmental liability system might lead the banks to require a site investigation of a firm prior to granting a loan. The costs of such investigation would represent a larger portion of the loan for a small firm (of about 2-5% of the loan) than a medium sized firm (about 0.5-1%). Hence this could have a larger impact on small firms.

[1] Ministry of Environment and Energy (1995), **Standard Agreement Concerning Environmental Investigations.** Ministry of Environment and Energy of Province of Ontario, CANADA. This initiative is reported in the Financial Times Environmental Liability Report, April 1995.

There may be some potential savings in these transaction costs if the banks require that a firm takes out an insurance policy to cover the potential environmental liabilities for their collateral assets.

During interviews for the country studies, leading banks in the UK, Spain and Hungary commented that stricter environmental liability policies may prompt them to reduce their lending to firms in environmentally risky industries. The reduction in lending might particularly affect SMEs because bank loans to small firms are normally secured on the firm's assets - often the firm's property. This will compound the existing financial risks of lending to SMEs which prompts banks to require collateral for such lending.

3.5.5 *Implications of Specific Elements of Future Environmental Liability Policies*

Joint and Several Liability

Strict environmental liability systems involving joint and several liability for past and future environmental would create significant uncertainties for banks concerning the size of the potential liabilities for the individual firms for whom they have provided loans since it creates unlimited liabilities for the firms.

These uncertainties would be particularly significant if the banks are themselves considered joint and severally liable for the environmental and a deep pocket liable to pay for these liabilities. Such joint and several liability provisions would substantially reduce and might virtually stop the banks' propensity to lend to environmentally risky industries.

Compulsory Financial Security

Compulsory financial security is sometimes advocated so that a firm has to make separate provisions to pay for its environmental and to ensure that a firm's bankruptcy does not mean that the environmental liabilities are not covered, as has happened in the cases of 'orphan' contaminated sites for which there is no financially viable responsible party. Such provisions are designed to reduce the need for compensation funds to cover environmental liabilities.

Possible measures to provide financial security to pay for potential environmental liabilities include:

- the firm setting aside financial reserves to pay for potential environmental liabilities. This would entail significant opportunity costs since the firm could otherwise have used these financial resources for other investments.

- the firm setting aside some of its assets (eg property or land) as a collateral similar to the way firms provide collateral assets for bank loans. However, the firm's property might itself be affected by the environmental liability systems concerning, for example, contaminated land, which would reduce its potential value and use as a collateral asset, and also its ability to use that security for other borrowing.

- the firm providing a bond to be financed by an outside financial institution.

Compulsory financial security (of any type) would severely restrict firms' borrowing capacity. Providing collateral assets as security for environmental liabilities would reduce the firms' collateral assets needed to support other loans. This would particularly affect small firms for whom loans are usually secured against collateral assets.

Small firms' assets may already be used as security for existing loans so that small firms would particularly have to resort to the last type of financial security provisions above - paying for a bond provided by an outside financial institution.

There are considerable uncertainties about the actual level of a firm's environmental liabilities and hence the size of the financial security that an individual firm has to provide. For example, if the highest possible level for the environmental liabilities was five times greater than the most likely level (on average) and if each individual firm had to provide compulsory financial security for the highest possible level of its environmental liabilities, then this would lead to the resources being set aside by each individual firm to pay for environmental liabilities being five times greater than would be the case if the environmental liabilities could be pooled (eg by insurance) so that the overall damage was covered and the financial provision for any individual firm would cover the likely (average) level of the liabilities. Hence promoting the development of environmental insurance is more attractive than compulsory financial security. Compulsory financial security for an individual firm's highest possible environmental liabilities would be particularly costly for small firms who have a smaller base over which to spread the environmental risks.

Consequently it would be difficult and costly to implement compulsory financial security provisions.

The scope for bonds might be small and the level of any bonds for a small firm would have to be low since it would otherwise unduly restrict its investment capability. The low level of any such bonds might not be sufficient to cover the possible environmental damage.

Retrospective Liability

Banks, like insurers, would be adversely affected by retrospective liability since this might reduce the value of collateral assets and the risks of bad debts. Moreover, the banks have not allowed for the costs of such liabilities in their past lending practices and charges and have not taken any steps to limit their exposure through, for example, due diligence procedures.

3.5.6 *Conclusions*

Banks face great uncertainties concerning specific provisions of current and future environmental liability systems, which could significantly affect the value of collateral assets for their loans to firms whose sites are found to be contaminated. Compulsory financial security provisions would raise considerable practical difficulties.

The implications for banks lending would be particularly significant in respect of small firms, for whom the bank's transaction costs of assessing the environmental risks would be proportionally higher and since loans to small firms are usually secured on collateral assets.

3.6 *IMPLICATIONS FOR SMALL AND MEDIUM SIZED ENTREPRISES (SMEs)*

3.6.1 *Introduction*

A firm's strategic response to liability and compensation systems for environmental damage depends upon a number of company characteristics such as size, nature of production, technology, resources and management style. SMEs are not only small in size but have their own distinct structure and business approach. Limited access to resources makes SMEs slow to deal with environmental concerns. However, SMEs can be flexible and innovative.

This section therefore focuses on examining the critical sectors where SMEs have a particularly relevant share of total activity and identifying how elements of an environmental liability system will particularly effect SMEs.

3.6.2 *The Importance of SMEs*

Characteristics

SMEs are not simply smaller versions of large companies. SMEs have certain intrinsic features, notably limited access to capital, technology and information, rendering them vulnerable to their economic and regulatory environment. These characteristics increase levels of uncertainty for SMEs in managing environmental issues and reduces their capability to handle legal disputes and actions.

SMEs are usually unaware of their environmental impact and do not implement environmental management systems as extensively as many large companies. Given their lack of awareness of environmental issues and relatively low media profile, it more likely that they will cause environmental damage as a result of ignorance. While small firms do not usually have significant environmental impacts, a SME's impact can be proportionally greater than its size and SMEs' collective impact can thus be considerable.

SMEs are now being prompted to alter environmental management practices because of their position in the supply-chain of production. As the majority of SMEs are situated mid-supply chain, they have to meet the demands of larger customers. As environmental strategies are implemented by larger companies, they are also requesting suppliers to meet environmental standards, mostly for their products, but also for their production processes.

Contribution to EU Economies

SMEs play an economically very important role in European economies. They make up the bulk of firms, employ the majority of workers in the private sector and generate the greatest proportion of revenue. In the EC countries, SMEs (1-499 employees) account for approximately 70% of private sector employment and turnover. SMEs are a key element of European competitiveness and a crucial source of new employment.

The following categorisation of European countries can be identified in respect of whether their share of employment of small firms (less than 100 employees) is:

- less than the EU12 average - Belgium and Germany;
- approximately the EU12 average (49-55%) - France, Luxembourg, the Netherlands and the UK;
- higher than EU12 average - Denmark, Spain, Italy and Portugal.

Therefore any effects on SMEs will be more pronounced in the countries in the last group compared with the other two groups.

Percentage of SMEs in Selected Sectors of Industry

Sectors with higher compositions of SMEs will be more affected by the reactions of SMEs to environmental liability system provisions than sectors with low numbers of SMEs.

Table 3.6a *Comparison of SME contributions to industry sectors in selected countries (approx. SMEs' [1] % of total employment of each sector)*

	France	Germany	Italy	Spain	UK
chemical	na	20	60	80	30
minerals and oil refining	na	20	na	20	na
food, drink and tobacco	75	80	80	80	35
timber and wood furniture	90	90	99	99	75
manufacture of paper products	80	65	80	90	60

Table 3.6a shows that the paper products sector and the timber and wood sector have consistently high proportions of SMEs across the countries and will be extremely sensitive to the levels of productivity and profitability achieved by SMEs. The chemicals sector has a much lower level of SME employment, except in Spain where SMEs still predominate. Therefore the chemicals sector will be less adversely affected by problems for SMEs of a stricter environmental liability system.

3.6.3 *Environmental Liability Elements*

The components of an environmental liability system which may disproportionably affect SMEs are discussed below.

Joint and Several Liability

Under joint and several liability, any polluter may be held liable for the entire restoration cost and then seek compensation from other responsible

[1] Small and medium firms are defined as firms with less than 500 employees. Small firms are defined as firms with less than 100 employees.

paries, regardless of their degree of involvement. This could lead to two different consequences for SMEs:

- SMEs will face the risk of being held liable for pollution damage costs, considerably in excess of their financial resources. This high liability will be extremely difficult for SMEs to plan for, and could be financially damaging.

- SMEs may avoid payments if the plaintiff decides to sue a responsible party with the largest financial assets rather than the major source of pollution. Large corporations will bear the burden of this 'deep pockets' effect, although the large corporations can then try to seek compensation from SMEs for their share of the cost of the environmental .

Joint and several liability promotes litigation between disputing potentially responsible parties. The costs of this litigation are likely to be relatively greater for SMEs than the larger firms disputing claims.

Financial Limits on Liability Claims

Predetermined financial limits for liability claims reduce uncertainties for SMEs and facilitate financial planning. However, the maximum amount could still be too high for some SMEs, thus producing an advantage solely to larger firms. These limits can affect insurance levels which can already be costly for SMEs.

SMEs' limited financial capability may need to be separately considered, and financial claim limits set in relation to their turnover. However, this would leave more of the damage unremedied.

Burden of Proof

Reversing the burden of proof onto polluting firms could be particularly problematic for SMEs. They would have to acquire information about the pollution problems in order to find evidence to disprove the pollution claim. Lack of in-house information and expertise will make the acquisition of proof over pollution particularly difficult for SMEs.

Retroactive Liability

Retroactive liability will increase uncertainty for all firms. Uncertainty over historic pollution may be particularly high for SMEs because they are often not aware of pollution problems that they caused decades ago due to their poor management systems and low levels of record keeping.

Retroactive liability is likely to prove financially damaging to SMEs as it would expose them to liabilities potentially large pollution incidents. In one notable court case, a small firm had previously contaminated an aquifer. The court decision was that the company was not liable. However, if retroactive liability had been valid and the company declared guilty the consequent compensation payment would have led to its bankruptcy.

3.6.4 *Particular Concerns for SMEs*

Cost of Due Diligence

Insurance companies and banks may require site audits before offering or providing insurance or a loan. Audits are costly and are required by both financial backers and future insurers as part of due diligence during mergers and acquisitions. The additional costs to pay for legal advice, for verifying the existence of hidden liabilities, through audits, can be a large burden and inhibit SMEs expanding through acquisition strategies.

There are different types of audits which can be carried out:

- Compliance audits are used to check the compliance with environmental regulations. They are frequently just desk based.
- Due diligence audits are used for mergers, acquisitions and disinvestment. They involve at least a preliminary visit and if necessary a site investigation to identify hidden environmental liabilities and assess their magnitude. They can typically cost between 2,500 and 6,500 ECU.
- Management system audits focus on the analysis of management systems, examining company environmental policy, the development of an environmental protection programme and the preparation of adequate pollution prevention procedures and systems. This type of audit is more detailed than the others. Certification for EMAS involves one type of integrated environmental audit. The costs of the measures involved in achieving EMAS certification range from 12,500 to 100,000 ECU. SMEs will be at the lower end of this range.

The cost of an audit depends on the level of detail required, the size of operations to be audited, the complexity of the production processes and the maturity of the audit market. Some economies of scale, therefore, exist for audits, but the audit cost per output unit will certainly be higher for smaller firms.

There are also costs associated with adopting pollution prevention measures after a site assessment. A due diligence site investigation may be a SME's first environmental assessment. Therefore it may identify significant measures needed to be adopted before financing or insurance is granted, if it is granted at all, although such assessment can also yield benefits for the firms.

Risk Management Capability

Risk management is difficult for SMEs for two reasons. Firstly, in contrast to large firms, SMEs do not tend to have already established environmental risk assessments and management systems in place so that implementing such systems will entail an additional task for them.

Secondly, SMEs are more vulnerable to environmental risks since they are not as diversified as large firms; frequently their activities relate to a single product or process. caused by one process may therefore have a significant impact on their total costs. SMEs will be more exposed in case of an incident. Yet they have limited management capability for prevention.

Access to Finance

Liability risks could lead banks to take a more conservative approach to valuing fixed assets as collateral for loans. SMEs usually have less internal financial resources or other ways of raising financing than larger firms and banks tend to require small firms to provide collateral assets for loans. Therefore environmental liability systems might restrict SMEs' borrowing capacity which would result in lower investment.

Compulsory financial security provisions would particularly affect small firms who would be in most need of a bond by an outside financial institution. Compulsory financial security provisions could therefore severely reduce the investment capability of small firms (*see Section 3.5*).

Cost of insurance

SMEs have a greater need for insurance than many large firms. They do not have the possibility to share and pool risk among different products or sites within their ownership, which larger companies can do to their advantage. Also SMEs, due to their size, have little opportunity for self-insurance. Therefore any attempts to increase the environmental liability insurance market needs to take into consideration the high cost of insurance for SMEs.

The insurance premia can be high for SMEs because premia include fixed transactions cost which will be relatively higher for SMEs than larger companies, in relation to firm turnover. The fixed transaction costs include site assessments and implementation and administration of policy and handling claims. The transaction costs typically range between 25 and 40 percent of a premium.

Compulsory insurance may have a large impact on SMEs. Firms which cannot afford to reduce environmental risks sufficiently will not be offered insurance and will be forced to close.

However, future specialisation in the insurance market, where some companies target SMEs, may lead to some reduction in the premia for SMEs. The development of the insurance pools may also be advantageous. The insurance pools can develop policies suited for SMEs and support SMEs through disseminating information.

3.6.5 *Special Provisions for SMEs*

So far, national liability systems have few special provisions for SMEs. Some exceptions exist in practice. For example, in the UK where, under the Water Resources Act, the National Rivers Authority (NRA) does not pursue small polluters for the recovery of costs of restoring water courses damaged by small pollution incidents.

The cost of compliance of environmental legislation can be very high for SMEs, due to limited resources and a lack of economies of scale. However, if SMEs are polluting then they should be made to pay for clean up. It is not necessarily desirable to reduce payment obligations for SMEs.

Nevertheless, possible areas of assistance for SMEs include: reducing uncertainties to help with financial planning; perhaps reduce excessive financial obligations to prevent closures; and facilitating access to finance and insurance to ensure potential for investment and financial protection.

Policies which would particularly assist SMEs in these areas of uncertainty, excessive cost and financing are:

- Not putting the burden of proof on SMEs;
- Setting financial limits for claims;
- No compulsory financial security;
- Supporting risk assessment through subsidising site audits.

However, the first three of these measures would result in accordingly higher burdens of environmental damage costs being paid by victims.

4 *COMPENSATION FUNDS*

4.1 *INTRODUCTION*

A significant proportion of environmental damage costs may not be financially covered by a responsible party (polluter or insurer) under existing environmental liability systems. These include situations where: the responsible party cannot be identified because, for example, the responsible party has gone bankrupt; an identified party is incapable of making the required compensation payments. Compensation payments may also only be made in part, if financial limits are imposed on payments under an insurance policy. Several European countries as well as the US and Japan now have established compensation funds to finance these gaps of accountability in the liability system. The funds raise finances for the specific purposes of compensation or restoration of environmental damage. There are many alternative ways to raise, administer and allocate finances for such funds. Each element can have important implications for the role the fund eventually plays.

Section 4.2 first identifies when it might be appropriate for a compensation fund to cover environmental damage. *Section 4.3* reviews briefly experience with various compensation funds in selected countries and summarises the major characteristics of the various funds to identify the main options available for policy makers when developing a compensation fund system. The effectiveness of the existing compensation funds are then compared. *Section 4.4* then assesses specific elements of existing compensation funds to identify lessons for the EC regarding the use of different arrangements for a compensation fund.

A two stage research process was carried out. Current reports on compensation funds in France, Sweden, Netherlands, Japan and Germany were reviewed. Then interviews were carried out with members of the Ministries of Environment in the Netherlands and Japan.

4.2 *POTENTIAL ROLE OF COMPENSATION FUNDS*

Compensation systems are complements to, and not a substitute for, liability systems. They are to be used to cover environmental damage for which a liability system cannot find the responsible party or the responsible party cannot pay. It therefore can act as a 'safety net' for victims who otherwise would have not been able to seek compensation. The essential principle of a compensation fund is that are remedied or victims compensated, financed from a fund which in turn is financed by a collective group of polluters rather than by the general population (through general taxes) or by the victims (where go uncompensated).

In doing so funds can also function as a warning system, since claims to the fund could alert the government to the need to develop policy in other areas of environmental liability. Increased claims would show increased pollution, increased gaps in the existing liability compensation system or that criteria allowed for claims to be made were too broad leading to too many claims being made.

The circumstances where a compensation fund might be appropriate include:

- Where no liable party can be identified.
- Where the liable party no longer exists or is not sufficiently solvent.
- Where a large number of polluters and/or victims are involved and the transaction costs of proving liability and securing compensation would be high.
- Emergency cases where there is an urgent need to restore damage quickly due to direct danger to health, the state of the environment or viability of local enterprises.
- Where insurance will not or does not cover environmental damage or where the compensation to be paid goes beyond the limit of the insurance contract. This may include damage to the unowned environment since insurers have stated that they are unwilling to insure such damage due to uncertainties concerning their valuation. It might also include environmental damage that is self-insured in cases where the self insured firms become bankrupt.

These circumstances occur with sufficient frequency that significant amounts of damage may not be compensated. The issue therefore, is to ascertain the feasibility and desirability of the scope and mechanics of compensation funds for dealing with these outstanding environmental .

Conflict in the Role of Funds

There is, however, a fundamental problem with the role and construction of a compensation fund. Due to a fund's role of providing compensation or clean up when the responsible party cannot be identified or cannot pay, a conflict may arise between the goals of the government and the interest of firms.

Governments wish to use compensation funds to:

- ensure all damage is compensated/restored;
- ensure victims are compensated;
- minimise claims on the public purse;
- be able to intervene with a fund if remediation is too slow or transaction costs are too high.

These goals lead to funds being raised from a collective group of polluters instead of individual responsible parties.

Firms in general do not prefer this means of payment and compensation. Firms:

- accept the polluter pays principle, but do not want to pay for other peoples' (especially competitors') pollution;
- need efficient incentives for pollution prevention.

The pooling mechanism for raising finances to pay for compensation or clean up may not achieve the necessary incentives for firms to increase pollution prevention and may go against the polluter pays principle [1]. Examples of these problems can be seen in the compensation funds detailed in the following section.

4.2.1 *Experiences with Existing Funds*

This section reviews experience with various compensation funds in EU countries and Japan to identify lessons regarding possible compensation systems.

Role

There are two main systems in operation to cover:

- **Diffuse pollution** from many sources. Examples include compensation systems for claims made from sufferers of air pollution. The damage can either be to health (covered, for example, in the Japanese compensation fund) or private property (eg crops and car coatings covered in Netherlands' compensation fund). These funds are used because there are usually large numbers of polluters and individual liable parties cannot be identified.

- **Orphan sites.** This includes the restoration of contaminated sites. French and German funds target orphan sites. These funds are used as liable parties no longer exist or are not sufficiently solvent to finance clean up.

There is also a compensation system in Japan for dealing with large accidental pollution cases. In Japan the compensation fund aids firms in fulfilling compensation payments which become excessive due to large amounts of damage. This fund is also used for water pollution incidents. For example, funds were allocated to cover claims from the Minimata disease incident.

The Swedish system is more general and claims can be made for any type of injury and damage to property. This would include air and soil pollution.

Source of Funds

The means of collecting financing is a critical issue because:

- The extent to which a fund can restore environmental damage and compensate victims depends on the level of funds that are collected.

- The *source* of financing dictates who is held accountable for the clean up carried out by the compensation fund.

- The *type* of financing will give different signals to industry.

The types of financing in operation are:

- insurance premia surcharge (Sweden);

[1] This is similar to the moral hazard issue in insurance. Both situations arise due to the free rider problem in which an individual's activities that increases its environmental damage costs has little or no effects on its own costs since the damage costs are spread over all polluters through the contributions to the compensation fund. Similarly, the benefits of a firm's prevention measures to reduce its environmental liabilities will be spread over all firms.

- general tax (Netherlands);
- air pollution tax (Japan);
- fees from licenses for waste (Germany);
- landfill tax (France).

Air pollution tax is effectively an extra emissions charge on the parties causing the damage compensated by the fund. Fees from licenses for waste and the landfill tax also both create an extra charge for waste producers. Like the air pollution tax, this creates an incentive for firms to reduce their emissions of these pollutants which can be indirectly related to the environmental damage costs.

If the tax on polluting industries is proportional to the amount each company pollutes then an incentive measure is introduced for companies to adopt measures to reduce the emission of the charged pollutant. This type of tax is only possible if the polluting substance causing the damage settled by the fund can be identified, such as the sulphur dioxide emissions causing bronchitis in Japan.

A compensation fund can provide inefficient signals to industry when claims do not change in proportion to pollution prevention expenditures. This may happen when damage occurs or becomes evident some time after the pollution incident. In Japan the financial contribution by industry to the fund rose in spite of industry's substantial pollution control expenditures to reduce emissions. Claims increased due to the time lag in the worsening of health of the victims after the pollution occurred so that claims actually went up after pollution had decreased. As a result of industry complaints about the rising contribution, the Government decided in 1988 to allow no additional patients to claim compensation from air pollution related illnesses.

Administration

The possible arrangements in existence to organise fund activities are:

- central government body (Netherlands, France, Japan);
- regional government (Germany);
- private sector (France);
- insurance sector (Sweden);
- polluting firms (France).

These bodies take care of raising finances, distribution of funds and execution of actions.

Funds can be administered at a national scale, as in France, the Netherlands, Japan and Sweden, down to a regional and local scale as in Germany.

The option of scale will affect which government department is responsible for the fund and where finances can be obtained. It also can affect where fund money can be allocated. Regional governing bodies will have more control over clean up within their region under a regional fund than equivalent regional governments will have under national funds.

In the US, the Superfund reform package set out by the Environmental Protection Agency (EPA) proposes to move towards decentralisation and localisation of the administration of Superfund. States will have more authority in the allocation of funds and communities will have more involvement in the whole process.

In France the privately run compensation fund had a short life as companies had little incentive to voluntarily contribute to the fund. In Germany, the fund involving private company contributions also broke down when the fund attempted to widen its scope and thus increase the financial responsibility of the private members.

There is also the option to have cooperation between public and private agents such as in Germany and Sweden. In Sweden, the existing system for collecting insurance premia was used to levy contributions to the fund so as to reduce the costs of administering the fund [(1)]. In Germany, by requiring industry to contribute to the fund, the public authority reduced the need to raise finances through alternative taxation.

Claims

Financial limits can be imposed for every claim or on the total amount that can be claimed per year per person. For example, Sweden has limits on payments per year. However, like many other funds, due to its lack of activity (in this case, lack of claims compensated) the effectiveness of this policy cannot yet be determined. Japan laid down guidelines as to how much benefit could be claimed for different ailments per person.

Scale and Effectiveness of Existing Funds

Table 4.2a summarises the different levels of finances of each fund.

Table 4.2a ***Finances and Payments of Funds (ECU)***

	Level (ECU)	Compensation	Comments
France	10M/yr	target of 669 sites - none cleaned so far	too early to tell
Sweden	14M cumulative	no claims paid so far	despite no outlay the government felt it fills gaps in liability
Netherlands (soil)	145M/yr	4.8M/yr restored	
Netherlands (air)	2.4M/yr	2.4M/yr	small but needs based so appears to have a limited role to play
Japan	688M/yr	79,000 patients in 1994 collecting 688M/yr	collects substantial finances
Germany	<27M/yr	2,000 remedial actions	

The Netherlands' soil fund was set up under the 1992 Soil Remediation Law to pay for the restoration of sites contaminated before 1975. It raises a large amount. The German fund has been active, carrying out a total of 2,000 remedial actions at sites by 1993. The rate of clean up by the French compensation fund has yet to show how effective their contaminated land

[(1)] If insurance premia reflect pollution risk levels, this approach can also provide a mechanism to relate compensation fund contributions to relative shares of pollution.

fund can be. The US experience shows that the clean up process of contaminated land can be extremely slow.

With air pollution compensation funds the finance (after transaction costs such as administration and litigation) go directly to victims. Both the Japanese and the Netherlands funds raise finances retrospectively on a needs based system. In this way all validated compensation claims are satisfied by the funds. The Japanese fund raises the largest amount of funds for compensation purposes. It is a relatively generous fund giving victims on average 9,000 ECU per year which suggests that a fund can sometimes raise significant levels of financing to provide large compensation payments.

4.2.2 *Lessons Learnt*

Drawing on the experiences of existing compensation systems the most common fund options with their strengths and weaknesses are discussed below.

Role

A key issue is how to design a system that has sufficient funds to compensate victims which otherwise could not find a liable party from whom to seek compensation.

- Past pollution problems

Contaminated land funds raise financing from existing industry, such as the waste sector in France and Germany, to restore historic pollution problems in the form of orphan contaminated sites. Over time the firms who caused the pollution cannot now be identified or have become insolvent. Compensation funds therefore provide a financing bridge between current polluters and past pollution. The current polluters, however, did not cause the past pollution and that sets a limit on the extent to which current polluters can fund the clean up of past pollution. This type of approach conflicts with the polluter pays principle and fails to create incentives to prevent pollution in future.

- Multi-source pollution

A fund for air pollution damage compensation appears appropriate in certain circumstances. There is considerable difficulty for injured parties to prove precise causality of damage to a polluting party (such as a factory). Proving which industrial sector causes the damage is easier than pin-pointing the individual factory emitting the damaging substance. Also there may be more than one factory contributing to the pollution damage. Whenever there are multiple parties liable for damage a compensation fund may be more appropriate than individual action under an environmental liability system since a fund has the capacity to raise compensation from the collective parties involved (for example taxing a sector of industry). Japan's fund is a good illustration of the way a fund for multi-source pollution can function using the government to tax polluting industry. Financing the fund by an emissions tax creates incentives for preventing future emissions of the taxed pollutant (eg SO_2, waste level) and is consistent with the polluter pays principle.

The Japanese fund also shows the problems faced by funds when the damage covered manifests itself after a long lag. When lag times occur claims can be increasing even though industry has reduced pollution levels. In Japan, despite sulphur emission levels having dropped since the 1970s, claims kept rising in the 1980s. Eventually the government, in 1988, had to halt additional claims being made. The increasing claims lead to increased taxation on industry which then gave firms little inducement to reduce the pollution damage any further because the taxation was based on claims for damage caused by past industrial pollution levels.

A broadly based fund could also be used to restore ecological damage to the unowned environment where the damage is caused by many polluters and remediation would benefit a large population.

Scale

A local compensation fund will more equitably benefit the industry providing the finance it as it cleans up the local area. However, the common trend among the other countries is to establish a special body under the central government which can then utilize nationally raised funds (taxes) and national structures for the collection of revenues to finance national clean up or compensation payments.

Source of Funds

The two main options for financing funds are:

- from public funds through general taxation irrespective of who causes the pollution; and

- restricting taxation to the sector causing the pollution. In this situation the tax should be proportional to the amount of pollution the industry is producing.

A sectorally based taxation system to raise funds for compensation payments can provide an incentive for companies to adopt measures to reduce pollution if the tax is levied based on the level of a firm's pollution (such as sulphur emissions or waste production). The reduction of pollution levels by Japanese industry in the 1970s because of the sulphur emissions tax is an example of how this system can work.

This approach is more possible for air pollution than for contaminated land. This is because air pollution emissions from factories can be monitored and because the taxed emissions can to some extent be linked to the environmental damage. Thus this combines a compensation fund to remedy the environmental damage costs with an economic instrument such as a pollution charge to finance the fund.

For restoration of contaminated sites, linking polluters to the damage to be cleaned up is complex. Orphan sites exist specifically because the polluter cannot be found. Often the guilty industrial sector, such as mining, has since decreased in size. Other taxable sectors, such as the waste sector, taxed in Germany and France for compensation funds, are not the sectors which caused the environmental damage.

An alternative to raising financing for compensation funds is to fund clean up through general taxation. The difference would be that the destination of the funds would not be earmarked at the time the funds are raised. Taxes would be pooled and the remediation measures would be part of other governmental environmental protection expenditures. [1] This creates a financing mechanism for the fund but no incentives for prevention. Compensation of the environmental damage has to compete with alternative pressures on Government spending.

Administration

The breakdown of the two funds (in France and Germany) which relied on the active involvement of industry suggest that a compensation fund should be organised by a public body. Levying contributions to a compensation fund is an area which may need public authority involvement because firms are unwilling to volunteer contributions to a compensation fund.

However, industry's involvement not only increases the amount of funds which can be raised but can reduce administration costs for the government. For example, contributions to the compensation fund in Sweden are based on the system for collecting existing insurance premia payments.

Claims Basis

The basis of claims is important for the effectiveness of a fund. The conditions for the validity of a claim need to be carefully selected but not too limited. Japan's compensation fund had so many claimants that it became financially burdened and had to restrict further claims. Sweden's compensation fund, on the other hand, defined what it considered a valid claim in such a limiting manner that few claims were made and so far none have been deemed valid.

4.3 CONCLUSIONS

Advantages of Compensation Funds

The advantages of compensation funds are that they:

- Provide a mechanism for cleaning up environmental damage and/or compensating victims of environmental damage which might otherwise not be covered under a liability system either because the individual responsible party cannot be identified (eg orphan contaminated sites) or because the costs of the environmental liabilities would be excessive for an individual firm.
- Funds may intervene when remediation is too slow.
- Funds may avoid complicated cases of litigation involving high transaction costs between multiple parties and victims.
- A broadly based fund could also be used in restoring ecological damage to the unowned environment, where damage is caused by many polluters and remediation would benefit a large population.

(1) If the fund is allowed to be in deficit at times, it may also facilitate the gradual adjustment of contribution rates over time and handling of the lagged effect of pollution.

Limitations of Compensation Funds

The limitations of a compensation fund are:

- Industry may resist additional costs through compensation fund levies where it appears that they are paying for significant amounts of other firms' pollution.

- Under a compensation fund system the polluter pays principle is not adhered to and the mechanisms of finance may not lead to efficient incentives for firms to adopt pollution prevention measures and reduce their environmental liabilities. With a compensation fund the individual polluter, or even the same polluting sector of industry, does not precisely pay for the restoration of the it caused as they are paid for by the fund.

- Even when polluters are targeted it is often difficult to ascertain a firm's levels of pollution and its contributions to the environmental damage and hence its appropriate contribution to the fund. If the individual polluter can be precisely targeted, then a compensation fund is not needed since other instruments (including liability system) may be more effective. However, in cases where there are sources whose emissions can be fairly easily monitored and related to the damage (eg air pollution), then taxes on these emissions to finance a compensation fund to remedy the damage can be appropriate and can provide an incentive for firms to prevent pollution.

- Compensation funds can give perverse signals to industry where the fund covers the total level of claims made by victims and where the damage becomes evident some time after the pollutants were emitted. This can result in the level of claims rising and consequently the level of industries' contributions to the fund rising, while industries emissions have already reduced due to their implementing pollution control measures. Thus, having already incurred considerable expenditures to reduce their emissions, the industries are faced by rising contributions to the fund.

- There is potential for the 'safety net' role of a fund to be abused because victims seeking compensation may make a claim to a fund instead of the polluting parties if the fund is an easier option for compensation than trying to prove individual liability.

Scale

Some of the evidence might suggest that funds are better implemented at smaller scales such as regional or national as opposed to EU-level because:

- Smaller scales allow funds to isolate the financing base to the polluting sectors of industry and facilitate the polluter pays principle which is desired by industry.

- A local clean up program allows the taxed industry to enjoy the localized benefits of the clean up they paid for.

- Verifying and administering claims at the local level establishes local involvement and is more likely to lead to the adoption of cost-effective restoration standards. EU-level organisation would increase the amount of administration needed for a fund in order to connect authorities at each different scale.

However, it is not possible in this broad review to give full answers to many questions related to the effectiveness of compensation funds, such as the optimal scale of a fund. It is also not evident whether there are economies of scale with transaction costs so that administration costs decrease with funds of a larger scale.

In addition to a large variety in the financial capacity of funds there is also a large variety in the structural arrangements of the funds in each country. Methods of financing, fund administration and types of damage covered vary across the countries depending on national characteristics, such as the structure of administrative/political bodies and the government's views on possible sources of finance for remedying and compensating environment damage.

Annex A

References
Glossary of Terms
Abbreviations

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GLOSSARY OF TERMS

Audit: a physical assessment of a site's existing and potential environmental pollution, and liabilities. Audits can vary in purpose and detail of investigation.

Benefit Transfer: where the results of a valuation of environmental damage costs or benefits in one situation is applied to value the environmental damage costs or benefits in another situation.

Burden of proof: is a legislative provision which prescribes which party (victim or polluter) must provide evidence of whether pollution caused a specific damage to occur, when a claim is put forward.

Capital expenditures: investments made for a fixed asset such as equipment.

Claims made: an insurance policy trigger prescribing that the insurance company will only settle a claim made during the time an insurance policy is held by the insured.

Compulsory financial security: a firm must cover its environmental liabilities by putting up an asset or financing a bond in case of due payments or bankruptcy.

Contingent valuation method (CVM): value is estimated from surveys where users and non-users are asked directly for their willingness to pay for the changes in the quality of an environmental asset.

Deep pocket syndrome: under joint and several liability a claim for costs of total cleanup can be brought against any one of the responsible parties. Often a victim will bring the claim against the party with the greatest financial resources (the deep pocket).

Development risks: The risks that a substance might be found to create environmental hazards, as a result of scientific advances in knowledge, after they had previously been considered safe.

Dose response: the relationship between the emissions of a pollutant and its physical impacts (eg the extent of tree or crop damage).

Due diligence: an audit to assess the state and level of environmental liabilities.

Ecological damage: when damage occurs to components of an ecosystem (eg loss of a species).

Environmental liability: when pollution from a party causes damage for which it legally would have to pay to compensate the victim or remedy the damage.

Environmental Impairment Liability insurance where an insurance policy covers specific environmental liabilities from a plant.

Environmental expenditures: expenditures of firms with reference to the management of environmental problems or media (soil, air, water).

Environmental valuation: calculating through a specified methodology a monetary value of an environmental asset.

Fault based liability: where the polluter has to be contravening a specific environmental standard set by the authorities before the polluter can be liable for the damage.
to a specific standard by the victim before the polluter can be liable for the damage.

Financial limits: the maximum an insurer is liable under the insurance policy and will compensate the insured. It may be expressed as 'per accident', 'per event', 'per occurrence' or 'per annum'.

First party damage: when damage occurs to the polluter's own property or assets.

First verifiable loss: an insurance policy trigger which prescribes that an insurance company will only settle a claim that is made when damage is first noticed and if it is covered by a policy.

Forum shopping: where the (multiple) parties are based in various countries and where the victim searches for the jurisdiction with the most favourable regime in which to bring the claim.

General liability (GL) insurance: a liability insurance policy which covers employers liability, public liability and products liability as a 'package'.

Hedonic pricing methods: a technique for valuing an environmental good on the basis of differences in the prices or rents for properties and land in areas with different environmental pollution levels.

Insurance claim: when the insured or the insured's beneficiary seeks payment from the insurer for damage covered by the insurance contract.

Insurance premium: the price of insurance protection for a specified risk for a specific period of time.

Joint and several liability: a legislative provision which allows a compensation (either by a victim for damage incurred or a public authority for costs incurred from remediation actions) to be sought for the total damage or cleanup cost from any one of the responsible parties regardless of the proportion of the party's involvement in the pollution. This party can then seek compensation from the other responsible parties where possible.

Occurrence: an insurance policy trigger prescribing that an insurance company will only settle claims made anytime for an incident as long as the incident occurred under an insurance policy.

Orphan sites: contaminated land sites where there is no identifiable responsible party for the contamination or an identified party is no longer capable of financing site remediation due to insolvency.

Pollution control expenditures: both investment and current expenditure that is directly aimed at the prevention, reduction and elimination of pollution or nuisances that could have a harmful effect on the environment.

Proportionate liability: this is a legislative provision so that responsible parties are only liable for the proportion of the damage which they caused.

Residual damage: the reduction in environmental quality remaining after site cleanup has taken place or from emissions that take place after the firm has implemented pollution control measures and complied with the environmental standards.

Responsible party: an entity (such as an individual, a firm or a public sector body) which produced the pollution that caused specific and identified damage.

Retrospective liability: same as retroactive liability

Retroactive liability: a legislative provision which allows compensation to be sought for damage caused by past pollution.

Rights of action: this is a legislative provision which determines what type of party eg victim, interest group or public authority, can put forward a compensation claim against a responsible party.

Superfund: Introduced in 1980 in US to make parties responsible for contaminating sites pay for their clean up. Also known as CERCLA: The Comprehensive Environmental Response, Compensation and Liability Act.

Strict liability: this is a legislative provision which makes polluters liable for environmental damage they cause, regardless of whether they were complying with the prevailing environmental standards.

Third party damage: when damage occurs to the assets of a party which did not produce the pollution causing the damage.

Transaction costs: these are costs which are associated with an activity but do not directly contribute to it. These can include litigation, administration and site assessment costs.

Trigger: an incident which gives rise to a claim. In an insurance contract it is the component that specifies under what circumstances a claim can be validly made.

Type I environmental damage costs: are defined for the purposes of this study as environmental damage costs which can be fairly readily and reliably valued using more tangible valuation techniques such as estimates of the costs of restoring the damage or the level of defensive expenditures incurred as a result of the pollution or the market value of the physical impacts of the pollution estimated on the basis of dose response function.

Type II environmental damage costs: are defined for the purposes of this study as environmental damage costs which are normally valued by other techniques such as hedonic pricing methods or consumer surveys, such as contingent valuation methods. These valuation techniques are more difficult and involve greater uncertainties and potential for disputes, partly due to their greater subjective nature.

Unowned environment: territory which is not classed as private property and thus lies in the public domain. It includes natural habitats and species.

ABBREVIATIONS

BENELUX: Belgium, Netherlands and Luxembourg

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act introduced in 1980 in the US - also known as Superfund. It was designed to make parties responsible for contaminating sites pay for their clean up.

CVM: Contingent Valuation Methodology

DM: Deutsch Marks

EC: European Commission

EBRD: European Bank of Reconstruction and Development

EFTA: European Free Trade Agreement

EIL: Environmental Impairment Liability

ELS: Environmental Liability System

EMAS: Eco Management Audit Scheme

EPA: Environmental Protection Agency (US)

ERECO: European Economic Research and Advisory Consortium

EU: European Union

5EAP: The Fifth Environmental Action Programme of the EU

GDP: Gross Domestic Product

GL: General Liability

NGOs: Non Governmental Organisations

NRA: National Rivers Authority (UK)

NIMBY: Not In My Back Yard

NOAA: National Oceanic and Atmospheric Administration

OECD: Organisation for Economic Cooperation and Development

R&D: Research and Development

SMEs: Small and Medium Size Entreprises

UmweltHG: The law on environmental damage in Germany enacted in 1991.

WTP: Willingness To Pay

Annex B

Summary of Current Environmental Liability Laws in Selected European Countries

[To be provided upon receipt of summary table from legal study]

Annex C

Environmental Damage Cost Estimates in (Former) West Germany

Table C.1 presents estimates of environmental damage costs for the former West Germany. This is based on a short review of some available published studies. There is a lack of consistency of these studies in terms of their scope and valuation methodologies and the form in which the valuations are presented. As far as possible, overlaps between the various independent studies have been removed and the studies' findings have been converted into as consistent as possible a set of estimates, which are presented in 1992 prices. But it has proved difficult to provide a perfectly comprehensive and precise set of estimates. This table and analysis is designed to highlight specific issues concerning categories of environmental damage costs that are relevant to policy making concerning environmental liability systems.

The estimates have been broken down into the following environmental damage categories which are relevant for policy making concerning environmental liability systems either because existing environmental liability policies focus on certain categories or because the merits and feasibility of environmental liability systems can vary between these categories.

- By environmental media into which the pollutants are emitted (air, water, soil/land) since existing environmental liability systems have tended to focus on discharges to specific environmental media such as contaminated soil and water pollution.

- The type of environmental damage or receptor that is affected by the pollutant (eg damage to human health, forests, natural habitats) since some existing environmental liability systems (eg in Germany) focus on damages to human health and property (eg buildings). Insurers are reluctant to provide insurance for damages to ecology and natural habitats (ecological damages).

In addition, *Table C.1* distinguishes two types of environmental damage costs in respect of the techniques that have been commonly applied for valuing the environmental damage costs. These are defined as follows:

- Type I are the environmental damages that have been valued in monetary terms using estimates of restoration cost or effects on defensive expenditures or values of marketable outputs where the changes in these outputs have been derived from dose response relationships or from estimates of defensive expenditures incurred as a result of the pollution. *Table C.1* indicates that these Type I damage costs account for about one third of the total environmental damage costs.

- Type II are the environmental damage valuations derived on the basis of other techniques (eg consumer survey techniques such as contingent valuation). There are less estimates available on these environmental damage costs, which are more subjective and subject to greater uncertainties than the type I damage valuation techniques.

The estimates for noise includes valuations from willing to pay (WTP) studies on road traffic, rail traffic, air traffic noise and noise from factories, plus estimates of costs of illnesses associated with noise from road and air traffic.

It does not include damage (eg hearing loss) from noise in the workplace. It also does not include defensive expenditures by victims (eg expenditures on double glazing). The estimates for the value of environmental damage costs for noise for Germany appear higher than the estimates that have been derived by other studies. Thus Tinch [1] estimates that the costs of traffic noise pollution in the UK amount to about 0.4 - 0.7% of GDP. It is not clear if this difference is due to differences in the methodologies adopted by the different studies or differences in noise levels and valuations.

Table C.1 highlights the lack of available data on environmental damage costs for many types of damage - these items are denoted as NE in *Table C.1*. Important gaps concern waste disposal and type II damage cost estimates for the impacts of air and water pollution on human welfare and habitats and ecological damages and the impacts of air pollutants on historic buildings.

[1] Tinch R (1995) **The Valuation of Environmental Externalities.** Report prepared for the Department of Transport.

Table C.1 *Estimates of Environmental Damage Costs by Major Categories for Former West Germany (Billions DM 1992 prices)*

Damage/ Receptor	By Environmental Media: Air		Noise		Soil		Water		Others[1]		Total	
	I[1]	II[3]	I	II	I	II	I	II	I	II	Low[2]	High[2]
Health	5.4[4]	NE[5]	NE	27[6]		2.4-3.6[7]	NE	NE	NE		34.8	36
Buildings/ Materials	2.8	NE[8]			NE						2.8	>2.8
Agriculture	0.1[9]-1.0[10]										0.1	1.0
Land					3.0 -10.0[11]				0.2-0.7[12]		3.2	10.7
Forests	2.6	2.9 - 5.4[13]									5.5	8
Fishing industry							0.25	NE			0.25	>0.25
Water supply					3.9-6.7[14]		1.7[15]	8.3[15]			13.9	16.7
Habitat/ Ecological Damage		NE						NE		>3.4	3.4	>3.4
Others (excl global damage)		7.8 - 11.2 [16]									7.8	11.2
TOTAL	10.9 - 11.8	10.7 - 16.6	NE	27	6.9 - 16.7	2.4 - 3.6	1.95	8.3	0.2 - 0.7	>3.4	71.8	>90
Total as % of GDP	0.4	0.4 - 0.6		1.0	0.3 - 0.6	0.1	0.1	0.3		0.1	2.7%	>3.2%

Source: Estimates collated from various sources (see footnotes).

Footnotes to Table C.1

(1) Includes damage to buildings and agriculture from mining and mining subsidence and overall damage to habitats and ecological damage from various pressures.

(2) In summing the figures for damage costs for each receptor, where a range of damage costs are given for any individual category then the figures in the low and high columns contain the low and high figures of these ranges.

(3) Type I damage costs are based on restoration cost estimates or values of marketable outputs. Type II damage costs are more subjective and uncertain damage costs estimated by techniques such as consumer surveys.

(4) This estimate of 5.4 bn DM was derived by Heinz (1990b) on the basis of an analysis of health insurance data. Heinz covers impacts on respiratory diseases and diseases of heart, circulation and vessels, but excludes mortality impacts. It is of the same order of magnitude as the estimate derived by Marburger (1985) (of 2.3-5.8 bn DM) which includes mortality impacts and is derived on the basis of US dose response relationships.

(5) NE represents where pollution from this environmental media could affect the receptor but where no valuation of these damages have been made.

(6) Willecke, R, Weinberger, N, Thomassen, H, G. (1991) **Kosten des Larms in der Bundesrepublik Deutchsland.** Umweltbudesamt. Berichte 9/91, Berlin.

(7) This includes approximate estimates (in Hubler and Schablitzki 1991) of costs of illnesses and deaths due to contaminated food; extra expenditures on non-contaminated food; costs of prohibiting contaminated food and costs of food monitoring. It excludes Hubler and Schablitzki's estimate of costs to agriculture of controls on agricultural production due to exceeding heavy metals concentrations and costs of incineration of contaminated sewage sludge.

(8) Damage to historic buildings.

(9) Heinz (1990a).

(10) Wicke (1986)

(11) Wicke (1993), **Umweltokonomie, Verlag Franz Vahlen Munchen.** This range includes the costs of clean up, restoration and monitoring contaminated sites in West Germany over a ten year period.

(12) Hubler and Schablitzki (1991).

(13) Lost recreational values derived by travel cost method plus option values (study by Evers/Brabender/Brechtel (1986))

(14) Hubler, Schablitzki, G, (1991). This comprises the additional costs due to contamination of aquifers (eg extra costs of water purification or use of alternative supplies).

(15) Wicke (1993) assumes that water pollution will increase the costs of water and industrial water supply by 1.7bn DM pa. In addition, he suggests that water pollution entails losses of recreation values of about 8.3 bn DM pa so that he estimates the total damage cost of water pollution to be 10 billion DM pa (1992 prices).

(16) Wicke (1993)' estimates of the economic value of clean air based on WTP survey by Schulz (1986) updated to 1992 prices of 25 billion DMs pa. The quantified damage costs to health, buildings, agriculture, timber industry and recreational value of forests have been deducted to yield the remaining costs of air pollution damage costs given for other air pollution damage in *Table C.1*.

FINAL REPORT

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage

Volume II: Topic Papers

March 1996

Reference 3066

1 PREFACE

This report presents topic papers that were prepared as part of a study carried out by *ERM Economics* for the European Commission DG XI on:

> *Economic aspects of liability systems and joint compensation systems for remedying environmental damage.*

Environmental Liability System (ELS) is the term used where civil law (and sometimes administrative law) provides for pollution victims to bring claims for against polluters. If polluters are found to be liable for the damage, they will then be required to compensate the victims or remedy the damage.

Compensation Funds are usually designed to operate when polluters can not be identified or can not pay to remedy the damage. The compensation fund then either compensates victims or pays to remedy the damage. The fund is financed by a collective group of polluters.

Study Team

ERM Economics' core team was supported in this work by a large team of contributors including Fondazione Eni Enrico Mattei (FEEM) of Italy and by researchers from the Universities of Bonn and Dortmund in Germany. The main inputs to the study of these and other contributors are shown below:

ERM Economics*(Overall project management, UK country analysis, US review)*
Professor Helmut Karl, University of Bonn *(Germany country analysis)*
Professor Ingo Heinz, University of Dortmund *(Estimates of environmental damage costs).*
Dr Sven Erichsen, Jauch & Hubener *(German insurance industry)*
Dr Roberto Malaman and Dr Domenico Siniscalco, FEEM, *(Italy country analysis, small and medium sized enterprises)*
TAU Consultora Ambiental *(Spain country analysis)*
ERM Hungary *(Hungary country analysis)*
ERM Italy *(firm interviews in Italy)*
Mr Ted Buijs, Oranjewoud *(Insurance industry, compensation funds and Netherlands country analysis)*
Professor Alistair Ulph *(Simulations of industrial competitiveness)*
Professor David Pearce *(Valuation of environmental damage)*
Dr Anthony Heyes *(Economic analysis of policy instruments, future environmental damage).*

1.1 AIMS OF THE STUDY

This study was designed to analyse the economic effects of civil liability and joint compensation systems for remedying environmental damage, with a view to providing material on the basis of which the European Commission can develop its policy in this field. It focuses on the economic issues. A parallel study was undertaken to examine the legal issues.

The study addresses the following issues:

- What are the economic implications of extending the use of environmental liability systems and/or compensation funds?

- What are the main economic effects of action and non-action of the EU regarding civil liability for environmental damage?

- What are the economic costs and benefits of alternative types of liability systems and compensation funds?

1.2 RESEARCH METHODS

The study has been carried by a multi-disciplinary team drawn from several countries, and followed four principle lines of research:

- *Existing studies;* reviewing existing economic studies and experience in selected EU (and some non-EU) countries.

- *Interviews and country analyses;* undertaking interviews with key economic actors (firms, insurance companies and banks) in selected countries.

Interviews

The research focused on five countries selected to be representative of the range of approaches to environmental protection and stages of development of liability systems in Europe. These countries were:

- Germany;
- Italy;
- Spain;
- UK;
- Hungary.

Specific research was also carried out in the Netherlands, Denmark, Sweden, France and Japan, and the US experience of Superfund was also reviewed.

Interviews were carried out with 16 insurance companies, 7 banks and 63 industrial firms in the UK, Germany, Italy, Spain and Hungary to assess the costs and implications of existing environmental liability systems and to seek views on current and possible future liability systems and compensation funds. The industrial interviews covered the following sectors:

- chemicals, petrochemicals, oil production and refining;
- pulp and paper;
- pharmaceuticals;
- leather tanning;
- electronics;
- wood treatment;
- mining;
- iron and metals.

CONTENTS

This *Volume II* to the *Main Report* presents topic papers on the following issues of particular concern for this study:

1 Valuation of environmental damage costs

2 Impacts of environmental liability systems on the competitiveness of industry.

3 Economic implications for the insurance sector of covering environmental damage

4 Implications for small and medium sized entreprises (SMEs)

5 Compensation funds

6 Review of Economic Implications of Superfund in the US

TOPIC PAPER 1

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Valuation of Environmental Damage

Prepared by ERM with assistance from Professor Pearce (EFTEC)

March 1996

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CONTENTS

1 INTRODUCTION

1.1 INTRODUCTION AND OBJECTIVES OF TOPIC PAPER

Sound and uncontroversial environmental valuation techniques are ideally desired for the implementation of an environmental liability system. An Environmental liability systems involves actual financial payments. Consequently, doubts about the robustness of the underpinning valuation techniques creates the potential for costly disputes, although the implementation of an environmental liability systems could itself significantly increase the application and robustness of techniques to value environmental damage - as has occurred in the US.

The valuation of environmental damage costs both for individual cases and at the aggregate level (see *Section 2.1* of the Main Report) concerns the main parties involved in making key decisions concerning an environmental liability systems:

- the Courts who determine the appropriate the level for the damage costs;
- the authorities who would have to determine the appropriate level for the environmental damage costs to be recovered from polluters (in administrative liability cases);
- the firms who would have to determine the level of their environmental liabilities and the extent to which they should implement pollution prevention measures to reduce these liabilities;
- the insurers who would have to determine the extent of their possible exposure for environmental liabilities so as to determine whether it is worthwhile for them to offer insurance and, if so, the appropriate level of premia to set for such policies;
- the banks who would have to determine: the extent of environmental liabilities for firms to whom they provide loans and their effect on the bank's bad debts; and also whether the banks would provide bonds for the environmental liabilities of firms;
- the victims who need to know the level of environmental damage costs to press for.

This topic paper therefore examines the existing techniques for valuing various types of environmental damage costs with respect to their adequacy for the implementation of environmental liability systems.

In addition, this topic paper examines briefly any variations in the valuation techniques that are commonly applied in different European countries so as to indicate how an EU wide environmental liability system could be consistently applied across the EU.

1.2 *Criteria for Assessing Valuation Techniques*

A key issue for the effective and efficient operation of a liability and compensation system for remedying environmental damage is how adequate are the existing available techniques for determining a monetary valuation for the environmental damage costs in question.

Criteria for assessing the adequacy of existing valuation techniques to fulfil this role are:

- Robustness of the valuations and hence the scope for disputes. This concerns the following issues:
  - The validity of the assumptions that have to be made concerning key variables on which data are lacking.
  - To what extent different valuations have been or can be produced by the plaintiffs and victims due to differences in approaches, methodologies, data and assumptions; and hence what is the incentive for both parties to incur transaction costs in commissioning separate studies and critiques of each other's studies.
  - Extent of disputes or consensus about the appropriate approach and methodology for valuing the environmental damage costs.
- Public acceptance of the valuations.
- Acceptance of the techniques by the courts.
- Practicability in terms of availability of data.
- Costs of acquiring data and applying the valuation techniques.

Whereas some valuation techniques may be appropriate for determining approximately the significance of environmental damage to input into the environmental policy making process, their application for an environmental liability system entails much stricter tests in respect of the criteria outlined above.

2 REVIEW OF TECHNIQUES FOR VALUING ENVIRONMENTAL DAMAGE COSTS

2.1 TECHNIQUES FOR VALUING ENVIRONMENTAL DAMAGE COSTS

Major possible types of environmental damage costs are use values which include:

- Losses of economic outputs such as reduction in yields in agriculture or forestry due to air pollution.

- Extra defensive expenditures incurred by individuals or firms such as increased expenditures on repainting or replacing materials damaged by air pollution or expenditure incurred to prevent damage arising (eg moving stock animals away from a polluted site).

- User damage costs such as lower or impaired recreation benefits due to water pollution or damage to forests caused by air pollution or destruction of natural habitats.

In addition, there can be non-use values which include:

- Welfare losses to individuals who do not currently use the affected environment but derive welfare benefits from having the option of doing so or from knowing about the quality of the environmental assets (existence values). Such non-use values were particularly significant in the case of the Exxon Valdez oil spill since few people would actually visit the affected area (Prince William Sound in Alaska) but nonetheless expressed a high valuation for the damage costs to this remote area.

- Intrinsic valuations of damage to the natural environment for its own sake rather than the above valuations which concern losses of human welfare arising from damage to environmental assets.

The uncertainties and difficulties of valuation become progressively greater as one moves down the above list of possible types of environmental damage costs.

The four main steps involved in the valuation of environmental damage costs include:

- identifying and estimating the level of the discharges of the pollutants that caused the damage;

- converting the discharges into ambient concentration levels of the pollutants;

- assessing the physical impacts of these ambient concentrations through the use of dose response relationships;

- assessing the economic valuation (and significance) of these impacts.

The lack of information, uncertainties and scope for controversy are more pronounced as one moves towards the last step.

The techniques for the economic valuation of environmental damage costs include:

- Estimating the costs of restoring the damaged environmental asset. It is relatively easy to obtain such cost estimates. However, this technique does not estimate the value of the damaged environmental asset as such, which might be more or less than the costs of its restoration. Hence it should really only be used when it is not feasible to obtain a proper valuation of the asset in question. In addition, this technique raises important and difficult issues concerning definition of the standards to which the asset should be restored since using a cost-effective fitness for use standard entails much lower costs than restoring the environment to its original condition [(1)], which can be difficult to specify.

- Estimating the defensive expenditures incurred as a result of the pollutants (eg the costs of protecting, cleaning, repairing or replacing the affected assets such as materials and buildings).

- Market based approaches which apply existing market prices to the physical impacts estimated through dose response relationships (eg changes in yields of agricultural crops or timber due to air pollution).

These valuation techniques can be fairly readily applied to derive directly tangible estimates of damage costs for certain types of environmental damage, although considerable uncertainties and potential for disputes still remain concerning the estimates. These environmental damage costs are termed type I environmental damage costs in *Section* 2.2.2 of the main report.

In addition, there are the following types of techniques for valuing environmental damage costs which involve greater uncertainties and difficulties - these are termed type II environmental damage costs in *Section* 2.2.2 of the main report.

- Travel costs methods which have been used to assess impacts on recreation where the extra travel costs that consumers pay to visit a recreation site, instead of an alternative, are used to estimate the value of damage costs to this site (eg water pollution at a lake).

- Hedonic pricing methods where the differences in prices or rents for properties and land in areas with different environmental pollution levels (eg noise or air pollution) are analysed to indicate the value of damage costs from these pollutants.

[(1)] Brattle/IRI (1995) **Assessment of Cost Savings Resulting from Implementation of the CMA Remedy Selection Approach.** Report prepared for the Chemical Manufacturers Association, USA.

- Analysis of wage differentials for workers in environmentally risky occupations.

- Surveys where users and non-users are asked either directly for their willingness to pay for the changes in the quality of an environmental asset (eg loss of a natural habitat, damage to a lake or river) (contingent valuation methods (CVM)) or their willingness to pay estimates are derived from their responses to questions about their relative preferences for the environmental impacts (eg noise or air pollution emissions from traffic) compared with an item involving a monetary payment (eg fares) (stated preference techniques).

- Benefit transfer methods where the valuations derived from any of the above studies for other situations are applied to the particular case.

Navrud and Pruckner (1996) [1] review the existing studies involving the above valuation techniques and found that some hedonic pricing studies were carried out in Europe and the US in the 70s and early 80s, but that there has since been a move away from hedonic pricing and travel cost techniques towards contingent valuation methods.

They also state that benefit transfer methods compound the uncertainties due to potential for disputes about the valuations made in the original study and its applicability to the case in question. They conclude that benefit transfer is best suited for deriving ball park estimates to guide policy development, but that their use is not defensible for environmental liability cases (Navrud and Pruckner (1996) p9). Consequently, original damage valuation studies are likely to be needed for environmental liability cases entailing considerable transaction costs.

Table 2.1a identifies some possible techniques for valuing the environmental damage cost categories examined in *Annex C* of the Main Report (see *Table C.1*) and highlights some issues regarding the current state of the art in their application.

- The valuation techniques have been most extensively applied for the traditional pollutants (eg acid rain) on which there is a body of experience and data on their application.

- The least knowledge, experience and data are available on the main emerging pollution problems (such as health impacts of chronic toxic water and air pollutants) about which there is currently the greatest uncertainty and concern.

[1] Navrud, S, Pruckner, G J (1996) **Environmental Valuation - To use or not to use? A comparative study of the United States and Europe.** Forthcoming in Environmental and Resources Economics.

Table 2.1a ***Valuation Techniques for Specific Environmental Damage Costs***

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
Human health	Mortality impacts	Dose response functions plus: standard value of statistical life estimates- ie WTP to reduce risk faced by individuals medical costs of treatment paid by rest of society some forgone output and productivity	Health Costs of Particulate Matter, Pearce and Crowards (1996). Health Costs of SO_2, NO_x, and Particulates, Landrieu (1995).	Dose response relationships for some pollutants (PM_{10}, NO_x,SO_2 and Lead), but great uncertainties for other pollutants(CO, dioxins, VOCs, POPs, Ozone); chronic effects of pollutants much less understood than acute effects; Will courts accept economic values of life?
	Morbidity impacts:	Dose response functions plus: person a's WTP to avoid morbidity estimates, or medical treatment costs.	Health Costs of Particulate Matter, Pearce and Crowards (1996)	As above Uncertainties and disputes over survey methodology and findings; costs of surveys
Buildings	Material replacement/restoration costs	Analysis of incremental replacement/repairing costs	Benefit of Reducing SO_2 emissions, ECOTEC (1994).	Fairly well established; need inventory of materials affected; uncertainties about dose response relationships for specific pollutants
	Loss of historic buildings	WTP surveys Travel costs methods	Durham Cathedral Study, Willis (1994)	See above Problems of interpreting results.
Agriculture	Loss of crop output	Dose response relationships plus market value of loss output	Effect of Ozone on Wheat, Brown et al., (1996).	Fairly well established; Uncertainties about dose response relationships and specific effects of pollutants
Industry/commerce	Loss of tourist profits	Changes in tourism profits	Costs of Amoco Cadiz oil spill (Bonnieux and Rainelli (1991))	Lack of data on tourism (visitor numbers and profits) so that surrogate indicators needed (bread consumption); Problems of determining baseline of position in absence of oil spill.
	Increased industrial costs (eg water treatment, repair of buildings)	Estimates of extra costs (market based techniques)		Determining extent extra costs due to pollution; Definition of extra costs - whether just incremental expenditures or short or long run marginal costs of additional resources used.

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
Land	Costs of treating contaminated soil	Estimate of costs of techniques	Costs of treating contaminated sites (Carrera and Robertiello (1993))	Definition of standard for treatment (?use of cost-effective and fitness for use criteria); Variations in definition of sites needing treatment; lack of consistent data on sites and their costs.
	Contamination of aquifers	WTP surveys	Nitrate Pollution, Hanley 1989.	Usual concerns over CVM applies.
			Milan study, Press 1995.	
		Costs of treating aquifer or alternative water supply source	Cambridge Water Co vs Eastern Counties Leather	No dispute over level of claim and estimate costs of remedying contaminated aquifer
			Study for Chemical Manufacturers Association of cost-effectiveness of treating Superfund sites	Whether alternative more cost-effective options are available (eg alternative supplies); determination of the opportunity costs of these supplies.
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution	Dose response relationships, plus valuation by Market based studies of extra costs and foregone profits	Damage to Forests in Europe	Fairly well established; but problem of determining baseline of costs and profits without air pollution; long lags before pollutants affect trees; disputes about dose response relationships.
	Reduced recreational benefits	Surveys of visitors' views on impacts and WTP to prevent them	Recreational Value of Forests, Willis and Benson (1991)	See above for surveys re historic buildings
		Travel cost methods		Ditto
		Hedonic Property Price Method	Garrod and Willis (1991) Merlo and Signorelli (1990)	
		Costs of remedying damage (eg replant trees) or recreating a forest or habitat elsewhere		Fairly easy to estimate; but possible disputes about whether costs reasonable and most cost-effective options; Are replaced trees an adequate substitute? lack of baseline data on original conditions of forest
	Non-user and option value benefits	Surveys of general population	Norfolk Forest (forthcoming) Bateman.	See above for surveys of historic buildings;
Fishing industry	Lost yields/catch and extra costs	Market based studies	ECOTEC (1994).	Fairly straight forward, but problems of determining baseline position without pollution; Problem of previous position of overfishing

Receptor	Type of Damage	Possible Valuation Technique	Example	Adequacy
Water supply	Extra water treatment costs	Estimates of extra costs		Fairly straightforward
Natural habitats and biodiversity loss	Loss of biodiversity from acid deposition	WTP study	MacMillan et al., 1994.	
	Costs of remedying damages to water courses from water pollution incident	Costs of restocking river; Costs of remedial operations	Section 161 of Water Resources Act in UK; NRA's guidance on standard costings	NRA's guidance facilitates cost recovery; but lack of baseline data on env conditions before pollution incident; disputes about mortality rates for restocked fish and number of new fish needed
	Residual damages that cannot be restored	Surveys of users/visitors to natural habitats		Definition of residual damages; problems with surveys even more marked due to intangible nature of damages to irreplaceable assets; increasing importance of damages due to rising pressures on natural habitats and increasing public concern
	Option values and non-users' values			Ditto; plus problems of defining sample
	Loss of Tourism and user benefits	Economic impacts on tourism	Impacts of Amoco Cadiz (Bonnieux and Rainnelli (1991))	Difficulties of defining baseline of tourism levels in absence of environmental impacts; how allow for changes in quality as well as number of visits
		Surveys of users		See above for problems of surveys, especially how users perceive the environmental damages

Footnote: WTP = what individuals are willing to pay to secure or prevent an environmental change - WTP usually estimated by surveys of individuals.

- The long time lags before many current pollutants create perceived damage (eg increased deaths or illnesses) increase the uncertainties and disputes about damage costs and the difficulties of valuing them.

- Lack of baseline data, especially on environmental conditions before the incident, makes it difficult to assess the damage caused by an incident.

There are uncertainties concerning the survey techniques, such as contingent valuation, to determine individuals' willingness to pay for the remediation of intangible environmental damage costs such as damage to the natural environment. These uncertainties concern:

- whether the respondents can adequately comprehend the changes in environmental conditions;

- whether the questioner providing information on the environmental conditions biases the respondents' views;

- the specific manner in which the questions are posed;

- how respondents have interpreted these questions;

- which specific aspects of the environmental conditions that respondents are giving valuations;

- how respondents have interpreted the questions;

- possible biases in respondents' valuation such as over estimating the value where they think they will not in fact have to pay (free rider issues);

- whether the sample is representative and how the findings should be interpreted and grossed up.

Moreover, the value of these intangible environmental damage costs are essentially determined by the public preferences which are difficult to anticipate. Public concern about environmental damage, especially for damage to natural habitats, is likely to keep rising in the future as incomes rise and with increasing pressures on a declining stock of natural habitats.

As a result, it would be difficult for insurers to anticipate and predict what the public's preferences and valuations will be and hence what could be their liabilities for ecological damage due to a pollution incident that might arise some time in the future.

Table 2.1b presents US data showing that different studies yield estimates for the same environmental good that vary significantly by up to a factor of three. This is due to differences in the valuation techniques adopted (eg CVM or travel cost method(TCM)) and differences in the assumptions (eg for value of time for leisure trips). Very few studies in Europe have applied more than one technique to a problem. One study in Italy found that TCM and CVM gave similar figures for the value of recreational benefits at a lake.

Table 2.1b ***Differences in Values Given by Different Studies***

	CVM Results		Indirect Market Study	
Study	Commodity	Value	Method	Value
Knetsch & Davies, 1966	Recreation Days	$1.71 per household per day	TCM	$1.66 per household per day
Bishop and Heberlein, 1979	Hunting Days	$21 per permit	TCM value of time (VOT) =0	$11
			VOT=1/4 median income	$28
			VOT=median income	$45
Desvouges, Smith &McGivney, 1983	Water quality improvements:		TCM	
	loss of use	$21.41		$82.65
	boatable to fishable	$12.26		$7.01
	boatable to swimmable	$29.64		$14.71
Seller, Stoll & Chavas, 1984	Boat Permit to:		TCM	
	Lake Conroe	$39.38		$32.06
	Lake Livingston	$35.21		$102.09
	Lake Houston	$13.01		$13.81
Thayer, 1981	Recreation Site	Population value per household per day $2.54	Site Substitution	Population value per household per day $2.04
Brookshire et al., 1982	Air quality improvements:	Monthly value	HPM	Monthly value
	poor to fair	$14.54		$45.92
	fair to good	$20.31		$59.09
Brookshire et al., 1985	Natural hazard information	$47 per month	HPM	$37 per month

Source: Cummings, Brookshire and Schulze, 1986.

Note: TCM = travel cost method
VOT = value of time
HPM = hedonic pricing method

Valuations based on what individuals are willing to pay (WTP) for environmental benefits or the prevention of environmental damage costs tend to be less than what individuals are willing to accept (WTA) in compensation for environmental damage costs, the discrepancy is larger where the damaged environmental asset is scarce and has fewer substitutes. Whether WTP or WTA is appropriate depends on the prevailing property and legal rights and the individuals' perceptions of their environmental rights.

Navrud and Pruckner (1996) review the experience in Europe with environmental valuation and suggests that there are large differences across Europe in people's preferences towards environmental protection. This is due in part to differences in income levels and environmental conditions. Differences in people's environmental preferences and valuations due to these factors would not affect the efficiency and effectiveness of environmental liability systems. One potential advantage of an Environmental liability systems is that it could provide a mechanism for raising environmental standards in those locations where the individuals concerned are most concerned about the environmental damage costs.

However, the differences across Europe in people's preferences and valuations also fundamentally differ due to differences in the availability of information on the state of the environment and their knowledge and perceptions of the environmental damage. Therefore better information is needed on environmental conditions. Differences in individual's knowledge and perception mean that an Environmental liability systems based on civil liability would lead to greater clean up and pollution prevention in countries where the individuals are more aware of the damage and also where the individuals (or the environmental groups) are more likely to take legal action. These countries are likely to be those with already higher environmental standards (eg Germany, UK). Hence there is unlikely to be an even application of environmental liability systems across Europe, especially if there are differences in the acceptance of valuation techniques across Europe (see below).

2.2 *CURRENT PRACTICE WITH VALUATION TECHNIQUES IN EUROPE*

Valuation techniques have been much less extensively applied in Europe than is the case in the US [(1)]. Experience with applying valuation techniques is currently more limited in Europe, especially in Cohesion

[(1)] For a review of valuation studies in Europe see:
Georgiou, S (1994), **UK Studies of the Economic Valuation of Environmental Impacts.** Review prepared for the Department of the Environment.
Navrud, S, Pruckner, G J (1996) **Environmental Valuation - To use or not to use? A comparative study of the United States and Europe.** Forthcoming in Environmental and Resources Economics.
Navrud, S (ed) (1992) **Pricing the European Environment.** Oxford University Press, Oxford.
Merlo, M, Della Puppa, F, (1994), **Public Benefit Valuation in Italy. A review of forestry and farming applications.** In Budgaard, A, Bateman, I, Merlo, M, (eds) **Identification and Valuation of Public Benefits from Farming and Countryside Stewardship.**
For a review of contingent valuation studies see:
Carson N, Wright R T J, Alberini A, Flores N, (1995): **A bibliography of Contingent Valuation Studies and Papers.** Natural Resource Damage Assessment Inc.

countries although some valuation studies have been carried out over the last few years in Spain and Portugal.

There is a lack of scientific and economic data in Europe concerning emissions levels, ambient environmental conditions, scientific dose response relationships and the economic valuation of (marginal) changes in the levels of these impacts. CORINE provides data on air emissions [1], but there is a lack of consistent data on water pollution, wastes and contaminated sites.

A number of valuation studies have been carried out in Germany, Netherlands, Sweden, UK and France on, for example, the impacts of air pollutants such as SO2 on human health, forests, agricultural and buildings. Most of this work has built on scientific analysis of dose response relationships. Many of the existing studies have applied market based techniques such as estimates of additional costs of repairing damage to buildings.

Interest and application of Contingent Valuation methods has occurred later in Europe than in the US, but the number of CV studies has increased significantly over the last few years - mostly in the UK, Norway and Sweden.

Table 2.2a shows the number of the various types of valuation studies that have been carried out in UK, Germany, Netherlands, Italy, Sweden, Finland, Norway and Spain. These countries were selected to cover the different countries in the EU. The scandinavian countries were included to cover the new entrants to the EU (Finland and Sweden) and because valuation techniques have been extensively applied in Norway and Sweden. *Tables 2.2b-h* detail the specific environmental impacts that have been valued by specific techniques in studies in each of these countries. A study is defined as the application of an economic valuation technique that follows standard valuation guidelines (eg the NOAA guideline on CVM) [2] that yield monetary estimates for the valuation of the environmental damage or benefits. The dose response studies often provide the scientific basis to estimate the physical impacts which are then valued using one of the other economic valuation techniques shown in these tables. *Tables 2.2a-h* are based on a review prepared by EFTEC of existing valuation studies in Europe. This review is considered to provide a representative coverage of the existing studies.

Valuation studies have been most extensively applied in the UK, Sweden and Norway. In particular, contingent valuation and stated preference techniques have been much more extensively applied in these European Countries than in Germany, the Netherlands and in Southern and Eastern Europe. In Germany and Netherlands, market based and replacement cost valuation of physical impacts from close response studies are used relatively more often than the other valuation techniques such as CVM.

(1) Eurostat (1995) **Europe's Environment: Statistical Compendium for the Dobris Assessment.**

(2) Arrow, K Solow, R, Portney, P R, Leamer, E,E, Radner, R, Schuman, H, (1993). Report of the National Oceanic and Atmospheric Administration Panel on Contingent Valuation. 58 Federal Register, 4601-4614.

Table 2.2a *Number of Studies to Value Environmental Damage Costs in Selected European Countries*

European country	Dose response	Market based studies (eg value of lost outputs)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
UK	21	9	2	7	21	40	1
Germany	8	3	2		3	7	
Netherlands	5	2	3	1	1	5	
Italy	4	2		2	1	2	
Hungary				1		1	
Sweden	6				2	30	
Finland					1	7	1
Norway	4			8	3	26	
Spain						10	

Source (also for data in Tables 2.2b - h): EFTEC

Table 2.2b ***Number of Studies to Value Specific Environmental Damage Costs in the UK***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts	4					1	
	Morbidity impacts:	4	3					
Buildings	Material replacement/restoration costs	5		2				
	Loss of historic buildings						3	
Agriculture	Loss of crop output	2	1			1		
Land	Contamination of aquifers						1	
Forests	Lost revenue and extra costs from reduced tree growth	3	3					
	Reduced recreational benefits, non-user value and amenity value				6	7	5	
Fishing industry	Lost yields/catch	1			1			
Noise	Welfare loss from road traffic noise					3	3	1
Natural habitats	Costs of liming acidified lakes[1]	2	2					
	Residual damages not restored							
	Coastal Zones recreational/amenity value					1	9	
	Inland waterways					2	7	
Biodiversity	Nature/ wildlife/landscape amenity loss					7	11	
Total		21	9	2	7	21	40	1

1 Results transfered from Sweden.

Table 2.2c ***Number of Studies to Value Specific Environmental Damage Costs in Germany***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts	2					1	
	Morbidity impacts:	1						
Buildings	Welfare loss or material replacement/restoration costs	2		2			1	
	Loss of historic buildings							
Agriculture	Loss of crop output	1	1					
Land	Contamination of aquifers							
Forests	Lost revenue and extra costs from reduced tree growth due to air pollution	1	2					
	Welfare loss from reduced recreational benefits, non-user value and amenity value							
Fishing industry	Lost yields/catch							
Noise	Welfare loss from road traffic noise					2	2	
Natural habitats and	Costs of liming acidified lakes[1]	1						
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways					1	1	
Biodiversity loss	Nature/ wildlife/ landscape amenity loss						2	
Total		8	3	2		3	7	

1 Results transferred from Sweden

Table 2.2d ***Number of Studies to Value Specific Environmental Damage Costs in The Netherlands***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts	1						
	Morbidity impacts:	1						
Buildings	Welfare loss or material replacement/restoration costs	1		1				
	Loss of historic buildings			1				
Agriculture	Loss of crop output	1	1				1	
Land	Contamination of aquifers							
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution	1					1	
	Welfare loss from reduced recreational benefits, non-user value and amenity value				1		1	
Fishing industry	Lost yields/catch							
Noise	Welfare loss from road traffic noise					1	1	
Natural habitats and	Costs of liming acidified lakes[1]							
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways		1	1			1	
Biodiversity loss	Nature/ wildlife/ landscape amenity loss							
Total		5	2	3	1	1	5	

1 Results transferred from Sweden

Table 2.2e ***Number of Studies to Value Specific Environmental Damage Costs in Sweden***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts	1					6	
	Morbidity impacts:	1				1	6	
Buildings	Welfare loss or material replacement/restoration costs	1						
	Loss of historic buildings							
Agriculture	Loss of crop output							
Land	Contamination of aquifers							
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution	1						
	Welfare loss from reduced recreational benefits, non-user value and amentiy value						8	
Fishing industry	Lost yields/catch	1						
Noise	Welfare loss from road traffic noise							
Natural habitats and biodiversity loss	Costs of liming acidified lakes	1						
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways							
	Nature/ wildlife/ landscape amenity loss					1	10	
Total		6				2	30	

Table 2.2f ***Number of Studies to Value Specific Environmental Damage Costs in Finland***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts							
	Morbidity impacts:							
Buildings	Welfare loss or material replacement/restoration costs							
	Loss of historic buildings							
Agriculture	Loss of crop output							
Land	Contamination of aquifers							
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution							
	Welfare loss from reduced recreational benefits, non-user value and amentiy value							
Fishing industry	Lost yields/catch						2	
Noise	Welfare loss from road traffic noise							
Natural habitats and biodiversity loss	Costs of liming acidified lakes							
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways					1	1	
	Nature/ wildlife/ landscape amenity loss						4	1
Total						1	7	1

Table 2.2g ***Number of Studies to Value Specific Environmental Damage Costs in Norway***

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts	1					2	
	Morbidity impacts:	1					2	
Buildings	Welfare loss or material replacement/restoration costs	1					1	
	Loss of historic buildings						3	
Agriculture	Loss of crop output	1						
Land	Contamination of aquifers							
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution							
	Welfare loss from reduced recreational benefits, non-user value and amentiy value						9	
Fishing industry	Lost yields/catch							
Noise	Welfare loss from road traffic noise					2		
Natural habitats and biodiversity loss	Costs of liming acidified lakes							
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways				8	1	8	
	Nature/ wildlife/ landscape amenity loss						1	
Total		4			8	3	26	

Table 2.2h **Number of Studies to Value Specific Environmental Damage Costs in Spain**

Receptor/Type of Damage	Type of Damage	Dose response	Market based studies (value of lost output)	Replacement costs/ avertive behaviour	Travel costs	Hedonic pricing	Contingent valuation/ stated preference	Others
Human health	Mortality impacts							
	Morbidity impacts:							
Buildings	Welfare loss or material replacement/restoration costs							
	Loss of historic buildings							
Agriculture	Loss of crop output							
Land	Contamination of aquifers							
Forests	Loss of revenue and extra costs from deterioration in tree growth due to air pollution							
	Welfare loss from reduced recreational benefits, non-user value and amentiy value						5	
Fishing industry	Lost yields/catch							
Noise	Welfare loss from road traffic noise							
Natural habitats and biodiversity loss	Costs of liming acidified lakes							
	Residual damages that cannot be restored							
	Coastal Zones recreational/amenity value							
	Inland waterways							
	Nature/ wildlife/ landscape amenity loss						5	
Total							10	

Valuation techniques have so far not been extensively applied in Southern and Eastern European countries. These marked differences in the application of environmental valuation techniques between individual EU countries are largely due to the lack of expertise in Southern and Eastern European countries to apply such techniques, and possibly also a preference in Germany to focus on valuing the more tangible and less uncertain environmental damage costs.

Tables 2.2c and *2.2d* suggest that, in Germany and the Netherlands, attention has focused on the more tangible environmental damage costs (eg loss of agricultural output, costs of repairing damaged materials etc). These were defined as type I environmental damage costs in *Section* 2.2 of the main report which suggests that they account for about one third of total environmental damage costs. Consequently, substantial differences in the environmental damage costs covered by environmental liability systems might arise due to the differences in the present application of the valuation techniques in Germany and the Netherlands as compared with other European countries such as the UK or Sweden where there is greater use of CVM.

Some efforts have been made to promote valuation of environmental damage costs. For example, the UK's Department of the Environment (1991, 1994) has published guidance for Government Departments to promote application of various environmental valuation techniques [1]. The National Rivers Authority has prepared guidelines for the recovery of costs of remedying a water pollution incident [2]. This includes standard costs for items such as analyses, fish restocking and time of personnel.

Increased application of valuation techniques in European countries is needed to develop the greater experience and data needed to underpin an environmental liability system.

The European Community's Fifth Environmental Action Programme [3] recommends that a community cost-benefit methodology should be drawn up for application to all projects and policies with an environmental dimension. There are differences in Member States' current practices and experience regarding the alternative valuation techniques. Adoption of best practice appears necessary to achieve a consistent application of techniques across member states. However under the prevailing situation, it would probably not be effective to *require* simply the adoption of best practice.

Therefore as a first step it appears fruitful and necessary to *encourage* the adoption of best practice by collating and sharing available experience on the application of valuation techniques in European countries, developing and promulgating best practice guidelines for the performance of valuation

(1) Department of the Environment (1991), **Policy Appraisal and the Environment: A guide for Government Departments.** HMSO, London

(2) National Rivers Authority (1995) **Pollution Incident Cost Recording and Recovery in the Northumbria and Yorkshire Region of the NRA - A guide for Environment Protection Staff**

(3) European Commission (1993) **Towards Sustainability: A European Community Programme of Policy and Action in Relation to the Environment and Sustainable Development.**

studies and promoting the development of expertise to carry out such studies (eg by training and technical assistance and financial assistance).

2.3 *Application of Valuation Techniques in Environmental Liability Cases*

2.3.1 *US Experience*

Valuation techniques have for many years been applied much more extensively in the US than in Europe. The greater expertise in the US is partly related to the greater interest in environmental valuation in the US. Thus Executive order 12291 of 1981, for instance, required that a formal regulatory impact analysis be carried out of the costs and benefits of policies or regulations imposing significant costs.

Interest and experience in valuing environmental impacts in the USA has been increased by the passage of CERCLA. Importantly, in tandem with the implementation of CERCLA, considerable efforts were made in the US to develop and promulgate best practice guidance on valuation methodologies. This included the work of the National Oceanic and Atmospheric Administration (NOAA) [(1)]. A specific Government Department - the Department of Interior - was responsible for promoting the assessments of environmental damage costs and promulgating regulations for the assessment of natural resource damage costs under CERCLA.

The Department of the Interior (DOI) has also specified that extensive assessments should only be carried out for major pollution incidents. These should be based on restoration or replacement costs and the diminution of use values where restoration is not cost-effective. For minor oil spills, the DOI specify that simplified assessments should be followed based on the Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME) since in such minor cases, the costs of a full assessment can exceed by a factor of eight the detectable damage costs.

Annex A presents a hierarchy of techniques for valuing damage costs to natural resources that the US Department of Interior developed. This expressed a preference for the use of market prices to value the losses or, where market prices are not appropriate, then to apply the uniform appraisal methodology used for federal land acquisition. Only for those types of environmental damage costs, such as non-use and option values, should contingent valuation (CVM) techniques be applied. The DOI's hierarchy of techniques led to a dispute about the suitability of CVM.

The Exxon Valdez oil spill created further disputes about the validity of using CVM to value the damage costs, especially in respect of non-use values. Exxon's consultants presented theoretical and empirical studies stating that CVM did not yield consistent, reliable and unbiased estimates for non-use values, which should therefore be omitted from the damage cost assessment.

[(1)] National Oceanic and Atmospheric Administration (1994) Notice of Proposed Rulemaking: Natural Resource Damage Assessments. 59 Federal Register 1062, January 7 1994.

Consequently a panel headed by Professors Arrow and Solow was set up to advise NOAA on the use of CVM. This panel concluded that CVM studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive-use values where they are applied carefully [1]. The Panel drew up guidelines for carrying out reliable CVM studies that should be followed as closely as possible.

NOAA published in January 1994 proposed regulations on natural resource damage assessment [2], which reiterate the Panel's recommendations, but also proposed that the willingness to pay estimates from a CVM should be reduced by 50% because the hypothetical WTP estimates reported by CVM surveys overstate what individuals would actually be willing to pay in practice. NOAA is still seeking comments on this proposal.

2.3.2 *Existing Liability Cases*

Recent environmental liability cases have revealed substantial differences between the damage costs estimates made by the plaintiffs and those by the defendants. The size of these differences gives each party a strong incentive to carry out their own damage valuations and scrutinise those of the other parties, which can entail significant transaction costs.

The differences in the valuations were largely due to differences in the assumptions used in the analysis rather than disagreements regarding the basic valuation techniques and methodologies.

Boxes 2.3a and 2.3b present two examples to illustrate the scale, nature and source of such differences in the valuations.

(1) Arrow, K Solow, R, Portney, P R, Leamer, E,E, Radner, R, Schuman, H, (1993). Report of the National Oceanic and Atmospheric Administration Panel on Contingent Valuation. 58 Federal Register, 4601-4614.

(2) National Oceanic and Atmospheric Administration (1994) **Notice of Proposed Rulemaking: Natural Resource Damage Assessments.** 59 Federal Register 1062, January 7 1994.

Box 2.3a *Idarado Mine: Colorado*

The tailings pond of the Idarado mining complex contaminated with hexavelant chromium two municipal water supply wells, a river, a reservoir and several properties. The defendants valued the damages at less than $0.5m; while the plaintiffs' (the state of Colorado) valued the damages at some 16-40 times higher at between $8m and $40m plus an additional $100m for past damages. The reasons for these differences were:

- The plaintiffs used the estimates of the costs of surface treatment of the contaminated water to yield a damage value of $3-5m; while the defendant argued that the costs of drilling new wells would be $205k. This raised questions about the true opportunity costs of this alternative water supply and whether this alternative well might become contaminated by pollutants from the mine at some time in the future.

- The plaintiff used experience from a similar case in Utah to argue that the soil contamination would reduce property values by 10-15% which amounted to $2m in total; while the defendant argued that the soil contamination could be overcome by covering with new top soil at a cost of $275k. This then raises questions about: the cost-effectiveness of the treatment options; whether the defendant's option would effectively clean up the contamination and the perceptions on this of the local residents and property market.

- The plaintiff estimated the lost recreational benefits at the reservoir by multiplying the US Forest Service's standard value for trout fishing ($14-22 per day) by an estimate of the potential additional fishing activity on the reservoir if it had not been contaminated. This yielded total fishing damages of $0.9 - 1.4m. The defendant disputed this estimate of the potential fishing activity and argued that any potential fishing activity at the damaged reservoir should be valued at users' marginal benefit of fishing at this reservoir instead of alternative sites (about 7cts per day) which yielded an estimate of the damages of $14k.

Box 2.3b *Amoco Cadiz*

In 1978, the supertanker Amoco Cadiz ran aground in a storm discharging 220,000 tonnes of crude oil, of which about 35% came ashore damaging 200 miles of the coast of North Brittany. Compensation claims were brought against the company (Amoco) by the French Government for the recovery of the clean up costs by local authorities, businesses and associations. These claims raised the following important issues concerning the valuation of environmental damages:

- The court only permitted the French Government to recover the additional incremental expenses incurred by the armed forces and not for the costs of their time and equipment used for the clean up operations;

- No data were available on tourist levels to enable firm estimation of the impacts of the oil spills on tourism. Consequently the plaintiffs used flour deliveries to derive surrogate measures of changes in tourism levels due to the oil spill on the grounds that bread production correlated well with the number of people staying in the area. This was multiplied by an estimate for the value of a visitor day to estimate the total reduction in tourist expenditures at 503m francs. The defendants used economic models to estimate loss of profits for the tourist industry to exceed 124m french francs. The court rejected the defendants' method of estimating lost tourist revenue and decided on a total claim of 2.2m french francs for losses to the tourist industry.

- The plaintiffs compared tourist profits in 1978 with those in the previous year. This was about twice as high as the estimates by the defendant who compared the profits in 1978 with the average of the profits in 1979 and 1977. The court agreed with the latter approach, even though the plaintiffs argued that losses to the tourist industry were still apparent in 1979 and amounted to about one quarter of the losses incurred in 1978.

- Estimates of the losses to the fishing industry were disputed on the grounds that overfishing was taking place before the oil spill.

- There were disputes about how long the effects of the oil spill on the tourist industry and oyster production persisted.

- The court only compensated the League for the Protection of Birds (LPO) for the costs of their small restocking programme. The court rejected the defendants' claims for other ecological damages based on estimates of biomass affected and a proposed restoration programme - the latter on the grounds that the expenditures had not actually been incurred.

3 CONCLUSIONS

In environmental liability cases, the techniques used for valuing environmental damage costs are subject to considerable scrutiny. This scrutiny is much more demanding than occurs in general environmental policy making since actual financial payments are at stake in the liability cases.

The existing liability cases reveal wide divergences between the damage valuations made by the opposing parties. These are due to differences in the assumptions made in estimating the costs (eg whether the most cost-effective remediation option has been costed, estimates of number of people affected). Such assumptions often have to be made due to the lack of data on the appropriate variables such as baseline economic and environmental conditions.

The difficulties surrounding the valuation of environmental damage costs are particularly marked in respect of:

- chronic pollutants (eg gradual releases of toxic air or water pollutants).
- ecological damage and other intangible environmental damage.

The following types of environmental damage costs have the greatest potential of being able to be valued:

- acute pollution incidents such as water pollution accidents, rather than chronic pollution;
- expenditures resulting from the environmental damage (eg costs of replacing or repainting damaged assets);
- costs of restoring ecological assets damaged by the pollution incidents (eg restocking a river after a fish kill as in Section 161 of the Water Resources Act in the UK).

In the last two cases, however, the cost estimates do not represent the value of the environmental damage costs as such. If this approach is used, it raises issues concerning the definition of the standard to which to restore the damaged environmental asset since restoration of the damaged asset to its original or natural state may be very expensive and may not be worthwhile.

Current experience with the practical application of valuation techniques in European countries is more limited than that in the USA, where CERCLA was introduced in tandem with great efforts to promulgate best practice regarding valuation techniques, and where the implementation of CERCLA has increased the use of techniques to value environmental impacts.

Current experience with valuation techniques in Europe and the availability of the required supporting information is unlikely at present to be able to provide valuations reliable enough to support an efficient environmental liability system in Europe. The disputes concerning the valuations could result in considerable transaction costs by each party.

The uncertainties concerning the valuation of environmental liabilities are a barrier to the effective and efficient development at present of an environmental liability systems. Due to these uncertainties, firms, insurers and banks and would be unlikely to undertake an efficient level of prevention measures under an Environmental liability systems. On account of these uncertainties, insurers are not currently willing to provide insurance cover for ecological damage to the unowned natural environment.

There are some differences in the extent and manner in which environmental valuation techniques are currently accepted and applied in practice in EU countries. Such differences could limit the extent to which an environmental liability systems could be evenly applied at present throughout the EU. Thus, some countries (eg Germany and the Netherlands), focus on using market based techniques to value the more tangible environmental damage costs (eg costs of restoring buildings damaged by air pollution, lost agricultural outputs). Such valuation techniques could only cover less than one third of the total environmental damage costs. Contingent Valuation Methods (CVM) to value the other more intangible environmental damage costs (eg loss of recreation and non-user benefits) raise considerable uncertainties and methodological and empirical difficulties. They are less accepted and used less extensively in some European countries (eg Germany, Netherlands) than in others (eg UK, Sweden).

Increased use of valuation techniques in European countries is needed to develop the greater experience with environmental valuation techniques and data needed to underpin an environmental liability system.

These differences are largely due to lack of expertise in Southern and Eastern European countries to apply the various valuation techniques and possibly also a preference in Germany to focus on valuing the more tangible and less uncertain environmental damage costs.

Developing a common approach to environmental valuations would seem worthwhile given the advances in the theory and practice of valuing environmental damage costs that have been achieved over the last decade, although it does raise issues concerning the differences in views between Member States regarding the appropriateness of the alternative valuation techniques.

For all the difficulties, though, an even application of an environmental liability system in the EU does require the development of common guidelines for the assessment of environmental damage and for the applicability of the different techniques in different circumstances.

Therefore it would appear fruitful now to encourage the adoption of best practice by:

- collating and sharing available experience on the application of valuation techniques in European countries;
- developing and promulgating a framework for assessing environmental damage costs with best practice guidelines for the application of environmental valuation techniques in their appropriate circumstances;
- promoting the development of expertise to carry out such techniques especially in Southern European countries (eg support for training and technical assistance).

Annex A

US Department of Interior Hierarchy and Classification of Methods for Measuring Environmental Damage

Annex A *US Department of Interior Hierarchy and Classification of Methods for Measuring Environmental Damage costs*

Type of Method	Method	Definition
Cost estimating methodologies		
1. Restoration cost		Application of accounting and engineering principles to derive actual costs to restore, rehabilitate, replace, and/or acquire equivalent resources.
Lost use and nonuse valuation methodologies		
1. Market-based	Market	Use of existing market prices for resource to measure diminution in quantities due to the damage.
	Appraisal	Where market exists for existing or similar resources, measurement of difference with and without damage.
2. Related markets/revealed preference	Travel Cost	For recreational resources where travel costs to the site are used to estimate the values of the site.
	Hedonic pricing	For resource services that are important attributes of marketed resources, such as water quality for shoreline property, effect of change in environmental quality on property prices.
3. Hypothetical markets	Contingent valuation	Responses of survey participants in a hypothetical questionnaire on the values associated with the changes in environmental quality.
4. Benefit Transfer	All methods	Use of valuation results from a comparable situation based on any of the above methods.
	Unit day value	Use of preassigned dollar values per day for recreational use of similar resources.

Source: US Department of the Interior (DOI) (1991)

Annex B

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TOPIC PAPER 2

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Impacts of Environmental Liability Systems on the Competitiveness of Industry

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CONTENTS

1 *INTRODUCTION*

1.1 *OBJECTIVE*

1.1.1 *Aim of Topic Paper on Competitiveness*

The aim of this topic paper on competitiveness is to assess the impacts on the competitiveness of European industries of:

- differences between the existing liability systems of individual European Member states;
- differences in possible environmental liability systems if some European countries implement stricter environmental liability systems while others do not, in the absence of EU action.

Interviews with industry indicate that the existing liability systems in European countries do not entail significantly increased costs for European industries and hence are unlikely to impair the competitiveness of European industries.

Consequently, this paper focuses on the second objective. This objective is tackled by simulations of scenarios with different levels of costs of environmental liability systems in different European countries. These scenarios are analysed with respect to the existing strict environmental liability system in the USA and the existing liability systems in other OECD countries, while it is assumed that the rest of the world has no environmental liability system and no associated costs.

1.1.2 *Objective of the Simulations*

This topic paper is based on some simulations of the impacts of environmental liability systems in different European and other countries on the competitiveness of the chemical industry. It uses a simulation model of the chemical industry developed by Professor Tony Venables and Professor Alistair Ulph at the University of Southampton in the UK.

The objectives of these simulations are to:

- provide insights into the impacts on the competitiveness of the chemicals industry of different levels of stringency of environmental liability systems in different European and other countries;
- provide the basis for a qualitative analysis of the impacts on the competitiveness of other European industries of existing and alternative environmental liability systems.

1.2 *OUTLINE OF PAPER*

Section 2.1 describes briefly the model used. *Section 2.2* sets out the policy scenario and assumptions used in the simulations presented in this paper.

Section 3 presents the findings of these simulations for the chemicals industry.

Section 4 presents a qualitative analysis and commentary of the impacts of environmental liability systems for the leather tanning, pulp, paper and board, semi-finished wood products, pharmaceuticals, electronics and coal mining industries.

2 METHODOLOGY

2.1 THE MODEL

The model focuses on inter-sectoral linkages between different sectors of industry. In each sector there will be a number of firms (or plants) located in different countries, each firm producing a different variety of the same product (ie there is product differentiation). Within each sector firms compete with each other in setting the price of their product (so there is imperfect competition with firms competing by price (Bertrand competition)).

In each country there is demand for the output of the sector; firms can sell either in the domestic market or in any of the foreign markets, although if they sell in foreign markets they have to incur transport costs (more generally trade costs). On the cost side firms have to incur costs of setting up plants and there are economies of scale in production. Although we assume that there is imperfect competition, so that firms are able to exploit market power to raise prices above marginal cost, we consider a long-run equilibrium in the industry; ie we assume that there is free entry and exit of firms (plants) so that in each country the number of plants is set so that firms just make a normal rate of return on their capital investment.

The distinguishing feature of this model is that the sectors of industry are linked to each other through an input-output structure of production. The demand for the output of a particular sector in any one country is thus made up of two elements - final demand and intermediate demand (ie demand by firms in other sectors who use this product as an input into their production). The implication of this is that the decisions on where plants in one sector locate depends upon the location decisions of plants in related sectors. To see this, suppose that in a particular sector a new plant moves into a particular country; that will have three effects:

(i) first there is the usual effect that it will make that sector more competitive in that country and drive down the price of that sector's output in that country and hence drive down the profits of other firms in the same sector, discouraging any further entry;

(ii) but that will now have a second effect - namely that by lowering the price of that sector's output, it will lower the costs of production of firms in other sectors which use this sector's output as an input to their production; that will raise the profits of those firms and make it more attractive for firms in such sectors to move into this country;

(iii) there will be a further effect: when the original firm moves into a country, that will also increase the (intermediate) demand for the outputs of other sectors which this firm uses as an input; that will raise the profits of these firms and hence attract entry of firms in these sectors.

Thus there are complex inter-linkages between the location decisions of firms in different sectors, with a tendency towards *agglomeration* - ie firms want to locate close to their markets and close to their sources of supply, so there are benefits from firms in different sectors locating close to each other.

The model allows for all these interactions. The model has been calibrated to data on the chemical industry. Since the model was developed in the early 90s, and had to use consistent published data on trade, production, input-output structure etc for all the major countries of the world, the most recent such data we could obtain was data for 1985.

To study the impact of environmental liabilities on the chemical industry, we assume that different countries impose different levels of liabilities on firms in the basic chemical and other chemicals sector and hence those firms face different increases in their costs of production. The baseline situation is the pattern of production and plant location that prevailed in 1985 when, while CERCLA was enacted in the USA in 1980, in Europe there were few environmental liability policies with little or no impacts on costs.

We compare this baseline with the situation that would prevail after the cost increases were imposed, assuming that these cost differences prevailed for a sufficiently long period of time that the chemical industry could adjust both its pattern of production and its pattern of plant locations. The model thus traces out the *long-run* effect of such cost differences.

Impact Mechanisms Covered in the Model Simulations

To understand what goes on it is useful to trace the steps in two stages:

Stage 1

Firms in the basic chemical industry will face an increase in their operating costs and so they will be forced to raise the price of their products, both in their domestic market and in all the foreign markets in which they trade (the functional form used for demand means that when firms set prices to maximise profits they use a simple price-cost mark-up rule). This increase in price means they will lose some market share to their competitors in each of their markets. The extent to which this happens depends on:

- the original increase in costs and hence price;

- the extent to which rival firms in any particular market are also forced to raise their price because of increase in their costs;

- the degree to which the different varieties produced by each firm are substitutes for each other (this will determine the elasticity of demand for the product of each firm).

In the simulations presented here we have assumed that the chemical industry is fairly competitive and therefore the products of different producers are close substitutes for each other.

Stage 2

The effects outlined in stage 1 will affect the operating profits of producers in different countries, lowering the operating profits of producers who face relatively high increases in costs and hence relatively large reductions in market share. This now affects the location decisions of producers, essentially inducing fewer firms to locate in countries which have relatively lower operating profits. (It is important to be clear that the model is a comparative static one, so it does not actually trace through the dynamic process by which existing firms might leave a sector in a particular country). These location decisions in the basic chemical sector have complex spillover effects into the location decisions in the other chemicals sector through the inter-sectoral linkages spelt out above, and these in turn have further feed back effects on the location decisions in basic chemicals.

One final point should be noted. The rest of the world sector is rather large (it has about 75% of the initial market share in basic chemicals). Because the data for this sector is rather poor, the output and number of firms in this sector were held constant in the simulations.

2.1.1 *Definition of the Chemicals Industry*

The simulations presented in this paper are for basic chemicals (NACE code 251 & 255). The findings for other chemicals [1] are similar to those presented here for basic chemicals.

2.2 *POLICY SCENARIOS AND ASSUMPTIONS*

2.2.1 *Definition of Country Groups*

Since we wanted to study the impact of environmental liabilities on international competition both within the EC (which was the 12-country EC of 1985) and between the EC and the rest of the world we used the following classification of countries:

- Germany;
- France;
- Italy;
- UK and Ireland;
- EC South, (Spain, Portugal and Greece);
- EC North (Benelux, Denmark);
- US & Canada;
- Japan;
- Australia and New Zealand; and
- Rest of the World.

[1] Other chemicals includes: Chemical products, used principally in industry and agriculture, essential oils and perfumes, soaps, synthetic detergents, perfumes and toilet preparations (NACE codes 256, 258, 259); pharmaceuticals (NACE code 257); rubber products and repairing of tyres (NACE code 481 & 482); processing of plastics (NACE code 483).

2.2.2 *Scenario of Future Liability Systems*

The simulations are based on the following five different levels of stringency of environmental liability systems in the following five groups of countries:

- *Group I* comprises U.S. and Canada, for whom it is assumed that the environmental liability systems are as strict as Superfund but cover all environmental damage;

- *Group II* comprises Italy and EC North. This corresponds to the countries who have signed up to the Lugano Convention;

- *Group III* comprises Germany, France, U.K. and Ireland, Japan, Australia and New Zealand. These are the countries who are adopting their own national policies, at a moderate level of impact;

- *Group IV* comprises EC South. These countries have fairly limited environmental liability systems that are below the level of stringency currently undertaken by the group III countries;

- *Group V* comprises the rest of the World. These countries are assumed to do nothing about environmental liabilities, and so incur no additional costs over the baseline.

The above scenario is largely based on countries' existing environmental liability systems. However, it also includes in the second group countries who have said they will sign up to the Lugano Convention. Hence it is designed to reflect likely environmental liability systems in the near future **in the absence of EU wide action**. It aims to pick up the effect of some European countries implementing the Lugano Convention while others do not; since the research for the country studies suggests that this might lead to greater potential distortion of the competitiveness of industries in these respective countries than would arise under the existing environmental liability systems currently in place in European countries.

2.2.3 *Assumptions on Costs of Environmental Liability Systems for Chemicals Industry*

Model simulations have been carried out for the following three main scenarios:

- *Case H* is a scenario of the costs of environmental liability systems for the chemicals industry expressed as a % of the industry's value added. This assumes that the increased costs fall on both labour and capital.

- *Case K* is this same scenario of the costs of environmental liability systems for the chemicals industry but with the costs expressed as a % increase in capital costs for the chemicals industry. This employs the more extreme assumption that the increase in costs is borne solely by increased costs of capital equipment. *Table 2.2.3a* shows these estimates of the % increase in the costs of capital equipment assumed in Case K alongside the costs expressed as % of value added in Case H.

- *Case L* is a scenario of slightly lower estimates for the costs of environmental liability systems for the chemicals industry, expressed as a % of the industry's value added.

Case H and K are based on an initial analysis of possible costs of future liability systems, derived from the US Superfund experience.

Case L represents lower cost estimates that were derived after discussions with the EC and further analysis of the available data. This is similar to the earlier run, except that the costs (as % of value added) for the US and Canada for case L are lower (2% rather than 2.4%). We have based our analysis on the estimates of the costs for the chemicals industry of Superfund [(1)]. These costs were then extrapolated to estimate the costs for the chemicals industry of a strict liability system covering all environmental damage costs. *Annex A* details the assumptions behind the estimation of the cost estimates used in case L. All these cases H, K and L are reported here to give as much analysis as possible of the available simulations.

We have assumed that countries in group I face twice the increase in costs of those in group II, those in group II face twice the increase in costs of countries in group III, and countries in group III face twice the increase in costs of those in group IV, and countries in group V face no costs of environmental liability systems.

These assumptions are designed to simulate the effects of possible differences in costs for various countries. Discussions with the chemicals industry indicated that these cost levels are a useful basis for our analysis.

[(1)] Probst et al (1995) Footing the Bill for Superfund Clean up: Who pays and how? The Brookings Institute and Resources for the Future

Table 2.2.3a *Assumptions for % Increase in Costs Due to Environmental Liability Systems*

Country/Bloc	Case H: % Increase in Costs of Value Added	Case K: % Increase in Costs of Capital
Germany	0.6	3.0
France	0.6	3.0
Italy	1.2	6.0
EC South	0.3	1.5
EC North	1.2	6.0
UK and Ireland	0.6	3.0
US and Canada	2.4	12.0
Japan	0.6	3.0
Australia and NZ	0.6	3.0
Rest of the World	0.0	0.0

2.2.4 *Sensitivity Analyses*

Table 2.2.4a outlines the assumptions used in the simulations for the costs of environmental liability systems in the various countries identified above.

We have carried out sensitivity analyses for the high and low cases H and L above with the following different assumptions for the levels of costs of environmental liability systems in the various countries:

- The policy cases H and L, which are represented as case H1 and L1.
- Cases H2 and L2 is a case of differential European policies' simulation. This is the same as case H1 and L1 respectively, but with the market shares of all non-EU countries kept constant (as in the baseline data in the model).
- Cases H3 and L3 is a run with the costs for EC North under Lugano increased so that they are the same as under the stricter Superfund scenario, as for Group I countries. However, we have not increased the costs for Italy on the grounds that the convention would not be enforced to this extent in Italy.
- Cases H4 and I4 is the same as cases H3 and I3 respectively, but with the market shares of all non-EU countries kept constant (as in the baseline data in the model). These cases (and cases H2 and I2) are designed to simulate the effects on intra-EU trade and competitiveness of differences between European countries' costs of environmental liability systems.

Thus in total eight simulations have been analysed for the two main cases H and L. These are summarised in *Table 2.2.4a*.

Table 2.2.4a ***Summary of Assumptions for Costs of Liability Systems for Chemicals Industry (as % of value added) in Simulation Cases Analysed***

	CASE							
Country	H1	H2	H3	H4	L1	L2	L3	L4
Germany	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
France	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Italy	1.2	1.2	1.2	1.2	1	1	1	1
EC South	0.3	0.3	0.3	0.3	0.25	0.25	0.25	0.25
EC North	1.2	1.2	2.4	2.4	1	1	2	2
UK & Ireland	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
US & Canada	2.4	c(1)	2.4	c	2	c	2	c
Japan	0.6	c	0.6	c	0.5	c	0.5	c
Australia and New Zealand	0.6	c	0.6	c	0.5	c	0.5	c
Rest of the world	0	0	0	0	0	0	0	0

(1) C = constant market shares as in baseline of model.

3.1 FINDINGS OF THE SIMULATIONS

The results of the simulations for Case H1 and Case K are shown in *Tables 3.1a and 3.1b* respectively in terms of the % change in market share and number of plants arising from the implementation of environmental liability systems for the basic chemicals sector. These tables represent *relative* losses of market share. Thus, in case H1, EC South's market share rises from 2% to 2.08% of world trade - an absolute rise of 0.08 percentage points but a relative rise of 4%.

In both tables we show the market share and number of plants of each country before the imposition of environmental liabilities, after the imposition of environmental liabilities and the % difference between the two. Note that the number of plants is treated as a real number not an integer, although in the base case scenario the model was calibrated to data where the number of plants were integers. This means that the change in the number of plants needs to be interpreted carefully as reflecting changes in cost pressures on decisions on plant locations rather than in changes in numbers of plants as such. For the results presented here the only significant effect would be the loss of a plant in the US in Case H1.

Table 3.1a ***Impact of Environmental Liabilities - Case H1.***

Country	Market Share (%)			Number of Plants		
	Before	After	% Change	Before	After	% Change
Germany	2.9	3.00	3.6	18	18.40	2.0
France	1.3	1.21	-7.0	9	8.55	-5.0
Italy	1.8	1.80	0.0	12	12.00	0.0
EC South	2.0	2.08	4.0	13	13.39	3.0
EC North	2.0	2.00	0.0	12	12.00	0.0
UK & I.	5.4	5.40	0.0	34	34.00	0.0
US & C.	2.0	1.82	-9.0	12	10.80	-10.00
Japan	4.0	4.10	2.6	24	24.48	2.0
A. & N.Z.	1.0	1.03	3.0	7	7.10	1.4

Table 3.1b *Impact of Environmental Liabilities - Case K*

Country	Market Share (%)			Number of Plants		
	Before	After	% Change	Before	After	% Change
Germany	2.9	2.94	1.5	18	18.02	0.1
France	1.3	1.30	0.0	9	9.00	0.0
Italy	1.8	1.80	0.0	12	12.00	0.0
EC South	2.0	2.00	0.0	13	13.00	0.0
EC North	2.0	2.00	0.0	12	12.00	0.0
UK & I.	5.4	5.30	-1.9	34	33.97	-0.1
US & C.	2.0	1.96	-2.0	12	11.88	-1.0
Japan	4.0	4.00	0.0	24	24.00	0.0
A. & N.Z.	1.0	1.00	0.0	7	7.00	0.0

Direction of Impacts

The direction of the changes is broadly what one would expect: eg for Case H1, the US and Canada have the biggest increase in costs and have the biggest loss in market share, principally to Japan and Germany. Within the EC, EC South has the smallest increase in costs and so gains market share.

While these changes in market shares can be readily understood in terms of changes in costs, it is important to remember that what also matters are the trade linkages between countries, and this can explain other changes in market share. Thus the fact that France's market share falls while Germany's market share rises, despite the two countries having the same cost increases, is due to changes in market shares elsewhere. The loss of market share in the US and Canada has adverse effects on France's market share, reflecting French inputs to US production; on the other hand Germany gains, reflecting the fact that they are in direct competition with the US and France, so their loss is Germany's gain.

It is worth noting that the results are strikingly different from an earlier set of simulations where Japan, Australia and New Zealand had a lower increase in costs (equal to EC South); those simulations produced a much more dramatic set of changes, with the US and Canada losing 40% of their market share, with bigger increases for both the non-EC OECD countries and Germany, with the latter effect having further impacts on market shares within the EC. The contrast between those results and the ones presented here suggests that the US chemical industry is particularly vulnerable to competition from the Pacific Rim countries.

Size of Impacts

The size of the changes in market share may appear rather large given the relatively low increases in costs; eg in case H1 the increase in U.S. value added costs are only 1.2- 2.1% higher than its European or Pacific Rim competitors, yet it loses nearly 10% of its market share. There are a number of reasons for this.

- The chemical industry is very competitive, ie there are large numbers of producers and products of different producers are close substitutes for each other. This means that demand elasticities are high; small differences in costs and hence price can have large effects on outputs.

- There are some small number effects - ie if a country has a small initial market share then a small absolute change in market share may give a large relative change (this would apply to France).

- We are modelling long-run changes in the industry, so we allow for firms to relocate. Obviously these effects would only arise over a long period (say 10- 15 years), and only then if the differential in costs was maintained.

- The model is partial, in that it assumes there is no response to factor prices (eg wages) as firms relocate and hence employment falls. In the long-run this is unrealistic. The effect of the partial analysis is to make small cost changes have a larger effect than would be true in practice.

Comparing cases H and K it can be seen that increases in costs of value added (case H) have a bigger effect on market shares than increases in costs of capital (case K). The reason is straightforward. If the costs falls only on capital (case K), that will affect profitability and location decisions; but it will not affect operating costs, and so will not affect output decisions directly. On the other hand increases in value added costs (case H) will increase both capital costs and operating costs; the latter acts like a tax on output - reducing output which will in turn also affect profitability and choice of location. Thus an increase in costs of capital affect output only indirectly through location and plant decisions, while an increase in value added costs affects output both directly and indirectly.

Are the changes in market share of the magnitude shown by the simulations likely? *Table 3.1c* presents data on trends in shares of world output for chemicals. This includes all chemical products, including not only basic chemicals but also other chemicals, manmade fibres and photographic materials. Hence the absolute numbers are not directly comparable with the figures for basic chemicals presented in *Tables 3.1a and 3.1b*. Nevertheless the percentage changes in market shares in the last column can be compared with the percentage changes in market shares in the simulations in *Tables 3.1a and 3.1b*. This shows that the model simulations for the changes in the market shares due to the costs of environmental liability systems are of a smaller magnitude than the overall changes that actually occurred (due to all economic factors) during the period 1979 - 1994. Nevertheless, the model simulates quite large changes. It should be noted that cost differences of the size modelled here would have to persist for a long period (ie over 10 years) in order for the simulated market share changes to occur.

This latter point is of some importance, since it is also clear from *Table 3.1c* that, with the exception of Japan, the changes in market shares for the different country blocs have been quite large and going in different directions over shorter five-year periods. For example, within the overall loss of market share for the USA of -0.7% (absolute) over the period 79-94 there was an increase in market share of 2.5% between 1979-84, followed by a loss of 2.8% over the period 1984-89, and a final further loss of 0.4% over the period 1989-94. Clearly there have been many factors affecting actual market shares, some positive some negative, so the long-term trend in actual market shares is likely to be rather damped. The nature of the exercise carried out in the simulations, where only one factor is assumed to affect costs over a long period of time, is thus likely to produce the appearance of exaggerated effects in comparison with historical data.

Discussions with the chemicals industry emphasised the importance of future competition from the Far East. In the model simulations, the market share of the rest of the world has been kept constant. But the implementation of environmental liability systems in European and other OECD countries could be expected to lead to some increase in the market share of the rest of the world. Hence the simulations may understate this aspect of the impacts on the competitiveness of the chemicals industry in Europe and other OECD countries.

The simulations indicate greater impacts of environmental policies on competitiveness and market shares than do other time series and cross country regression studies which show either small or statistically insignificant effects - see the review in Jaffe et al (1995) [(1)]. This may be partly because of the difficulties of providing consistent data on the costs of environmental policies for the regression analyses and also separating out the effect of other changes over the time period in question. Nevertheless, the review by Jaffe et al highlights that differences in the stringency and costs of the environmental policies may in fact have little influence on industries' decisions on investments in new plant. In the interviews for the country studies, the multinational companies said that they would base these decisions on the latest environmental standards - one company stated that this would be based on standards that are roughly mid-way between the latest standards in the US and Europe.

[(1)] Jaffe A B, Peterson, S R Portney P R, Stavins R N, (1995) **Environmental Regulations and the Competitiveness of US Manufacturing: What does the evidence tell us?** Journal of Economic Literature, Vol 33, March 1995 pp 132 - 163.

Table 3.1c ***Trends in Countries' Market Shares in Chemicals [1] (in %)***

Country	Market Share (%) 74	79	84	89	94	Change 79-94 Absolute change in % points	Relative change in % points
UK	3.0%	3.1%	2.3%	2.5%	2.5%	-0.6%	-20.4%
Western Europe (excl UK)	18.4%	17.6%	14.5%	16.1%	15.5%	-2.1%	-11.8%
USA	16.5%	16.1%	18.6%	15.8%	15.4%	-0.7%	-4.4%
Japan	7.1%	7.3%	7.7%	9.1%	10.5%	+3.2%	44.3%
Rest of the World	55.0%	55.9%	56.9%	56.3%	56.1%	+0.2%	0.4%

Source: ICI

3.2 *LIMITATIONS OF THE MODEL SIMULATIONS*

It is important to emphasise that the results of the modelling exercise carried out above should be treated with caution for the following reasons:

(i) The model is designed to focus on intersectoral linkages, and employs a sectoral disaggregation which is rather coarse.

(ii) It is likely to exaggerate the impact on the competitiveness of environmental liability policies for the reasons outlined above, particularly because it is being assumed that the cost differences in *Table 2.2.4a* are expected to be maintained over a sufficiently long period of time to influence plant location decisions. Moreover, the predicted changes in market shares for the US are relatively large compared with actual changes that have occurred over the last 15 years.

(iii) Discussion with economists in the chemicals industry suggested that the model simulations overstate the likely changes in the number of plants, which are relatively large compared with those that have actually occurred over the last 10 years. Moreover, Jaffe et al (1995) [2] review available studies and found little direct evidence of the stringency of environmental regulations having significant effects on plant location choices (see section *3.1 above)*. This implies that there are other factors and barriers affecting decisions on the relocation of plants which are not costed and reflected in

[1] This includes chemical products under the International Standard Industrial Classifications 351 and 351, which include basic chemicals, fertilisers, pesticides, synthetic resins, plastics, man-made fibres, paints and varnishes, pharmaceuticals, soaps, cleaning preparations and toiletries. In addition, the table includes photographic materials.

[2] Jaffe A B, Peterson, S R Portney P R, Stavins R N, (1995) **Environmental Regulations and the Competitiveness of US Manufacturing: What does the evidence tell us?** Journal of Economic Literature, Vol 33, March 1995 pp 132 - 163.

the model so that the model will overstate the impacts on the location of plants and market shares.

(iv) The model simulations do not allow for the effects of increasing competition from the rest of world - most notably the Far East - about which the chemicals industry is most concerned. Hence the simulations may understate the extent to which environmental liability systems in Europe and other OECD countries could impair the competitiveness of the chemicals industry in these countries compared to the newly industrialising countries in the Far East.

(v) The model is calibrated on 1985 data which to some extent will already take into account the costs for cleaning up contaminated land under CERCLA which was enacted in 1980. Therefore the additional costs for the USA under our liability policies scenarios may overstate the impacts on the market share of the US chemical industry. Consequently we have carried out sensitivity analyses focusing on differences between EU countries and which keep constant the market shares of non EU countries (see *Section 3.3 below*).

3.3 *FINDINGS OF THE SENSITIVITY ANALYSES*

This section reports the results of the additional simulations, which were described in *Section 2.2.4* and summarised in *Table 2.2.4a*.

Table 3.3a presents the percentage changes in market shares for the eight cases identified in *Table 2.2.4a*. Obviously the results for H1 are the same as was presented in *Table 3.1a*, but are reproduced here for ease of comparison.

Cases L1-L4, where the costs are about 10% lower than the costs in case H1-H4, simply scales down the effect of the cost increases on market shares; the change is not proportional, as would be expected - in models with scale economies, changes in market share are likely to be proportionately larger than the increase in costs.

The effect of holding constant the market shares of non-EU countries is quite striking (L2 and H2). The negative impact on France's market share disappears, indicating that the trade links with the US are important; and that in turn scales down the gains to Germany. This shows that to some extent the market share changes for EU countries in previous simulations may be driven by the trade links with non-EU members; the small difference in costs between EU members in L2 and H2 have little impact on market shares. Note that the results presented show some gains in market shares, but no losses. This is just because the changes in market shares are not significant at one decimal point.

The effect of raising the costs of EC North in line with those for US and Canada also has a striking effect (L3 and H3); relative to the base case, not surprisingly EC North now loses market share; but they are losing it mainly to the US and Japan, since the US loss of market share in the base cases is almost eliminated in case L3 and they have a slight gain in case H3; again this has important implications for France, which, as in the previous case, no longer loses market share, and there are consequent implications for Germany.

Finally, the increase in costs for EC North but with constant market shares for non-EU countries (cases L4 and H4) yields essentially negligible effects on market shares for EU members.

Table 3.3a *% Change in Market Shares for Scenarios H1-H4, L1-L4*

Country	CASE							
	H1	H2	H3	H4	L1	L2	L3	L4
Germany	3.6	1.3	0.0	0.0	2.0	0.7	0.0	0.0
France	-7.0	0.0	0.0	0.0	-4.0	0.0	0.0	0.0
Italy	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.6
EC South	4.0	5.0	0.0	0.0	2.0	0.9	0.0	0.0
EC North	0.0	0.0	-5.0	0.0	0.0	0.0	-3.0	0.0
UK & I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US & C	-9.0	c(1)	-0.5	c	-5.0	c	-0.4	c
Japan	2.6	c	3.0	c	2.9	c	1.5	c
A & NZ	3.0	c	0.0	c	0.4	c	0.0	c

(1) C = Constant market shares as in baseline model

Further Limitations of the Model Simulations and Sensitivity Analyses

It is possible that the model findings above *understate* the impacts on competitiveness of differences in costs of liability systems between European Countries since they are based on 1985 trade and cost data which do not allow for the recent freer movement of goods and capital within the EU, especially since the single market. Thus intra-EC trade in chemicals increased by about 47% between 1985-1992; while extra-EC exports and imports increased by 15% and 48% respectively. If the model was calibrated to current data, then it would show larger impacts for the scenarios focusing on differences between EU countries.

Another reason is that the simulations focusing on European differences (cases H2 and H4 and L2 and L4) reduce the number of countries whose market shares can change and this reduces the extent to which increases in costs can affect the market shares of remaining countries since there are fewer countries to expand output if one country incurs extra costs and contracts its output.

It may appear strange that a doubling of the cost increase for EC North countries has so little impacts in the simulation looking only at EU countries (cases H4 and L4); while it has a significant effect when the non-EU OECD countries are included. This is due to the two reservations noted above.

3.4 CONCLUSIONS ON MODEL SIMULATIONS

On balance the model probably overstates the impacts. The reason is that the kind of arguments about forward and backward linkages which are emphasised in the model apply to more than just the sectors of the chemical industry, but more widely to other sectors of the economy as well, including financial markets, the availability of pools of skilled labour likely to be found in other high technology industries. While there are obviously exceptions such as South-East Asian Tiger countries, in general countries in the rest of the world are unlikely to have the kind of industrial and financial structures which would make location of chemical plants in those countries as attractive as in other OECD countries, other things being equal. Therefore the barriers to the movement of plants to rest of the world countries are likely to be rather greater than is the case of movements of a plant from one EU country to another or to other OECD countries.

In view of the limitations of the model, attention should not be focused on the numerical findings of the model simulations but rather on the following insights they give. The basic message still appears valid - that in an industry which is very competitive, and where the products of the industries in the various countries are close substitutes for each other, then relatively small differences in costs can have significant effects on loss of market share.

4 *IMPACTS ON COMPETITIVENESS OF OTHER INDUSTRIES*

4.1 *ASSUMPTIONS ON COSTS OF ENVIRONMENTAL LIABILITY SYSTEMS FOR OTHER INDUSTRIES*

Table 4.1a presents approximate estimates for the costs of liability systems for other industries which have been derived on the basis of various assumptions as to whether the costs for these industries would be relatively less or more than those for chemicals (expressed as a % of value added). This is designed to input into the qualitative analysis and commentary in this *Section 4* on the impacts of liability systems on the competitiveness of these industries. *Annex A* outlines the assumptions behind these relative costings.

4.2 *LEATHER TANNING*

The assumptions on the increase in costs in the Leather Tanning industry from environmental liabilities were set out in *Table 4.1a* which shows that the cost increases are calculated to be twice those used in the simulations for the chemical industry. However there are a number of important features of the tanning industry which make it very different from the chemical industry.

There are no significant economies of scale in tanning - there are over 3000 tanneries in the EC. This implies that plants tend to be located close to final users eg footwear, clothing, furniture. This is reinforced by a very strong national and regional concentration of tanneries - Italy accounts for 60% of EC output and 90% of Italian sole leather comes from just five centres.

There has been a long-term decline in the consumption and production of leather in the EC. From 1985 to 1993 consumption has fallen from 7051m ecu to 6150m ecu, while production has fallen from 7341m ecu to 6500m ecu. This probably reflects a loss of competitiveness in the shoe industry to developing countries and eastern Europe (India and Pakistan account for 30% of extra-EC imports of finished leather). Despite this, trade in leather has remained steady, with extra-EC exports, at 1100m ecu in 1993 virtually unchanged from the figure of 1087m ecu in 1985, and the trade balance rising from 300m ecu in 1985 to 350m ecu in 1993. Intra-EC trade has also stayed virtually constant - 1253m ecu in 1985, 1200m ecu in 1993 [1].

[1] All the data presented are in current prices.

Table 4.1a Assumptions for Costs Due to Environmental Liability Systems (for base policy case L1) as % of value added for various industries

		Industries						
Scenario	Country/Bloc	Chemicals	Leather	Pulp & paper	Mining	Wood Products	Petroleum	Electronics
C	US and Canada	2	4	2	3	2.5	1.5	.5
B (Lugano)	EC North	1	2	1	1.5	1.25	0.75	0.25
B (Lugano)	Italy	1	2	1	1.5	1.25	0.75	0.25
A (Existing policies)	France	.5	1	.5	0.75	0.6	0.4	0.1
	Germany	.5	1	.5	0.75	0.6	0.4	0.1
	UK and Ireland	.5	1	.5	0.75	0.6	0.4	0.1
	Japan	.5	1	.5	0.75	0.6	0.4	0.1
	Australia and NZ	.5	1	.5	0.75	0.6	0.4	0.1
A* (Weak existing policies)	EC South	0.25	.5	.25	.4	0.3	0.2	0.06
	Rest of the World	0	0	0	0	0	0	0

A number of points emerge from these figures. The leather industry has a relatively low trade intensity (exports are only about 15% of production and imports are 12% of consumption) compared to the chemical industry. This is because of the low degree of scale economies and the close linkage with the final users of leather. While there clearly has been some loss of market share by final users this has not been matched by a comparable loss of export markets for leather. This is probably because, while the EC has lost final output, and hence leather production, in the bulk market, there has been a growth of demand for the higher quality leather produced by EC, particularly tied to the EC's leading role in fashion design.

What all this suggests is that the EC leather tanning industry faces low elasticity of demand for its product. The EC is estimated to suffer a cost disadvantage for finished leather of about 20% relative to Argentina or India, (due mainly to differences in costs of hides - environmental costs account for only about 2-4% of cost differences), yet as noted the EC has maintained a fairly constant level of exports. What will be relevant will be not the increase in the cost of leather itself, but any resulting increase in the cost of production of bulk leather goods like shoes, and hence any further loss of EC market share in the markets which incorporate finished leather. To the extent that the EC has already lost much of that market to foreign competition, then the EC may be able to maintain its remaining market share due to the higher quality of its product, and in particular the links to other sectors, such as high fashion goods.

In summary, the tanning industry might face larger cost increases than the chemical industry, and hence larger cost differentials, which might have greater impacts on the international competitiveness of the European leather tanning industry. However, the market for leather products is not as internationally competitive as that for chemicals so that the impacts of environmental liability systems on the international competitiveness of the European leather tanning industry might be less than that for chemicals.

4.3 *PULP, PAPER AND BOARD*

From *Table 4.1a* it can be seen that the cost increases for this sector from environmental liabilities are of the same order of magnitude as for the chemical industry. However, for a number of reasons we believe that the impact of environmental liabilities on EC industry is likely to be less than for the chemical industry. To understand this it is useful to consider a number of salient features of the industry.

In the period 1983-92, extra-EC exports of paper, pulp and board have grown faster than extra-EC imports (8.8% p.a. compared to 5.5% p.a.), although in the last five years the two rates of growth have been more or less equal (6.0% and 5.7% respectively). Despite this the EC's trade balance has got steadily worse in absolute terms. In 1992 extra-EC imports were 14.5 m ecu (about 30% of EC consumption) while extra-EC exports were only 2.7 m ecu, less than 10% of EC production. While EC exports are widely spread through the world (60.6% went to Rest of the World in 1992), EC imports are much more concentrated - 55% from Sweden and Finland, 21% from US and Canada.

It is fairly clear why the EC is at a competitive disadvantage in this industry. First, there is the obvious comparative advantage of countries like Sweden, Finland and Canada of having abundant land for growing timber, the main input to the pulping process, and given costs of transporting timber, it clearly makes sense to locate pulp mills close to this important input. Second, but closely related, the EC's major sources of imports have been able to develop economies of scale in the production of pulp, paper and board; mills in US and EFTA countries are bigger than EC mills; 75% of EC mills are non-integrated and have a capacity less than 50,000 tonnes; 60% of EFTA mills are integrated, with a capacity greater than 50,000 tonnes. The EC has been following a restructuring strategy, partly of building bigger mills, but partly also moving out of the bulk market for pulp paper and board into more specialised products, such as carbonless paper, thermal paper and watermarked paper.

From this account of the industry there are two reasons why the cost increases envisaged for the pulp paper and board industry is likely to have much less impact on this industry than on chemicals. First, the EC is not a major exporter and so is unlikely to lose much in foreign markets; on the other hand the EC's major competitors in the home market (US and Canada, Sweden and Finland, are likely to be faced with at least as great an increase in costs as the EC (we assume that EFTA are likely to face cost increases comparable to EC North). By contrast, in the case of chemicals we argued that much of the competition for the EC is likely to come from countries in the Pacific Rim. Second, it is likely that the restructuring strategy of the pulp paper and board industry will give it some protection from increased costs - they will be offset to some extent by the move to increase scale economies and the move to niche markets will provide lower elasticities of demand for EC products.

4.4 *SEMI-FINISHED WOOD PRODUCTS*

This sector is very similar to the paper, pulp and board sector just discussed. The scale of cost increases is similar to that for the chemical industry and only slightly higher than for pulp paper and board industry. The EC has been running a steady trade deficit, despite extra-EC exports growing slightly faster than extra-EC imports over the period 1983-92 (3.0% and 2.7% respectively). In 1992 extra-EC imports were 2.1m ecu, about 20% of EC consumption, while extra-EC exports were only 0.5m ecu, just above 5% of EC production. Again our major sources of imports were EFTA (34.4%) and US (18.8%), although it is also importing significant amounts from Rest of the World (34%), especially plywood from South-East Asia; our exports were also fairly concentrated (EFTA 54%), suggesting considerable intra-industry trade. Economies of scale are again important in production, although the degree of intra-industry trade with EFTA suggests that the EC is at less of a competitive disadvantage here than in the pulp paper and board sector. Again EC specialises in certain areas, like the production of oriented strand board (OSB) which is a new product, or particleboard and medium density fibreboard (MDF), while facing substantial foreign competition in standard bulk products like plyboard.

For the reasons given in the previous section, we believe that this sector is unlikely to be seriously disadvantaged by the imposition of environmental regulation- our major competitors are likely to be facing similar or larger cost increases (although is somewhat less true in this sector because of competition from SE Asia), and the production of specialised products again reduces the elasticity of demand for EC products.

4.5 *PHARMACEUTICALS*

The increases in the costs of the pharmaceuticals industry as a result of environmental liabilities are likely to be similar or lower than those for the chemical industry as a whole. There are a number of reasons why the industry is likely to be less affected in terms of international competitiveness than the chemical industry more generally. We first set out some salient characteristics of the industry, before drawing conclusions for competitiveness.

Note first that the industry is relatively concentrated - the ten largest companies account for 22% of the market. One reason for this is the very high level of R&D expenditure required in the pharmaceutical industry - 11% of turnover is for R&D, which is about the highest R&D/turnover ratio in industry. Since there are significant economies of scale, and more importantly scope, in R&D this explains the relatively high degree of concentration. This has the important implication that there are significant barriers to entry in the pharmaceutical industry, provided by this heavy investment in R&D and the protection provided by patents on new drugs.

The EC remains the world's most significant producer of pharmaceuticals (one third higher than USA and double Japan); moreover the EC is maintaining this advantage over the USA and Japan - since 1987 the EC has expanded production by 44%, the US and Japan by 8% and 17% respectively. The EC also remains a healthy net exporter of pharmaceuticals - in 1992 the EC production of 68.6b ecu of pharmaceuticals was consumed yielding a trade surplus of 4.9b ecu; extra EC exports were 10.6b ecu, and intra-EC trade 9.9b ecu (current prices). However, it should be noted that over the period 1983-92 extra EC imports grew at 5.4% p.a. while extra EC exports grew at only 2.6% p.a. so while the trade balance grew in absolute terms, it contracted slightly in relative terms. On the other hand intra-EC trade has tripled over the period 1983-92. Exports are widely dispersed, with more than half exports going to developing countries, while imports are highly concentrated - the USA and EFTA countries account for 85% of imports.

As can be seen from the above figures, the industry is not as trade intensive as the chemical industry - extra-EC exports account for only about 15% of EC production with intra EC trade of a similar scale. This is explained by the regulated nature of the pharmaceutical industry; both for prescription medicines and for 'over the counter' (OTC) medicines, individual countries have national regulations and consumer preferences which have tended to favour locally produced drugs. Attempts by national governments to cut the cost of drugs, for example by using generic rather than specific prescriptions, may alter this picture and expose national drug companies to greater foreign competition.

We can now summarise what this implies for the impact of environmental liabilities on international competitiveness. There are four reasons why we believe that the impact of the cost differences shown in *Table 4.1a* will have a smaller impact in pharamaceuticals than in chemicals more generally.

(i) The high degree of R&D intensity provides a barrier to entry which provides some protection to companies faced with cost increases imposed by environmental liabilities.

(ii) This is particularly important when it is recognised that the high R&D intensity means that our major competitors are other advanced nations, such as the USA and Japan, and the former will have even higher cost increases then the EC while the latter may have a similar cost increase to many of the EC countries. Competition from developing countries is much less relevant than in the chemical industry.

(iii) High R&D intensity also leads to a high degree of product differentiation, with specific drugs being protected through patents from competition from close substitutes. This is reflected in the significant extent of intra-industry trade, with nations trading the drugs for which they have been successful in R&D. What this implies is that there is a relatively low degree of substitution between individual pharmaceutical products, and hence a relatively low demand elasticity. Again this means that countries are less vulnerable to cost differentials.

(iv) Finally, the regulated nature of the industry, exacerbating preferences for locally produced drugs, reinforces a low elasticity of demand for individual pharmaceutical products and further reduces the vulnerability of international competitiveness to cost differences.

For all these reasons we believe that while the pharmaceutical industry will face similar increases in costs to the chemical industry, it will experience a smaller loss of international competitiveness.

4.6 *ELECTRONICS*

Table 4.1a shows that the cost increases predicted in electronics as a result of environmental liabilities are the smallest of all the industries studied, being only a quarter of those for chemicals. This reflects the "clean" nature of the industry. Obviously the impact on international competitiveness of environmental liabilities will be correspondingly lower than for the chemical industry. But in our view this is the only reason why the impact is likely to be smaller; in other respects the electronics industry has many of the characteristics of the chemical industry, as the following description of the industry suggests.

First the electronics industry is significantly open to international trade. In 1992 extra-EC exports amounted to about 20% of EC production, (32.2b ecu out of 171.2b ecu) while intra-EC imports amounted to about 30% of EC consumption (57.2b ecu out of 196.1 b ecu). Intra-EC trade accounted for a further 55b ecu.

The industry has experienced very rapid development, reflecting the impact of modern technology, with EC consumption and production growing at 6.5% and 6.2% p.a. over 1983-92; over the same period extra-EC exports and imports grew at 6.9% and 7.2% p.a.. The result of these different growth rates is that the trade deficit has tripled from 8b ecu to 25b ecu over this period. This has been accompanied by an erosion of 10% in the terms of trade between EC and non-EC countries; this is consistent with the net trade balance being quite sensitive to the terms of trade. Of particular concern has been the growth of imports from the NIC's, with the share of imports from the USA, Japan and EFTA decreasing (from 78.2% in 1987 to 67.3% in 1992).

The electronics industry is currently undertaking a high level of investment in new plants. Therefore environmental liability systems might affect where these new investments are located, especially for inward investment. During the interviews for the UK country, a multi-national foreign company said that they had decided to locate all their new plants in the UK, partly because of their greater confidence and certainty about the environmental policies (including environmental liability policies) in the UK. However, this was more to do with the greater confidence that the policies would be reasonably implemented rather than the stringency of the policies as such.

In short, the electronics industry, like the chemical industry, and especially basic chemicals, is a very competitive industry internationally, with a high degree of substitution between products and hence a high elasticity of demand for products. This makes international trade sensitive to cost differences. It is only because the cost differences induced by environmental liabilities are small that the competitive impacts are also likely to be small.

4.7 *MINING (HARD COAL)*

This section examines mining of hard coal. We assume that the cost increases induced by environmental liabilities for coal mining are the same as those for mining shown in *Table 4.1a* ie about two-thirds larger than those for the chemical industry.

It is difficult to be precise about the potential impact of these cost increases on the hard coal industry of the EC since many of the influences on the industry in recent years have come from political rather than economic considerations. It is likely that these considerations will continue.

From 1983 to 1992 EC consumption of hard coal remained relatively constant at between 300 and 320 m tonnes; but production has fallen steadily, from 260.3 m tonnes in 1980 to 183.4 p.a. in 1992. The balance between consumption and production has been met from rising imports, with the USA being the main supplier, providing over one third of EC imports, with South Africa and Australia providing another 20.8% and 15.6% respectively. Extra-EC exports have been trivial and declining (from 16.9m tonnes in 1980 to 5.7m tonnes in 1992). Intra-EC trade in coal has also been small and has fallen sharply, from 17.2 m tonnes in 1980 to 4.4 m tonnes in 1992.

The principal cause of these trends has been the uneconomic nature of EC production, mainly because only about 10% of EC coal comes from open-cast mines, compared to 50% in Australia, 60% in USA and 85% in Canada. On the other hand, economic pressures have not always had full sway. The European coal and steel community (ECSC) has allowed some forms of state aid to the coal mining industry; in addition 66% of coal production is used for thermal power stations, which are often state owned in the EC and, as in the UK until recently, there have been requirements on such power stations to use domestically produced coal. The phasing out of such direct and indirect support to domestic coal industries has had a major impact on domestic coal production, as seen most starkly in the UK. It is predicted that by 2000, EC production of hard coal will fall to 115 m tonnes, with imports accounting for 69% of consumption.

Against this background, the cost differences induced by environmental liabilities are unlikely to play a significant factor. EC domestic coal production is already uncompetitive in many areas and how fast it is replaced by foreign imports will depend on the political process of opening up the market, especially for power station coal, to foreign competition, and the construction of facilities for importing coal. Of course, given the high costs of transporting coal relative to pit head costs, there will be some inland power stations and other users who will continue to find it cheaper to buy from local mines rather than import. There may be some slight protection from the fact that the USA will face a greater increase in costs due to environmental liabilities than will EC member states, but this difference, of 2%, is unlikely to have any significant impact.

5 *CONCLUSIONS*

Existing liability systems in European countries are unlikely to have significant impacts on the competitiveness of European industries.

In the absence of a common approach to environmental liability systems across Europe, there might in the future be divergences between the environmental liability systems and their associated costs for different EU Member States. In industries such as chemicals which are very competitive and where the products of the industries in the various countries are close substitutes for each other, then relatively small differences in costs could lead to a more than proportional loss of market share. However, the differences in costs due to environmental liability systems would have to be perceived to persist for a sufficiently long time (ie more than 10 - 15 years) to influence plant location decisions.

Environmental liability systems might entail higher costs for other industries such as the leather tanning, lumber and mining industries, which may affect their international competitiveness. However, in comparison with the implications for the chemicals industry, the impacts of environmental liability systems on competitiveness of other industries are likely to be lower because: their markets are less subject to strong international competition (eg pharmaceuticals); or because the main competing countries are likely to be subject environmental liability systems that are as strict or stricter as those being considered in European countries (eg pulp and paper and lumber although the latter industry may face increasing competition from South East Asia); or because the costs of environmental liability systems are low as a proportion of value added (eg electronics).

However, the above analysis and conclusions assumes that the costs of the environmental liability system for a major polluting industry, such as chemicals, amount to a maximum of 2.4% of value added in the strictest environmental liability system. *If* certain European countries implemented more extensive and stricter environmental liability systems to internalise all environmental damage costs, then the resulting cost differences between countries would be higher and the impacts on the competitiveness of European industries would be larger.

Annex A

Assumptions behind Cost Estimates Used for Model Simulations

1 ASSUMPTIONS BEHIND COST ESTIMATES USED FOR MODEL SIMULATIONS

This annex details the assumptions behind the cost estimates for the model simulations presented for the various countries for the chemicals industry in *Table 2.2.4a* and for other industries in *Table 4.1a*.

1.1 CHEMICALS INDUSTRY

The estimates of the costs of the environmental liability systems for the chemicals industry are based on the following methodology:

- Available estimates in Probst [1] for the costs of Superfund for the chemicals industry in the USA.
- Extension of these data on clean up costs under Superfund to estimate the liability costs of all environmental damage for the chemicals industry.

Costs of Superfund for the Chemicals industry in the USA

The annual costs of Superfund for the chemicals industry comprise:

- Chemical industry's total responsible party costs for annual transaction and clean up costs for contaminated sites (Probst (1995), p 50) **$492m**
- Contributions to the trust fund to pay for EPA's costs for orphan sites through the chemical feedstock tax (Probst (1995), p 56) **$286m**
- Contributions to the trust fund through petroleum tax, corporate environmental income tax [2].
  $150m

Total annual costs of Superfund for the chemical industry in USA **$928m**
This represents about 0.7% of this industry's value added.

Extension to cover other environmental damage costs

The estimates of the costs of treating contaminated land have been extended to derive estimates of all environmental damage costs for the chemicals by applying an extension factor of the total environmental damage costs divided by the costs of treating contaminated land. The detailed data for the former West Germany (in *Table C1 of Annex* C of the main report) have been used to derive the following extension factors:

[1] Probst et al(1995) Footing the Bill for Superfund clean up: Who pays and how? The Brookings Institute and Resources for the Future.

[2] This is based on the figures in Probst (1995), Figure 4.2 (p 76) which indicate that the direct and indirect costs for the inorganic and organic chemicals, chemicals and allied chemicals industries of the petroleum and corporate environmental income tax represent more than half of the costs of the chemical feedstock tax.

- The estimates for total readily monetised and less readily monetised environmental damage costs divided by the costs of cleaning up contaminated sites plus the less readily monetised costs of contaminated soil. This yields an extension factor of about 6.

- However, there is considerable uncertainty over the damage costs estimates for the less readily monetised items. Dividing the more reliable estimates for the readily monetised environmental damage costs by the costs of cleaning up contaminated sites yields an extension factor of about 2.

In addition, according to US EPA data [1] on the distribution of the total direct compliance costs of pollution control, the costs associated with land represent about 27% of the total costs concerning all media (eg air, water etc) in the US. This yields an extension factor of 3.7.

This yields an extension factor of between 2-6, with an average of 4.

In addition, the following considerations have been taken into account:

- it may be difficult to assign liabilities for some of these other environmental damage costs - some of the air and water pollution damage costs are due to diffuse sources;

- the chemical industry's contribution to these other environmental damage costs may be proportionately less than its contribution to contaminated soil. The chemicals industry accounts for about 35% of the total responsible party costs for treating contaminated sites under Superfund, but about 22% of total pollution control expenditures. [2].

- The estimates of the costs for the chemicals industry under Superfund (given above) include not only the costs of cleaning up contaminated sites, but also the industry's transaction costs arising under this policy.

These considerations suggest that the extension factor should be at the lower end of the above range. Consequently we have used an extension factor of about 3, to indicate that the total environmental liability costs for the chemicals industry under a liability regime as strict as Superfund but covering all environmental damage costs would amount to about 2% of the industry's value added. This figure has been used for the essentially illustrative simulations of the impacts of these costs on the chemical industry's international competitiveness.

This basic sensitivity case therefore comprises:

[1] A Jaffee et al(1995), Environmental Regulation and the Competitiveness of US Manufacturing: What does the US evidence tell us, Journal of Economic Literature, March 1995.

[2] This is based on the estimates of industries' expenditures on pollution control for the UK given in OECD(1993) **Pollution Abatement and Control Expenditures in OECD countries**, OECD Environment Monographs NO 75, OECD Paris.

- A strict environmental liability scenario (taken as being as strict as Superfund) for Group I countries for which the costs for the chemicals industry would represent about 2% of value added.

- The costs for the Lugano Convention group II countries are assumed to be half the costs of for Group I.

- The costs of existing liability systems in Group III countries (UK, France, Germany, Japan, Australia and NZ) are assumed to be half the costs for Group II countries.

- The costs for Group IV countries with weaker existing liability systems (Southern European countries) are assumed to entail costs half of those for Group III countries.

- Rest of the world has no liability system entailing no costs.

1.2 *DERIVATION OF RELATIVE COST ESTIMATES FOR OTHER INDUSTRIES*

The estimates for the other industries are only intended to present approximate indications of the **relative** costs for these industries compared with chemicals, which are used to input into a qualitative assessment of whether the impacts on competitiveness are likely to be greater or less than those indicated by the model simulations for chemicals.

The relative factors have been derived on the basis of the estimates in Probst [(1)] for the costs of the clean up of contaminated sites under Superfund for the other industries compared with the costs for the chemicals industry - see *Table A.1*.

[(1)] Probst et al(1995) Footing the Bill for the Superfund clean up: Who pays and how? The Brookings institution and Resources for the future.

Table A.1 ***Relative Costs of Clean up of Contaminated Sites under SuperFund for Various Industries compared with Chemicals***

Industry	Costs of clean up as % of value added	Relative costs compared with chemicals	Amended Relative cost factor	Costs for all environmental liabilities as % of value added under scenario C
Chemicals	0.4% (1)	1	1	2%
Mining	0.7%	1.75	1.5	3%
Wood products (excl furniture mfr)	0.5%	1.25	1.25	2.5%
Petroleum	0.3%	0.75	0.75	1.5%
Electronics	0.1%	0.25	0.25	0.5%
Leather tanning		2	2	4%
Pulp and paper			1	2%

Source: Probst et al (1995)

OECD [2] estimates (for UK and Germany) that pollution control expenditures of the leather tanning industries are roughly double those of the chemicals industry **when presented as % of those industries' turnover.** Consequently we have assumed that the environmental liability costs for the leather tanning industry (when expressed as a % of value added) are about double those of the chemicals industry - ie 4% under the strict Environmental liability systems for Group I countries.

The above relative costings were discussed with an environmental insurance expert who considered that it was reasonable to assume that the leather tanning industry's environmental liabilities could be double those of the chemicals industry (when expressed as a % of value added) since the chemicals industry has been fairly well regulated in the past and has implemented considerable prevention measures while the leather industry has not been subject to such extensive environmental regulations in the past.

He suggested that the costs of all environmental liabilities for the pulp and paper industry would be roughly similar to those for the chemicals industry. He also considered that the figures from Probst gave reasonable relative factors for the other industries. He also suggested that the environmental liabilities of the pharmaceuticals industry are likely to be similar to or lower than those for the chemicals industry as a whole.

(1) *Table 2.2.b* presents the estimates for just the clean up of contaminated sites by responsible parties (ie it does not include contributions to the Trust Fund)

(2) OECD(1993) **Pollution Abatement and Control Expenditures in OECD Countries**, OECD Environment Monographs No 75, OECD, Paris.

However, the data for Superfund liabilities for mining may overestimate slightly the costs of all environmental liabilities for mining, since the mining industry's contribution to the costs of cleaning up contaminated sites is likely to be proportionately greater than its contribution for other types of environmental damage costs. Therefore we have reduced slightly the costs of all environmental liabilities for mining for a strict Environmental liability system for Group I countries to be 3% of value added.

The costs for these industries for the other groups of countries/scenarios have been derived in the same way as for chemicals to yield the cost estimates shown in *Table 4.1a*.

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

The Insurance Sector: Economic Implications of Covering Environmental Damage

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CONTENTS

1 INTRODUCTION

The insurance sector is extremely important in developing successful environmental liability legislation. It has three major potential roles. It guarantees financial cover for environmental damage costs. It spreads the risk of compensation payments through pooling so that individual industrial companies will not face excessive financial burdens from a liability claim. Furthermore, through offering a specialised service related to the environmental management of the policyholder, insurance companies could provide incentives to policyholders to adopt pollution prevention measures to reduce future damage.

1.1 OBJECTIVES

The objectives of this paper are to assess:

- the specific implications for the insurance industry of an environmental liability system (*Sections 2.1.3, 3.1, 3.2, 4.1 and 4.2*);
- how the insurance industry in the selected countries varies and is affected differently by an environmental liability system (*Section 4.1*);
- the problems encountered in issuing such insurance cover (*Sections 3.1 and 4.2*);
- how the problems can be overcome (*Sections 3.2 and 4.2*);
- the role that the insurance industry could play in instituting an effective environmental liability system (*Section 5.2*).

1.2 RESEARCH UNDERTAKEN

A two-pronged research programme was undertaken involving a literature survey and a series of interviews in selected European countries, covering insurance companies (see *Annex A*) and industrial firms.

The countries investigated are Germany, UK, Italy, Spain, and Hungary. In the Netherlands the insurance pool was also interviewed.

This section provides a framework to understand the situation currently faced by the insurance companies with development of the new environmental liability insurance market. The section first explains insurance companies' general economic considerations in providing cover for specified risk. It then discusses the specific environmental factors relating to environmental liability insurance contracts.

2.1 TRADITIONAL ROLE OF THE INSURANCE INDUSTRY

2.1.1 Financial Issues

Risk Spreading

The insurer provides a commercial service to private enterprises by pooling their individual risks. These risks would otherwise cause excessive financial hardship in the event of a pollution incident, if the incident had been borne by an individual firm. The insurer makes a profit from this service if total outlays, over time, are less then the total pooled premia (after allowing for investment income and administration costs). The provision of this service depends on:

- premia being high enough to build up capacity to cover potential compensation payments;
- sufficient numbers of policy holders taking up the cover to spread risks, so that compensation payments can be distributed from among pooled policy premia [1];and
- Insurers being able to predict compensation payments (amount and frequency) to calculate minimum reserve pool and balance cash flow. This requires case experience and clear valuation criteria. Without these future claims premia cannot be calculated (and will take on the characteristics of a bet).

Competition

The degree of competition in a market affects insurers' behaviour and ability to offer cover in the following ways:

- Those companies with significant exposures to an area of claims will suffer major drains on reserves and thus be competitively disadvantaged relative to those with little historic exposure in that area.

[1] Andre D Hellebuyck, Beware of Triggers! A Paper on Freedom of Contract in Liability Insurance, in New Liabilities & Challenges for Industry in Europe, 5th European Conference of Companies Lawyers, 1994.

- Tight markets put pressure on insurance companies to lower premia to attract customers.

- Reduced margins for profit and reserve building decreases the capacity of insurers to offer full cover, through reducing financial limits available.

These factors play an important role in the environmental liability insurance market. The first point has already happened in the US (see *Annex D*) with environmental liability exposure on old policies (see *Section 3.1*). The second point is occurring currently in Europe and is a complex issue affecting the development of the environmental liability insurance market (see *Section 3.2*). The third point could happen under certain scenarios (see *Section 4.2.3*).

2.1.2 *Implementation Issues*

Collectivity

Collectivity is the process of building up capacity to spread risk sufficiently. So whilst risk spreading is an internal financial strategy, collectivity involves the physical process of securing policyholders and premia. In order to maintain profits for the insurance industry the ability to find a sufficiently large number of candidate firms is necessary.

This process is particularly important and difficult when trying to develop and secure a new market. To build up a market insurers need to ascertain requirements of potential policy holders, through:

- information gathering using existing client base;
- proactive marketing.

These all incur high costs and add to future transaction costs to be recovered in future premia.

The time, financial expense and uncertainty of gaining a sufficiently large pool of policyholders makes insurers cautious about venturing into new markets. This holds true for environmental liability insurance markets, which is evidenced throughout the paper.

Expertise

Expertise is needed both when a policy is to be taken out and when a claim is made:

- to assess and value (environmental) risk and remediation possibilities;

- for verification of damage, and to establish causation and responsibility to determine the levels of compensation.

There are organisational costs associated with building up such expertise and carrying out site investigations for risk assessment. This can be developed either in-house or by sub-contracting. This expertise will significantly add to transaction costs. However, this cost decreases over time as expertise builds up.

Building up such expertise could lead to specialization in the market place as different risks are insured by different insurers. An alternative is to pool expertise among different insurers.

The requirement for technical expertise is very important for environmental liability insurance as environmental damage is not a traditional area of insurers' expertise (see *Sections 4.1.2 and 4.1.4*).

Moral Hazard and Self Selection

The insured know more about risks than insurers, especially in the new area of environmental damage with little claims history, there is a concern so that only high risk firms will seek insurance. This will push up premia and discourage low risk firms from seeking insurance. Once insured the firms may have less incentive to adopt pollution prevention measures knowing that they are financially covered in case of damage. However, the prevention incentive is still there to some degree as any damage caused will lead to an increased premium upon policy renewal.

Contract Components

Insurers have options in exactly what they offer to cover regarding:

- Types of damage - cause of damage, eg sudden & accidental vs gradual, normal operations vs unexpected;
- Financial limits - maximum predetermined payout for a claim;
- Size of excess - the amount per claim to be paid by the insured;
- Triggers - how and when a claim made is deemed valid.

These are explained in further detail in *Section 4.1*.

2.1.3 *Characteristics of Environmental Insurance Problems*

Incorporating environmental characteristics into insurance systems and policies is particularly difficult. The main problems are lack of claims experience and the physical characteristics of pollution problems leading to uncertainty in predicting future claims and debate over causality which in turn leads to litigation. These problems are expanded on below.

Claims Experience

The spread of claims over time will define premia. Premia are based on past claims history and predictions of the probability of future claims occurring and the scale of damage costs. In general, insurance requires a pattern of claims history, preferably high frequency and low magnitude.

There is minimal claims history for pollution events on which to base premia calculations. Also the events tend to be high magnitude and low frequency which make calculations and cover more difficult. Furthermore there is uncertainty over what value will be placed on environmental damage costs making scale of future claims difficult to estimate.

Litigation Matters

There is still lack of agreement on the definition of certain environmental concepts and terms such as point and timing of causality of environmental damage. These areas of controversy allow room for interpretation, which leads to litigation between potentially responsible parties trying to shift the financial burden off themselves.

Box 2.1a below is an example of a typical chain of events during a pollution incident. It highlights the root of the problems in defining:

- triggers;

- cause of damage:
  - sudden and accidental;
  - gradual;
  - unexpected;
  - in the course of normal operations;

- at what stage of the chain of events, shown in *Box 2.1a*, can or should a claim be made? Occurrence, first observation and claims made are different types of triggers. Each one would lead (and possibly arises on a different policy) to a claim at a different stage and point in time;

- what is the cause of the damage? Is it sudden and accidental because there is a rupture, or is it gradual because the substance slowly leaks into the soil and migrates over time into groundwater? Is it unexpected, because it is a rupture, or could it be argued to be part of normal operations because the cause of the rupture was corrosion of the tank which should have been checked by the polluter?

Box 2.1a *Chain of Events Leading to a Pollution Liability Claim* [(1)]

- a pre-condition setting the ground for the future problem eg corrosion of an underground storage tank
- the cause of the escape of a pollutant eg. the rupture of the tank
- the actual escape of the pollutant into the environment eg. the leakage of fuel oil
- the (often not perceived) presence of the pollutant in the environment eg. the presence of the fuel oil in the soil
- the changing situation of the pollution condition eg. the migration of the fuel via the groundwater to adjacent land
- the occurrence of a legally relevant loss eg. property damage to the adjacent land
- the manifestation of such loss eg. the damage associated with fuel contamination becoming noticeable
- a claim being made or a cleanup mandated by the government.

Time Lags

Time lags between an incident and the manifestation of damage will make it more difficult to predict projected rates for gradual pollution incidents and set appropriate premia.

Cumulative Risk

If a certain substance in widespread use were discovered in the future to have harmful consequences, then the whole industry using the substance would be affected. This would provoke an enormous number of claims. This could lead to financial difficulties, particularly for smaller insurers. This risk is one of the major reasons why insurers tend to limit their exposure for environmental liabilities.

Summary

The section shows what factors affect the successful functioning of insurance markets. These basic principles are used in the following analysis to gauge the insurers' reactions and practices to a changing environmental liability insurance market. It is evident that there are many difficulties associated with environmental liability insurance. The main problems faced by insurers in developing a market are:

- risk assessment:
  - need for technical expertise;

(1) Wilhelm Zeller, Cologne Reinsurance Company, Pollution Liability Exposure, How to get off the 'Sudden and Accidental' Timebomb?

- uncertainty of future claims;
- defining and selecting triggers;
- exposure to different types of cause of damage;
- high costs lead to high premia and tight margins which impede market growth.

2.2 *OTHER ACTORS*

Reinsurers

To cover themselves against financial loss, insurance companies reinsure their policies. This acts as a further mechanism for insurers to spread the risks. Reinsurers therefore become involved in covering environmental liability when they reinsure insurance policies covering environmental damage costs. Reinsurers have the option whether to accept covering such policies. Therefore, reinsurers will play an important part in influencing insurance practices because if the policies are viewed as entailing excessive liabilities the reinsurers will not reinsure.

Reinsurers have two procedures to assess and reinsure insurance policies. First they reinsure through a treaty mechanism. They will reinsure all of an insurers' policies in one package, conditional on them falling within certain defined parameters selected to limit risk. For individual policies falling beyond these criteria, individual risk assessment will be carried out to determine the conditions of reinsurance for them, if at all. The latter process is termed *facultative* reinsurance.

In *Germany*, reinsurers play a particularly important role in environmental liability insurance. The reinsurance market takes most of the risk with only a limited amount of risk being retained by the direct insurers, especially with regard to the insurance of the larger industrial companies. Due to the shrinkage of reinsurance capacity over recent years and losses indemnified under GL policies having been large, the reinsurers have exerted significant pressure and significantly influenced insurers to change the wording of liability policies.

In *Hungary* environmental risks are usually retained by the insurance company and not reinsured. Some individual cases are subject to *facultative* reinsurance.

In *Italy* there was no possibility to reinsure environmental liability contracts with existing reinsurance companies. This added to risk and might have been influential in the formation of the insurance Pool.

Professional Indemnity Underwriters

Professional Indemnity (PI) underwriters are also vulnerable to environmental liability. When contamination is found at a site the new owners may try to place the liability for them on those parties giving them advice when purchasing the land/asset. The insurers - PI underwriters - will then be called to cover the compensation payments payable.

Professional Indemnity exposure will arise for (1):

- planning authorities who granted negligent planning consent;
- valuers and surveyors who failed to take pollution into account;
- those who invested funds in land now found to be contaminated;
- solicitors involved in the sale, purchase or transfer of contaminated land;
- accountants who described land as assets without knowing its environmental condition.

This exposure could be significant if retroactive liability is in place.

Summary

- Reinsurers have similar strategies to insurers in trying to calculate and reduce risk. This can limit insurers' actions if reinsurers take a more conservative position, in their risk analysis, and decide not to cover specific policies.
- Insurers are not the only sector exposed to environmental liability. Costs of reinsurance and PI underwriters sectors should also be included in considering the implications of environmental liability legislation.

(1) Brian Street, ECS, Lloyds Environmental Liability Insurance conference

3 THE EVOLUTION OF ENVIRONMENTAL INSURANCE COVER

Insurance policy systems evolve based on past policy and claims experience and changing external forces. The external forces are legal, jurisdictional and public consciousness. External developments have made insurers reassess their initial service for covering environmental damage and rearrange the scope and price of such policies. Markets across Europe are now at different stages of offering cover for environmental damage. The Comité Européan Des Assurances (CEA) identifies four existing situations in EU countries.

- Old general liability policies which did not make a distinction between sudden and accidental pollution and gradual pollution.
- Total pollution exclusion from general liability with an optional surcharge for sudden and accidental damage.
- General liability insurance covering sudden and accidental pollution but not gradual pollution damage.
- In addition to the above, environmental impairment liability policies are offered which pertain specifically to environmental risk and include gradual pollution damage (which is often offered through an insurance pool).

This section describes how these forms of environmental cover developed, why these original services changed and what state countries are in now.

3.1 HISTORIC DEVELOPMENT OF LIABILITY POLICY

General Liability

General Liability, due to its non-specific nature, made no special provisions or restrictions for irresponsible actions by firms regarding their ensuing pollution damage. Sudden and accidental pollution was deemed part of general accident liability cover. Gradual pollution though was not covered. Original cover was based on occurrence based triggers with no time limit, exposing insurers to a long-tail of claims. This means, that if, for example, damage was discovered now which had first occurred in 1975, the insurance company providing cover in 1975 would be liable.

Wording was not careful enough to restrict the scope of responsibility of the insurers. Furthermore, no additional premium was required for this environmental cover.

Period of Transition

Until the 1980s and in many cases the 1990s, insurance companies took no special note of environmental liabilities [1]. They inadvertently incorporated cover for environmental pollution problems along with other damage and costs incurred by firms, under general liability policies. Although certain environmental liability regulations existed such as the German Water Resources Act, dating back to the 1960s [2], environmental liability was not a major legal issue before 1980 and the enactment of CERCLA. From the beginning of the 1980s German insurers faced some environmental claims. This coverage was also for first party damage. During the 1980s significant costs from environmental liability developed in the US, and even there it was initially limited and only grew as more problems of damage were realized. It was only in the late 1980s that US insurers were confronted with compensation claims by companies trying to avoid cleanup payments.

In the early 1990s other countries such as UK developed specific environmental policies which have liability elements [3]. The Spanish legislative system still does not have a specific environmental liability legislation. Liability for environmental problems falls directly under what is encompassed by general liability law. Hungary has the least stringent liability system although an environmental liability policy is under development. Thus the insurance industry in Europe for a long time did not explicitly consider environmental liability. Increasing awareness of environmental liabilities, accompanied by the development of stricter environmental legislations are part of the set of factors now altering insurers' coverage of environmental damage.

Insurance companies, under general liability provisions, left themselves potentially liable for a whole host of pollution problems. Due to the occurrence trigger [4] used to determine where claims can be made, insurers are liable for past pollution of the insured. Therefore where retroactive liability is established, insurers now fear that they will face an onslaught of lawsuits and possible compensation payments directed at the insured companies for past contamination covered unwittingly at no extra premium. This historical experience makes insurers nervous about providing cover on environmental liabilities and has led to their exclusion under current General Liability (GL) policies.

However, there is a potential growth market of industrial companies desiring environmental protection, resulting from stricter environmental liability laws.

[1] For some sectors, eg chemicals, policy change started to occur in the 1970s.

[2] Insurers were influenced by UmweltHG (land) and WHG (water). They are now also influenced by the stricter liability provisions of 1991 UHG environmental policy. The UHG broadened the concept of strict liability and introduced a slight facilitation of the burden of proof in favour of the plaintiff.

[3] Water Resources Act (1991) and the contaminated land provisions of the Environment Bill (1995) in the UK and the Environmental Protection Act (1969) and the Environmental Damage Act (1986) in Sweden.

[4] Occurrence trigger is where the insured can make claim for an incident as long as the incident occurred during the time period of an insurance policy. Due to the potentially long time lags between an incident and the damage becoming evident, this means that insurance companies can face a long tail of claims relating to past incidents under an occurrence trigger.

There is an opportunity for insurers to create and develop additional services to cover environmental damage that are or may be liable for compensation. This situation has led to some insurance companies developing specific environmental insurance provisions.

The following three response options have been applied by the insurance industry. These responses vary depending on national characteristics:

- form a pool of environmental insurers such as in Italy, Spain, Netherlands and France;
- form across the board policy guidelines for all insurers such as in Germany;
- individual company strategies such as in the UK.

In the latter two cases individual insurance companies were large enough to set up their own environmental insurance policies. In the first case, there are many small insurance companies and hence benefits from setting up an insurance pool to handle environmental liabilities.

Insurance Pools

In countries where the insurance industry is dominated by small insurance firms lacking resources to build new markets by themselves, insurers have come together and formed insurance pools specifically for environmental liability. Through acting together the companies can share financial resources, environmental expertise and reduce risk. In Italy, for example, insurance contracts are developed by the companies under the supervision of the pool, which provides technical assistance, a reference contract and provides advice on special conditions to impose, and assessment of the risks and costs related to specific sites. The pool covers nearly all environmental insurance contracts though a few are still carried out by individual companies and are reinsured outside the pool.

Pools have been established at different times in Europe. The Netherlands has the oldest pool, established 10 years ago, whilst the Spanish and French pools were only established in 1994 (discussed further in *Section 4.1.6*).

Environmental Impairment Liability

The tighter environmental legislation and exposure of industrial firms described above has led to the small but growing demand for Environmental Impairment Liability (EIL) policies. These policies are individual environmental insurance policies which are written and adopted in relation to potential environmental problems as opposed to general provisions for property and health damage. They are not yet well established and still do not have a wide market base or standardized premia levels. They require individual environmental risk assessments to calculate appropriate premia rates which will cover their future compensation payouts for claims. They also modify policy elements, such as triggers used, to restrict liability for the insurers in the future, unlike the old GL policies which were open-ended.

3.2 *CURRENT RELATIONSHIP BETWEEN GENERAL AND ENVIRONMENTAL LIABILITY POLICY*

In general, in this transitional period, insurers are reacting to the changing environmental context as set out above, by offering two concurrent insurance policies under general liability and specific environmental liability.

These policies presently overlap and the margins of difference between them vary between countries. Most insurers in the UK and Germany will insist that a firm has its GL policy and its EIL policy with the same insurer. This is for both financial and administrative reasons. Unlike GL, EIL is currently not a profitable service therefore insurers are only prepared to offer EIL when they can also obtain GL business. If the GL policy for a firm was held by one insurance company and the EIL policy by another, then there might be disputes as to who is responsible for the environmental liabilities. Therefore to avoid such disputes and to lower transaction costs of issuing the policy, an insurer prefers to hold both GL and EIL policies. When considering the insurance policies and contracts, both general liability (GL) and environmental impairment liability (EIL) policies should therefore be considered together, especially as in most countries the demand for EIL policies is still extremely limited.

In most countries insurance companies' GL policies cover only sudden and accidental pollution. In the UK, in 1991, the Association of British Insurers (ABI) issued a policy guidance to UK insurers to exclude all liability in respect of pollution other than where caused by a sudden, unintended and unexpected event. Therefore, if a manufacturer wants gradual pollution covered he must take out an EIL policy for named and audited sites. This is now common practice across the countries investigated (apart from Hungary). Further items that companies might want coverage for in the future will probably be included in an EIL policy instead of extended GL policies.

The overall trend in light of stricter environmental policies is to reduce GL environmental obligations and move coverage of environmental liabilities into EILs. Insurers are now seeking to go one step further than offering additional environmental coverage in EILs by isolating and excluding pollution insurance from their general policies. In the UK 'write back' clauses are made to specify that all pollution-related damage is excluded except certain identified items which are written back into the policy.

In attempting to reduce the potential environmental compensation obligations from GL policies, many insurers in the UK may seek to deny coverage of environmental liabilities under GL policies issued prior to April 1991. To be able to make a claim successfully the insured will have to prove that the loss/liability arose during the period of the policy and that the contract wording covered the specific type of event. Insurers will look very closely at the policy terms, conditions and exclusions and will deny coverage if the insured: failed to take all reasonable precautions; deliberately caused the pollution; failed to disclose material facts, or are late in notifying the claim. [(1)]

Germany, Italy and France are good examples of insurance sectors that have moved to a more restrictive environmental insurance policy.

In Germany the insurers developed a new EIL-insurance policy which covers environmental liability EIL in response to the new environmental liability law (UmweltHG) enacted in 1991 and existing growing exposure. This is to replace the old insurance policies covering environmental legislation. The former general liability coverage was very broad (especially for claims caused by substances harmful to water under Water Resources Act (WHG)). It encompassed, to a large extent, cleanup costs of insured's own premises, ie first party damage that are in principle not covered by liability insurance. This cover caused large losses in insurers' portfolios. Furthermore, wording of insurance contracts led to serious problems in the handling of claims by the insurers. Insurers would therefore have taken action without the introduction of the UHG to limit their exposure from WHG policies. Those changes would probably have been limited to WHG policies whereas the new UHG led to the development of a completely new policy.

In the 1970s Italian insurance companies excluded the term pollution from GL policies. In 1979 certain companies started EIL policies. These later cooperated and came together to form in 1980 an insurance pool, *Pool per l'Assurazione R.C. da Inquinamento* (see *Section 4.1.6* for more details on the pool).

In 1994 French insurers decided to stop covering pollution under general liability policy. They instead formed an insurance pool, *Assurpol*, which delivers cover for sudden and accidental and/or gradual pollution (see *Section 4.1.6*).

Tables 3.2a summarizes the different cover offered in the selected countries for past GL and current EIL policies to highlight the changes that have occurred.

The main trends identified in the table are that:

- under both policies insurers limit their liability to third party damage;
- cover for damage to the unowned environment is still not available;
- a transition has occurred from 'occurrence' to 'claims made' policies. This is to resolve the long tail liability problem; and

[(1)] Brian Street, An Insurer's View of the 1995 Environment Act, Fifth Environmental Insurance Conference, List of Lloyds Press.

- gradual pollution is now covered in an EIL policy, although this is still limited to pollution events outside the normal operations of business.

Table 3.2b shows the differences in market size between GL and EIL policies offered across the countries. The table shows that EIL premium income is very small in relation to the GL market. The UK, Italy and Spain have an EIL premium income which is less than 1% of GL premium income. Germany has the highest relative EIL premium income which is still less than 5% the size of GL premium income;

Table 3.2b *Premium income of GL and EIL policies (m ECU)*

	UK	Germany	Italy	Spain	Netherlands
Total GL premium income	950	5500	1100	850	540
Total EIL premium income	<1	210	9.5	<1	8

Conclusion

The insurers, due to poorly written past policies and changing legislation, have found themselves over-exposed to liability claims. In reaction to this they are now restricting cover offered under general liability. In addition to this polluting industries are more aware of their environmental risk. These factors have led to the emergence of a new environmentally specific insurance cover offered in conjunction with, and in addition to, general liability cover.

However, the demand for EIL policies to date in most of the countries has been limited. Another inhibiting factor in the development of EIL markets is that the premia for EIL policies being offered are high and much higher than premium rates for GL policies, so that firms would prefer to stay under GL cover. The lack of demand is partly because firms do not recognise the magnitude of the environmental liabilities that require cover and because cover is not compulsory under existing laws.

Germany is an exception where almost all policyholders of general liability also have an EIL policy. In Germany, where environmental legislation is stricter than in the other countries and was developed earlier, companies are more aware of the need for covering environmental liabilities, particularly due to the environmental liability law (Umwelt HG) passed in 1991. This is reflected in the higher number of EIL policies purchased in Germany.

Table 3.2a *The distinctions between GL and EIL coverage*

	UK		Germany		Italy		Spain		Netherlands	
	GL	EIL	GL	EIL	GL	EIL	GL	EIL	GL	EIL
Types of pollution covered										
accidental/ sudden	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
gradual		✓		✓		✓		✓		
past										
damage covered				(1)						
human health	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
property	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ecological damage										
first party		extra policy	✓							
third party	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
claims basis	occurrence	claims made [2]	occurrence	first verifiable discovery of loss		claims made	occurrence			

[1] All damage now caused by environmental impact on air, soil or bodies of water are excluded from general liability policies

[2] This means no retroactivity to avoid a long tail of claims. Claims must be made within 30 days of policy expiry.

4 COMPARISON OF INSURANCE STRATEGIES FOR COVERING ENVIRONMENTAL LIABILITY

The insurance industries in Germany, UK, Italy, Spain, Hungary and the Netherlands were investigated at firm level to ascertain the industry's existing environmental liability policy operations and how they feel the market could develop under stricter environmental liability systems. [1] Information for Sweden and France was gathered from secondary sources. The two sub-sections, in *Section 4*, examine insurers' current behaviour and their views on future changes in the market.

4.1 CURRENT PRACTICES AND KEY ISSUES

Introduction

This section provides a comparative analysis of the country findings to identify the major trends and variations across the insurance sectors in the selected countries. The country information shows examples of the specific elements of EIL cover offered by insurance companies. These country specific examples construct a picture of the relationship between environmental liability legislation and insurance behaviour. For each section information for each country is presented where available. [2]

4.1.1 *Contract Components*

Triggers

The trigger is the element of an insurance policy which determines the length of time under which insurers are contracted to respect claims.

Under *occurrence* triggers, claims can be made anytime after a pollution incident occurs even if the policy has since concluded, as long as the incident occurred during policy cover. *Claims made* means that the claim has to be made whilst policy cover is in operation.

In *Germany* the new EIL policy stimulated a new definition of the insurance trigger to *first verifiable discovery of loss*, where a claim must be made when the damage is first noticed. Damage must be proven to have occurred but the cause of the damage need not be recognisable at that moment. This *first verifiable discovery of loss* trigger is applicable in Germany and France where there are established and long lasting relationships between a firm and its insurance company [3].

[1] Insurance pools were interviewed in Italy, Spain and Netherlands

[2] Where no data are available countries are omitted from the discussion

[3] Hellebuyck A, D, (1994) Beware of Triggers! A paper on Freedom of Contract in Liability Insurance, in New Liabilities and Challenges in Europe; proceedings of 5th European Conference of Company Lawyers. Kluwer, Antwerpen. ISBN Kluwer 90-6321-926-1.

In *Hungary* the trigger on a general liability policy is claims made.

In general there has been a distinct move away from occurrence based to claims made triggers. This is to reduce the long-tails of claims. Delayed claims were very common due to the lags common in the manifestation of pollution problems after the occurrence of an incident. These claims were unpredictable and insurers achieve more certainty with claims based triggers.

However, there has been a recent decision in the French courts to make the 'claims made' triggers void. This required insurers to revert back to occurrence based triggers. The ruling shows that elements of contracts can be overturned and thus uncertainty over future claims remains high. Such judicial decisions make insurers more hesitant to pursue environmental liability insurance policies.

Scope of cover

Cover is usually restricted to third party damage. This is based on general civil liability practices.

In *Germany* the new EIL policy (UHG) is more restrictive in its coverage than the former broad policy. In relation to what used to be insured, insurers now only guarantee cover for 40% of sudden and accidental damage caused to soil or water, and only 20% of damage caused by contaminated sites.

In the *UK* insurers are trying to restrict the scope of cover for past policies. In order to restrict claims for past pollution British insurers are using a third party defence. The insurers claim that they are only liable for damage to third party property and not for the sites of the insured (first party). Insurers have declared that damage must come from injured parties through the court system and not from cleanup requirements made by regulatory bodies. For example insurers say that if a Local Authority (LAs) serves a notice to a firm to clean up its site, this is not third party damage and therefore they argue that the firm is not insured.

In *Sweden*, despite the existence of Environmental Liability Insurance, two of the largest insurance companies have extended the Standard Business Liability cover to include all environmental damage, except for pure economic loss. However, this extended coverage is only offered to companies who do not present specific environmental hazards. The cover is not available to companies which require a permit or an application for an activity under the Environmental Protection Act.

Financial limits

The financial limit is the maximum amount of compensation an insurer will offer for a claim, regardless of the size of the damage. Normally this ceiling is not reached. It is only used to prevent insurers becoming liable for huge sums of money if one of the firms insured created a disaster, such as an oil spill. So although most claims do not exceed the predetermined financial limits, the limit is a valuable element in containing insurers' potential liability and preventing insurers having to pay out excessive compensation payments.

These limits will vary depending on the type of policy formulated and premium paid. The limits stated are for a standard premium - they may be higher if desired by policyholders, but they will be accompanied by higher premia.

A wide range of financial limits are evident across the various countries. Some illustrative example are given below.

In the *UK* the average financial limit to liability insurance compensation is 6 million ECU (£5 million) per claim.

In *Sweden* the maximum coverage under standard policy is fairly low, ranging between 0.6-1.2 million ECU (SEK 5 -10 million).

In *Germany* insurance cover is available up to several hundred million ECU. However, usually insured limits range between 1 and 11 million ECU (2 and 20 million DM) for medium-sized enterprises, and even a limit of 21 million ECU (40 million DM) is a rare case.

In *Hungary* limits are low. They are generally 6000 ECU (Forint 1 million) for property damage and 120,000 ECU (Forint 20 million) for personal injuries.

In *Italy* financial limits vary between policies and are higher for Pool than non-Pool members. Pool limits for environmental insurance are 9.7 million ECU (20 billion Lire) per claim and 24 million ECU (50 billion Lire) for pollution accidents. This compares to only 0.24 - 2.4 million ECU (500 million - 5 billion Lire) limits by Pool insurers for covering sudden and accidental pollution under general liability and 0.24 - 0.5 million ECU (500 million - 1 billion Lire) limits by non-Pool members.

In the *Netherlands* compensation is up to 7.2 million ECU for EIL. This is much less than compensation payments under general liability. So far claims settled have ranged from 4,800 to 380,000 ECU.

4.1.2 Premia

It is clearly important for both insurers and firms that premia appropriate for the sustainability of EIL are set. The premia will be affected by what type and mode of damage is covered ie potential payout. In turn the size of the premia offered will affect market size as it will influence the level of interest by firms in attaining EIL cover as opposed to self-insurance or, where possible, retaining GL cover. Any special provisions such as premia discounts for adopting pollution prevention measures might also influence firm (manufacturer) behaviour.

In *Germany* the main factors influencing the size of premia issued are the size of the plant, the type of plant (as regards liability situation and permit requirements) and the individual assessment of the underwriter.

Available figures indicate that premia in *Germany* have risen about 20% in relation to the former general liability and WHG coverage. The increase is due to increased awareness of environmental liabilities and transaction costs of risk assessments and administering the contracts.

In the *UK* premia vary by the size of the firm but are typically 600 ECU per year for small firms and 12,000 ECU for large firms.

In *Italy* the Pool's premium range is approximately 1,500-50,000 ECU (3-100 million Lire). A discount of 30% is offered if gradual pollution is excluded from the environmental policy.

At present in *Spain* the Pool has 18 contracts worth 9 million pesetas which is equivalent to an average of just over 3,000 ECU premium per policy. This premium level is low in relation to the number of claims being made and the outflow of compensation payments. Insurance companies are thus losing money in this area. However, they are trying to increase this environmental market and may have set premia low on purpose to attract custom. [1]

In *Germany* and the *UK* premia are influenced only to a small extent by pollution prevention and measures put in place by a particular policy holder. Implementation of specific safety measures does not generally lead to substantial reductions in premia, and seldom more than by 10%. This means that any prevention measures made in order to gain such a discount would most likely not be cost-effective as most measures are more expensive than the small discount offered. However, the companies need to undertake prevention measures to reach an acceptable level of environmental management required to obtain EIL cover.

In *Hungary* there are no specific environmental premia. Insurers' policies concerning environmental liability are under preparation, and as yet there is no practice in this field. There are no specific discounts for preventative measures. However, between 5 and 10% premium reductions may be offered based on a subjective assessment of risk.

Risk Assessment

Risk assessments are key tools for insurers to filter out "bad" risks and determine suitable premia levels for those companies with sound enough environmental management to be covered.

In *Germany* in the early 1980s under the WHG-policy (for the Water Resources Act) cleanup of a contaminated site was nearly always over 55,000 ECU (100,000 DM) and insurers suffered enormous losses because these high cleanup costs had not been initially calculated into the premia. Underwriters had underestimated the magnitude of the problem. This was in part because the scientific knowledge on the toxicity of substances was not sufficient to indicate all the potential damage.

[1] Low premia could also be because risks were underestimated when formulating appropriate premia levels.

Since then insurers have intensified risk management and risk control measures. The risk assessment procedures take into account the differing legal liability situation of each plant. The UHG identifies plants considered most dangerous to the environment. These are the plants which are prioritised by insurers for examination.

The policy holders have to fill in a detailed questionnaire on their environmental risk situation. On the basis of these questionnaires insurers will carry out inspections of at least 30% of insured plants. The outcome will usually be insurance experts proposing prevention measures to the potential clients. Only 5% of the proposed prevention measures will be officially binding. However, usual practice is for companies to adopt even the non-binding recommendations.

Risk assessments can thus take the following forms:

- questionnaires to be filled out by the manufacturer [1];

- site audit carried out by environmental consultants:
  - paid directly by potential policyholder;
  - paid by insurer and cost to be included in premium;

- rating and weighting system based on information gathered.

In *Spain* the insurance pool has a developed process of risk assessment. This is a three part risk valuation procedure:

- *Risk associated with dangerous substances and processes.* They assess aspects such as the storage of products, mobility of substances etc. In order to determine risks they require companies to complete a questionnaire and carry out an inspection for those areas where uncertainty remains.

- *Environmental risk.* They ascertain the state of the environment surrounding the site to be insured to estimate the potential magnitude of damage that could amount if pollution problems occurred and to estimate the costs to decontaminate such pollution to restore the environment to acceptable levels.

- *Company activities.* The insurers assess the pollution prevention measures adopted by the company combined with its overall environmental management attitude. Also past pollution incidents by the company are taken into account. However, the insurers do not consider the economic status (insolvency potential) of the potential policy holder [2].

In *Hungary* insurance companies have no in-house capability to assess environmental risks so they request the services of environmental consultants.

(1) This can often be the final hurdle to obtain insurance without verification. This is because if a claim was made and upon investigation of the incident the insurer found that the initial questionnaire responses were false then the policy would be invalid.

(2) This could have important implications in case of foreclosure and changes of ownership.

Experience shows that it is critical to assess accurately potential costs and calculate contingency reserves in case unexpected results occur due to insufficient scientific knowledge.

Risk assessments are still in the initial stages of development. They still rely on subjective risk assessments and include much uncertainty. This has led to different levels of premia offered by different insurers for firms (of similar size) with similar levels of risk. There was also uncertainty amongst insurers over how much prevention measures would lead to lower premia.

4.1.3 *Transaction Costs*

Transaction costs occur for both the insured and insurer. The transaction costs of the insurer are incorporated into the premium. The transaction costs cover the following activities:

- risk assessment procedures before cover is given;
- administration of drawing up policies;
- handling claims;
- litigation over whether the insured party is liable for the environmental damage costs, or litigation over determining their share
- litigation over whether environmental liability is covered by the insurance policy;
- marketing costs.

The legal transaction costs are exceptionally high in the US due to the high amount of legal disputes mainly concerning the joint and several liability provisions in Superfund. The Rand Survey [(1)] of the experience of US Insurers regarding Superfund found that legal transaction costs made up a large proportion of insurers' total costs. The Rand Survey found that the legal transaction costs in their study were split roughly equally between: the costs of disputes as to whether the insured firm is liable for the damage and if so, determining their share; and the cost of disputes as to whether the environmental damage is covered under the insurance policy.

Transaction costs will influence the potential policyholder's decision on whether or not it is economic to take out specific environmental cover when a choice is available. The transaction costs as a percentage of premium will vary in proportion to the size of the plant or company being insured. Smaller firms with lower premium needs will still have to carry out audits and thus have higher relative transaction costs. However, it is difficult to arrive at concrete figures as transaction costs on the side of the insured arise in different departments of the firms, are not calculated separately, and also vary widely.

As the market develops, insurers will build up expertise in-house for assessing environmental risks as they grow accustomed to dealing with specific industries and their associated environmental risks. Risk assessments

(1) Acton, JP Dixon L,S, (1995) Superfund and Transaction Costs: The Experience of Insurers and Very large Industrial Firms. Report by RAND, The Institute for Civil Justice. ISBN 0-8330-1239-8

should become routine, less time consuming and hence less costly. This will eventually lead to a reduction in premium levels.

In *Germany* transaction costs under the new EIL policy (UHG) have risen considerably in comparison to former liability coverage (about 10%). This is because the EIL policy (UHG) requires a site audit upto 30% of the time.

In *Germany* transaction costs of EIL (UHG) policies for the insurers amount to approximately 40% of the premia. This includes marketing costs. Transaction costs for policy holders are estimated to be around 2% of their premium per annum. This includes premium negotiation, administration in making sure all plants are insured, providing risk information to insurers and handling claims. Total transaction costs are usually between 40 and 45% of total environmental liability premia.

In the *UK* transaction costs under GL are 10-15% of premia. This increased for EILs to 25-35% of premia. Such transaction costs could prove barriers for SMEs desiring EIL cover.

In *Italy* transaction costs are approximately 40% of net premium income. This is in comparison to roughly 30% for general liability policies.

In *Spain* transaction costs of insurers for EIL insurance policies are around 20% for internal expenses and 10% for external expenses (brokerage). This totals approximately 30% of premia levels.

In the *Netherlands* potential clients are required to carry out a risk assessment at their own expense. When a client decides to purchase a policy, insurers will bear part of the costs of the risk assessment by offering a 20% premium reduction for the first year. This discount is then excluded in subsequent years.

It is evident that there are differences between the countries for the proportion of premia accounted for by transaction costs. However, the differences are not that great, ranging from between 30 and 40% of premium levels. The differences are based on different amounts of administration, litigation and costs of site audits. Litigation, as seen in the US with Superfund, is the area of the greatest potential cost and transaction cost variation.

The high cost of transaction activities which increases premia levels acts as a disincentive for firms to take up such policies. Because a high proportion of these transaction costs are fixed costs, such as site audits, transaction costs will be relatively higher for smaller size policies. This will act as a greater disincentive for SMEs considering taking up such cover.

4.1.4 SMEs

Insurance companies can provide a useful service for SMEs by spreading the risks of environmental damage costs from individual incidents which would otherwise be excessive for an individual small firm. However, some of the transaction costs with EIL policies will be higher for SMEs as a proportion of their total insurance costs. Insurance cover may therefore be particularly costly for SMEs discouraging its uptake. This is particularly problematic as SMEs are least equipped with resources to deal with pollution incidents.

In *Germany* insurers do not differentiate UHG insurance according to the size of the enterprise. Premiums do differ slightly according to the size of the policyholder, with larger companies with more plants having lower premium per plant. The smaller firms have greater difficulty in implementing prevention measures.

In *Italy*, 30% of the Pool contracts are for companies whose turnover is under 5 million ECU.

In *Spain* the insurance pool targets SMEs for coverage as they have the greatest difficulty dealing with environmental liability.

In the *Netherlands*, to date, 40,000 policies have been for SMEs as opposed to only 100 for large companies.

So in some countries like the Netherlands and Spain it is mostly SMEs which take out EIL insurance, whilst in other countries such as the UK and Italy it is mostly large firms which take out EIL insurance.

4.1.5 Claims

Sudden & Accidental vs Gradual Pollution

Experience in Germany provides an opportunity to analyse the breakdown of environmental damage claims to understand the respective financial importance of different environmental hazards for insurance companies. The tables below show associated costs for these different types of insurance through claims paid. Actual damage amounts may have been much higher, as some cases were settled either because liability could not be proven or insurance cover was questioned.

Table 4.1a shows the share of claims attributed to soil and water pollution compared to other causes of environmental damage for two leading insurance companies and a large insurance broker. It shows that damage to soil and water (through both sudden and accidental and gradual pollution) are by far the most important in terms of both number of associated claims and compensation amounts, accounting for nearly 75% of all environmental claims settled.

Table 4.1.5a ***Environmental claims settled under insurance contracts in Germany***

Damage Class	Number Caused by Accidents	Number Caused by Normal Operations	Claims Amounts (m ECU)	Percentage of total amount
Sudden and accidental damage to soil and water	6,177	0	388	22
Contaminated sites/gradual pollution to soil and water	2	2,026	888	50
Air pollution	23	2	114	7
Fire and Explosion	7	0	166	9
Other	4	0	204	12
Total	6,213	2,028	1,759	100

Source: HDI, Allianz and Jauch & Hubener (1)

Table 4.1.5a also shows that although the number of claims for gradual pollution was one third of the claims for sudden pollution incidents, the amount of the claims for gradual pollution was twice as large.

Table 4.1.5b focuses further on these different financial consequences between the sudden and gradual pollution incident claims.

The companies examined show the same relative differences in size, with the average amount of gradual claims being six times larger than average claims for sudden damage.

HDI has the highest difference in claim amounts between sudden and accidental and gradual claims. Its total gradual claims amount is 200% greater than for sudden pollution incidents.

This claims experience from Germany indicates that insurers offering gradual pollution damage cover should expect significant increases in claims for the EIL policies. If the German figures are representative of the different claim amounts between sudden and accidental and gradual pollution then insurers may expect additional claims of between 50 and 200%.

(1) Allianz is the leading German insurer, HDI is a leading insurer for industrial risk, J&H is a large insurance broker.

Table 4.1.5b Statistics of WHG-policy-claims [1]

Company	No. of sudden claims	No. of gradual claims	Ave amount of sudden claims (000s ECU)	Ave amount of gradual claims (000s ECU)	Total sudden claims amount (m ECU)	Total gradual claims amount (m ECU)
HDI	1194 (64%)	682 (36%)	28	179	33	122
Allianz	4,895 (79%)	1,288 (21%)	13	78	63	100
J&H [2]	N/A (46%)	N/A (32%)	44	628	N/A	N/A

4.1.6 *Insurance Pools*

The insurance pools bring insurance companies together to share financial resources, environmental expertise and reduce individual risk. This is especially important for the countries with a predominance of small insurance firms. Pools have been set up in Italy, Spain and the Netherlands [3].

Italy

Insurance companies in *Italy* in 1980 came together to form an insurance pool, *Pool per l'Assicurazione da Inquinamento.*

In the early 1980s the pool attempted to carry out detailed risk assessments but did not manage to develop a systematic pricing model for their environmental premia. The pool will in most cases conduct an inspection through one of its own experts. Two thirds of this cost is financed by the pool, with the remaining third being borne by the policyholder.

The total amount of premia paid by Italian firms for environmental liability insurance is low, amounting to approximately 9.5 million ECU pa. However, premia income has increased substantially since 1988.

Spain

The insurance pool in *Spain* is very recent (1994) and limited. So far there are only 18 policies taken out, totalling 54,000 ECU. However the pool members expect large amounts of premium income growth based on expected market demand, with a target of 9 million ECU in premium income per year being collected within the next four years.

(1) The claims are for the period 1980-1993

(2) J&H data is as a percentage of overall environmental claims

(3) A Pool has also been set up in France but this has not been investigated.

Netherlands

The insurance pool in the *Netherlands* is well established. It is ten years old and has a reinsurance pool. However, it has experienced a stagnant market for its services for several years and is now totally restructuring its EIL policy. The new policies will take effect in 1996.

The total premium income is 8 million ECU per annum. The cost of organisation and pool administration is 600,000 ECU per year. This leaves current pool coverage capacity for environmental liability between 7.2-7.8 million ECU; 40% of this is reinsured. The net profit yielded is 950,000 ECU which is then divided by the 58 member insurance companies within the pool. This is a profit level of 12% of premium income.

The reasons that the pool has such small business is because there is not enough distinction in the cover offered between general liability policies and the environmental policies offered by the pool. The restructuring of the pool's policies is aimed to alter this by, for example, including gradual pollution in environmental liability policies and excluding any pollution from general liability policy.

Country Comparison

Table 4.1.6a summarises the current capacity and procedures of the insurance pools developed in Italy, Spain and Netherlands.

Table 4.1.6a Country Comparison of Insurance Pools

	Italy	Spain	Netherlands
EIL policy since	1979	1994	1984
Sudden in GL	no	yes	yes
No. of members in pool	78	24	52
No. of reinsurers	n/a	6	n/a
Limit available per claim	24m ECU	6m ECU	8.5m ECU
Trigger	claims made	first verifiable notification, and claims made	occurrence
Premium Income p.a.	9.2m ECU	54,000 ECU	8 m ECU
Development targets for the pool	maintenance	growth - target of 9m ECU by year 2,000	total review
No. of policies to date	2,000	18	50,000
No. of sites covered	6,000	n/a	n/a
Av. premia (ECU per policy)	4,600	3,000	160
Questionnaires	yes	yes	n/a
Site surveys required	yes	yes	yes

Through these pools, insurance companies can come together and set up standard procedures such as for conducting site inspections. The Italian pool has its own environmental risk experts. Such sharing of resources and expertise should lead to a reduction in transaction costs for individual policies.

Although transaction costs in Italy appear similar to other countries at 38%, compared to 25-35% in UK and 40% in Germany, without the Pool the transaction costs may have been much higher due to national insurance characteristics (such as high administrative costs). Indeed when comparing the relative difference in transaction costs between general and environmental liability policies within a country there is a significant trend. In the UK general liability transaction costs are 10-15% whilst for EIL policies transaction costs are 25-35%, approximately 100% larger. In Italy environmental transaction costs as a percentage of premium are only 25% greater than for general liability (see *Section 4.1.3*).

Another advantage of a Pool is that risk is shared by the insurers. Reduced risk makes the environmental policy market more appealing to insurers. This is particularly important at the early stages of market development when the risk of underestimating premia, through lack of prior experience, is so high.

There is a disadvantage from the Pool having only one unified policy. This makes the insurance companies vulnerable to systemic risk. If something has been overlooked, such as guarding against retroactive liability claims, then all companies in the Pool will be exposed, and the finances of the whole industry could suffer. By having individual policies, systemic risk could be restricted to only parts of the insurance industry.

The same holds true for basing insurance policy on assumed future environmental policies. Insurers are now guessing government moves and acting in accordance with their views on likely developments in government policies and developments in the market. If this is wrong then some companies will win and some lose. Under a unified Pool policy there is the possibility that all could lose if regulation takes an unexpected turn and safety provisions did not exist.

4.1.7 *Role of Insurance for Promoting Prevention Measures*

Insurers promote prevention measures through:

- not providing insurance cover if risks of environmental damage are too high;
- require that certain prevention measures be carried out if cover is to be provided;
- offering lower premia for companies with lower assessed environmental risks;
- setting financial limits which will be lowered for companies with higher risk;
- excess payments which will still necessitate the polluting firm to pay the first portion of the claim.

Insurers, wary about taking on new risks, only offer EIL cover to companies with low risks. This initial filtering out process of high risk companies prevents badly environmentally managed firms gaining insurance cover. If these companies want insurance they need to make substantial efforts to increase pollution prevention processes and adopt a proactive environmental management approach to show insurers they are serious about reducing environmental risk.

Risk assessment for pollution cover is still quite subjective and hence insurers are not able to calculate reliably the reduction in premia when certain risk management measures are adopted. Country experience indicates that, at present, discounts in premium for a company adopting specific pollution prevention measures is limited. In Germany and UK if a policyholder adopts specific safety measures it can generally only expect a maximum of a 10% premium reduction when a new policy is issued. Therefore there is minimal financial incentive, at present, for firms to expend on such provisions and this does not make prevention measures undertaken for this reason cost-effective.

Insurers can provide expertise in the area of pollution prevention once their experience in the area grows. Suggestions are often made by insurers after site audits take place. This occurs in Germany and, although the suggestions are non-binding as stated in *Section 4.1.2*, the measures are often adopted by the potential policyholder. However, insurers are reluctant to take the main role of enforcing prevention measures. Regulators are better placed to do this.

If premia are altered significantly in succeeding years based on claims then policyholders could be continually stimulated to maintain a low level of environmental risk.

In fact, the Italian Pool Inquinamento does not renew policies automatically each year. The Pool demands a new set of risk information before deciding on renewing a contract. This safety mechanism will prevent industry policyholders from reducing prevention measures and most probably will encourage them to consider pollution prevention measures.

The self-insurance components of a contract are greater incentives than premia discounts for companies to reduce their risks. Differences in financial limits can lead to large differences in payments by a company if a large pollution incident occurs. Being able to attain high financial limits may be good reason for maintaining sound environmental management.

Finally, insurance is only one of many factors giving incentives to firms to reduce their risk. By itself it appears to have a negligible impact on firms but acting in conjunction with other factors such as cost savings or regulations it can increase the incentive package for firms to reduce risk. Its role, therefore, has to be considered as a complement to the other influences already in place.

4.1.8 Insurance capacity in relation to environmental damage

This section estimates how much existing national environmental damage is covered by the insurance capacity built up for EIL policies in the various countries. The premium income (less transaction costs) is assumed to be available for compensation payments and thus represents the amount of financing potentially available for compensating liable environmental damage costs. Insurance only needs to be available for environmental damage which falls under a liability system. As liability systems only cover a portion of environmental damage costs, usually property and health, insurance premium should not be expected to be equivalent to total environmental damage costs.

The following section compares current total EIL premium income for Germany and Italy with national annual environmental damage costs and then estimates the relation between potential total EIL premium income for UK and Spain with national annual environmental damage costs (see *valuation paper* for an explanation of the damage costs used) to show what proportion of environmental damage costs are covered by environmental insurance policies.

Current EIL Cover as a Percentage of Environmental Damage

In *Germany* UHG-policy premium income is 208 million ECU (382 million DM) per annum. This is compared to total annual environmental damage costs of 16 billion ECU for (monetary) or 109 billion ECU (for both monetary and non-monetary) (30 or 200 billion DM). This means that only 1.4% of quantifiable environmental damage costs are covered by insurance premium or 0.2% of all environmental damage costs.

Deducting the 101 million ECU (160 million DM) that go to transaction costs, then the percentage of damage covered drops to less than 1% and less than 0.1%, respectively.

In *Italy* the pool has a capacity of 9.2 million ECU (19 billion Lire in 1993) compared to total annual environmental damage costs of 7.2 billion ECU (15,000 billion Lire). So environmental insurance covers only 0.1% of environmental damages costs. Even if the EIL income ever matched the GL income of the Pool (2,405 billion Lire) the amount of potential compensation would still only cover 16% of environmental damage costs.

In the US insurance premia covers 17% of Superfund cleanup costs. Annual cleanup costs are approximately $2 billion [(1)] and premium volume for pollution liability is $340 million [(2)].

Potential EIL Cover as Percentage of Environmental Damage Costs

In the *UK* initial calculations were made in an attempt to compare levels of insurance coverage if all firms were covered by existing EIL products, to total environmental damage costs estimated for the UK.

Using the following assumptions:

- all small firms pay a premium of 800 ECU
- all large firms pay a premium of 12000 ECU
- transaction costs of insurers are 30%

It is estimated that at current premia levels total premia income would come to 200 million ECU if all firms potentially affected by liability provisions purchased EIL insurance [(3)]. This only comes to 2% of the estimated total damage in the UK.

(1) Probst et al.

(2) Chipman, N (1993), Submission of Comments on the Communication from The Commission to the Council and Parliament: Green Paper on Remedying Environmental Damage. Sedgwick Group plc, 1993.

(3) Assuming there are approximately 200,000 small firms who might be affected by the liability provisions and need insurance cover (10-499 employees), and 10,000 large firms.

In *Spain* the Pool is expected to grow to a premium income of 9 million ECU. Total cleanup costs of contaminated land alone in Spain are estimated to be 13 billion ECU. This means that if the target is met then less than 0.1% of contaminated land cleanup needs would be covered through insurance annually.

The conclusion from these estimates is that insurance cover is very limited in relation to existing environmental damage. A massive expansion would be required for insurance to cover a significant part of damage. It could take many years for capacity to grow to this extent.

4.2 *INDUSTRY VIEWS ON ALTERNATIVE LIABILITY SYSTEMS*

At the moment in the UK, Germany and Spain, EIL insurance is not seen to be very attractive and insurers would be cautious about offering policies under stricter environmental liability regimes. Insurers would probably follow the German example of the UGH-policy and restrict cover in reaction to broadened strict liability under law. Some elements will present greater difficulties for cover and others will increase the potential costs being covered.

The main elements considered are:

- retroactive liability;
- joint and several liability;
- compulsory insurance;
- covering ecological damage.

4.2.1 *Retroactive Liability*

Insurers are extremely concerned about the imposition of retroactive liability. Old policies leave insurers potentially responsible for compensating past damage. Therefore if retroactive liability is imposed and old policyholders are held liable for past damage the insurers will get left paying the bill unless they find supportable defences. These liabilities are potentially enormous as seen in the US (see *Annex D*).

If insurance companies are made to pay for exposed historic liability they may experience a significant drain on resources, such as in the US. Their ability to pay claims may decrease and this would adversely affect them through a drop in credit rating.

The insurers will also need to re-evaluate internal reserve capacity needs and build them up in light of exposure under retroactive liability.

To protect against retroactive liability they now will not cover historic damage in new policies. Claims made means that insurers will limit their responsibility for pollution occurring from now but which is not found for years to come. They will only be responsible if the company still has a policy when the claim is made. However, in order to prove what pollution has occurred before and after the initiation of a policy contract a detailed site audit needs to be carried out, to assess past damage costs that would not be covered in a new policy.

4.2.2 *Joint and Several Liability*

Joint and several means that each polluter may be liable for the total damage irrespective of the actual share of pollution they caused. Many times it is the largest companies which are targeted to recover the damage costs as they have more financial resources. The liable company then may try to recoup the costs of the environmental liabilities from the other responsible parties. This problem is commonly referred to as the 'deep pockets' syndrome. The firm with the highest insurance cover would become the 'deep pocket', so insurers and firms would have incentives to impose financial limits.

The difference between value of damage caused and amount liable would vary case by case depending on the situation of the other responsible parties. Therefore there would be no method of estimating the actual amount a company may be liable for even if its potential damage costs could be assessed.

Insurers would find it very difficult to price a policy under a liability regime in which financial liability could not be clearly related to the pollution risk of an individual firm or plant for which they are providing cover (and for which they receive premia). The uncertainty would mean that the premia could not be appropriately set. Insurers would have to overestimate liabilities in case, through joint and several liability, a policyholder was unexpectedly found liable for someone else's damage. This would increase the premia set.

4.2.3 *Compulsory Insurance*

Compulsory insurance is asymmetric. Firms can be required to have insurance but individual insurers cannot be forced to provide cover. Given the potential rise of total damage costs and the various types of damage and many types of cover, it would be difficult for insurers to calculate appropriate premia levels and to cover all firms for many years until claims experience and risk assessment were developed. Cover would have to be very restrictive. Furthermore, firms not being able to obtain insurance would be legally forced out of business.

Insuring every industrial company with all their varied types of activities and damage costs and subsequent policy components and premia would be very difficult and thus expensive. Assessing all risks would be time consuming. It would take a long time to build up a claims history for all types of activity and damage costs. Insurers would try to limit scope of cover for high risk firms. This would require the governing body to step in and set standard operating procedures to ensure adequate cover of every firm. Insurers would otherwise set financial limits for the environmental damage costs covered at low levels. However, if high financial limits were required by law, the ensuing premium would be very expensive for a high risk company (and probably excessively so) and could bear particularly heavily on SMEs.

The German experience exemplifies these specific difficulties of mandatory insurance. The ordinance under UHG, initiated in 1991/2, to deal with compulsory insurance is still not complete. It is estimated that it will take several more years before it comes into force. This delay is because it has not resolved the problem of setting legal requirements to prevent insurers offering insufficient financial limits and narrow scopes of damage for high risk firms seeking compulsory insurance.

Due to uncertainties in environmental damage costs compulsory insurance in this area would be completely different from compulsory insurance for other areas like motor vehicles, where risk is regular and known.

It would be many years before the insurance industry would be prepared and capable to offer cover to all firms for all types of environmental damage and, without this, compulsory insurance is not workable.

4.2.4 Covering Ecological Damage

Ecological damage includes:

- owned environment;
- unowned environment;
- natural resources depletion.

Damage to the owned environment is covered under property damage. Insurers do not cover damage to the unowned environment.

Ecological damage creates difficulties because of:

- quantifying loss;
- valuation problems;
- diffuse sources of pollution;
- proving causality;
- identifying victims;
- how to compensate.

Quantifying Loss and Problems of Valuation

Ecological damage covers loss of both measurable and unquantifiable elements of environmental damage. Physical assets such as fish and tree populations have market values which can act as a proxy for loss value. However, there can be damage to other ecological components such as a species, habitats or ecosystems which cannot be approximated through market prices. Such valuation is highly subjective and uncertain. It also depends on whether loss value or replacement costs are calculated (see *Topic Paper 1 on Valuation of Environmental Damage Costs)*. There is also the problem of irreversible damage which makes valuation more complicated.

One of the reasons why insurers do not cover ecological damage is due to the uncertainties concerning the valuation of such damage which makes it difficult for them to determine appropriate premia rates. Another reason is because the ecological assets are unowned. This raises questions about who can make a claim for such ecological damage and to whom should the compensation be paid.

For compensation payments a valuation system is needed for ecological elements. A potential way to do this is to set up predetermined financial limits for liability upon damaging specific aspects of an ecosystem. Whatever the number placed on ecosystem components consistency would be needed for insurance calculations of potential loss.

Proof of Causation

For the victims or claimants a major problem is proving causation of damage to large unowned areas due to diffuse sources of pollution and claims requiring many steps to prove causality.

Increase in Litigation and Rights of Action

The problem with ecological damage to the unowned environment is that there is no individual or direct victim who can then seek liability. Therefore action groups might be given rights to seek compensation for damage to the unowned environment. Insurers though are apprehensive of a liability provision to allow environmental groups to sue companies for ecological damage to the unowned environment since they fear that this would lead to increased litigation and claims for insurers which would be passed on to industry through higher premia.

There are two ways to compensate for ecological damage. One is through compensation payments and the other is through restoration of the damage.

Compensation payments are not very practical because of the following questions:

- who has the right to sue?
- who keeps the payment from won claims?
- who decides what happens to the payment?
- how can losses be valued with any consistency?

It would be more feasible for an insurer to cover restoration of measurable and quantifiable ecological loss, *if* a reasonable estimate can be agreed on a cost-effective restoration programme. The financial cost of restoration is more objective and predictable and so easier for insurers to cover. Guidance would be needed for the required levels of restoration as there would be dispute over suitable levels. For example if a woodland is damaged, would it be acceptable to replace it with young trees, as opposed to the mature trees damaged by the pollution? The issue becomes more complex for irreversible damage.

Purchased Rights within the Unowned Environment

There are also cases where parts of the damaged ecological assets are owned by individuals, such as animals through hunting or fishing rights. These cases may become an area for claims and litigation. In Germany, for example, fishermen who had paid for fishing licenses and thus paid for the right to catch fish sought and received compensation when a river's decreased water quality due to pollution led to a decrease in fish populations.

4.2.5 *Access to Information*

Access to information raises issues arise concerning: who should have rights; what information should be released; and when should access to the information be allowed (before or after the start of litigation).

Insurers do not like the idea of the development of public registers listing pollution incidents of firms and sites where there might be *potential* pollution problems since this can raise excessive and unnecessary fears amongst the public about "potential" problems. This has led to concern by insurers that "ambulance chasing" law firms would encourage local residents to claim damage to health or property against those with potential for causing the pollution. [1]

[1] Brian Street, ECS, 5th Environmental Insurance Conference, Lloyds of London Press 1995.

5 CONCLUSIONS

5.1 *EFFECTS OF ENVIRONMENTAL LIABILITY ON INSURERS*

There are two distinct effects. One is the increased vulnerability of insurance companies from old policy exposure for historic pollution. The other is how insurance policy is changing to cope with stricter environmental liability.

Historic Pollution Problems

Insurance companies, under general liability provisions, left themselves potentially liable for a large amount of claims for old pollution problems. Due to the occurrence claims trigger; insurers may become liable for past pollution of the insured. Therefore where retroactive liability is established, insurers now fear that they will face an onslaught of lawsuits and possible compensation payments directed at the insured companies for their past contamination which the insurers unwittingly covered at no extra premium. This historical experience has led insurers to be cautious about providing cover on environmental liabilities.

The role insurance companies can play in current and future liability coverage may depend, in part, on how much of their financial resources will be used to pay for past liabilities not built into old insurance premia (as in the US).

Future Pollution Cover

Insurers now manage the process of offering environmental damage cover more carefully under an Environmental Impairment Liability (EIL) insurance policy. This involves greater risk assessment and focusing on clearly specified environmental risks so that insurers can estimate better the level of their potential liabilities and set premia accordingly.

To address the problems of a long tail of claims now being experienced due to the occurrence claims' trigger potential in previous general liability policies, the insurers are trying to move from 'occurrence' to 'claims made' policies. Occurrence based policies limit the time period for which a policyholder can file a claim to the duration of the policy.

Gradual pollution as well as sudden and accidental pollution can be covered under EIL policies.

Cover for ecological damage to the unowned environment is still not available, and it is not expected to become available in the near future.

Site audits are increasingly required before insurance is given to polluting industries. These increase transaction costs and can affect SMEs' capacity to purchase insurance. Site audits can be useful for the insured to assess and understand their environmental risks and also to prompt them to implement pollution prevention measures.

Overall, insurers are unable to quantify the scope of the cover they will provide, or the change in the size of premia, under stricter liability regimes.

Potential EIL Market

There has so far been limited uptake of new EIL policies designed to insure future pollution. This is reflected in the limited growth of the EIL market, except for Germany.

One reason is that insurers have been slow to expand their exposure in this market since they are reluctant to cover unknown risk. Insurance companies are also greatly influenced by the uncertainties still remaining in potential losses to be covered. Uncertainty makes insurers' plans for covering environmental damage more conservative. There is still a large degree of uncertainty regarding the cost of covering environmental damage. The uncertainty arises from:

- lack of a claims history;
- legal changes;
- difficulties in predicting likely future public concern:
  - level of restoration demanded;
  - number of cases taken to court;
- lack of technical expertise to underwrite risks;
- valuation problems of environmental damage;
- inability to foresee hazards not recognised at present, especially in relation to gradual or chronic pollution.

However, even when insurance companies offer environmental liability cover, many firms are not aware of the magnitude of their environmental liabilities, and consider that obtaining the policy is not needed or worth the additional premia costs.

The perspective of the industry is that good business opportunities do not currently exist in this market for at least the short to medium term. Therefore a rapid expansion of the market cannot be expected, and much time will be required for the market to evolve and mature sustainably.

5.2 *IMPLICATIONS FOR A FUTURE ENVIRONMENTAL LIABILITY POLICY*

Insurance companies have the option to offer cover where this is commercially attractive to them and conversely not do so where this is not commercially attractive.

Many companies (particularly SMEs) have restricted financial resources to cope with liability and thus need insurance. Areas which lack insurance are not necessarily financially covered because firms can become insolvent.

A tension exists between the insurers' reluctance to insure environmental risk and the need for financial resources to support environmental liability.

Thus for the effective and sustainable development of environmental insurance cover, the developments in environmental liability policies should be strict enough to stimulate a market for EIL so that insurance companies will offer a wide enough scope of cover to provide compensation for a substantial portion of environmental damage, but not too demanding or uncertain since this might deter insurance companies from developing EIL policies and expanding the EIL market.

5.2.1 *Potential Role of the Insurance Sector*

If insurance coverage is desired for polluting firms then any decisions taken on what will be included in a future more rigorous environmental liability system should take into account the views and financial interests of the insurance industry, which can limit its coverage in accordance with its perception of the severity of the system to be instituted and its associated potential costs to industry.

Compensation of Damage

The insurance sector is a financial system which pools resources from potential polluters to provide for remediation if pollution eventually occurs. This reduces the need for individual firms to save sufficient resources in case of pollution incidents and thus have to divert resources from other areas of investment.

A disadvantage is that insurers become another player which can become involved in litigation in determining responsibility for compensation payments.

Promoting Prevention

Environmental insurance premia can provide signals to the market on costs of environmental damage. At present risk assessment for environmental liability insurance policies cannot be sufficiently detailed to indicate accurately the true damage costs. Due to this problem, and lack of systematic methods of assessing risk, there are no systematic discounts offered in premia levels for policyholders lowering environmental risk. Where offered, discounts are limited to no more than 10% of premia for well managed firms. Therefore, policyholders do not have a strong incentive to adopt pollution prevention measures to obtain lower premia.

5.2.2 *Compulsory Insurance*

Compulsory insurance would prove problematic for potential industrial policyholders. Insurance companies could turn down high risk companies which would then either have to close or incur a large financial burden of achieving satisfactory pollution prevention standards to be considered for insurance cover. Insurers would also try to limit cover for high risk firms through reducing the financial limits offered. To ensure adequate cover was being offered to all firms the governing body would have to intervene with guidelines specifying what form of compulsory insurance had to be provided at what premia. This would be difficult to achieve. Thus in Germany, where compulsory insurance was introduced on a limited scale, it is proving difficult to reach agreement over these guidelines.

Annex A

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Association of European Insurers
Association of British Insurers (ABI)
MAS, the Netherlands insurance pool
Pool per l'Assicurazione R.C. da Inquinamento, the Italian insurance pool
Assucurazioni Generali, Italy
Hungaria Biztosito, Hungary
AIG Europe, Spain
Mapfre, Spain
Spanish Pool for environmental risk

Annex B

Glossary

GLOSSARY

civil liability: an individual in their private capacity can incur legal liability which can be either a breach of criminal law or breach of civil law. Civil liability may arise through tort or contract. Tort includes negligence, trespass and nuisance. Tort is the breach of civil duty imposed by law and owed to one's fellow citizen generally.

general liability: this is a liability insurance policy, which cover employer's liability, public liability and products liability as a 'package'

a claim: when the insured or the insured's beneficiary seeks payment from the insurer for damage covered by the insurance contract

premium: the price of insurance protection for a specified risk for a specified period of time

net premium income: this is the premium after discounts have been deducted

premium income: total revenue received by the insurer from all premia collected

financial limit: the maximum the insurer is liable under insurance and will compensate the insured. It may be expressed as 'per accident', 'per event', 'per occurrence' or 'per annum'.

time limit: the maximum amount of time allowed after a policy terminates or an incident occurs for a claim still to be made

trigger: an incident that gives rise to a claim. In an insurance contract it is the component that specifies under what circumstances a claim can be validly made; possible triggers include:

- *claims made*: a claim must be made during the time a policy is held by the insured

- *occurrence*: a claim can be made anytime for an incident as long as the incident occurred under a policy

- *first verifiable loss*: a claim must be made when damage is first noticed and if it is covered by a policy

reserve capacity: the amount of capital insurers need to save in case of compensation obligations

Annex C

The Insurance Fund Option

A unique system was put in place by the Swedish government for using the insurance system as an administrative mechanism to levy contributions to a compensation fund.

Swedish Environmental Damage Insurance Regulation

In Sweden a person who has suffered an injury or damage to his property can not obtain compensation under the 1986 Environment Damage Act if it is impossible to ascertain who is responsible, or those responsible are insolvent, or if the right to claim compensation is 'statute-barred'. In order to remedy the problem of having unidentifiable or insolvent polluters the government decided to set up a fund system.

Initially the government wanted to set up a government fund, financed by taxes and levies on certain hazardous substances. However industry resisted a tax-financed arrangement for the fund. The solution was to set up an insurance scheme, The Environmental Damage Insurance, regulated by amendments to the Environmental Protection Act, ss 65-69 (1988:924) and in the Ordinance on Environmental Damage Insurance (1989:365). The legislation came into force in July 1989.

Structure

The consequent insurance scheme is subsidiary only and the claimant must claim compensation from the responsible parties wherever possible. For property damage it only deals with disturbance occurring after July 1989 (ie not retroactive).

The insurance is compulsory for companies who carry out hazardous activities to the environment, defined by the requirement of a permit or an application under the Environment Protection Act, or according to the directives issued under the Act. Those companies performing such activities are obliged to contribute to the compensation fund through levies approved by the government. It was decided to make the insurance compulsory as it was too difficult to distinguish which companies carrying out the dangerous activities were causing the environmental damage and which were not.

The Environmental Damage Insurance (EDI) is run by a consortium (Miljoskadekonsortiet) consisting of five insurance companies. The financial limits payed by this consortium are SEK 5 million for bodily injury compensation and SEK 50 million for property damage per claim. A total of SEK 200 million can be claimed for in one year for any type of damage.

Results

Since its establishment in 1989 SEK 120 million have been paid into the scheme. By February 1993 the Consortium only received 27 claims. And as of this year no compensation payments have yet been made. None of the claims made were deemed valid under the insurance scheme.

Due to this zero outlay of funds the purpose of the Fund was called into question and in 1992 a government commission was established to evaluate the scheme. Its conclusion was that despite the lack o. compensation payments, the scheme did play a critical role in filling serious gaps in the compensation and cleanup system. The Commission also recommended an extension of the EDI in the form of a separate Decontamination Insurance for a new area called 'assistance costs'.

'Assistance costs' are to clean up when commercial operations are halted due to lack of funds and hazardous waste and other material such as process chemicals are left behind. The EDI does not cover costs of such disposal or decontamination. They so far have been financed by appropriated funds administered by the Swedish Environmental Protection Agency. However, the increased number of bankruptcies in recent years has created an urgent need for more funds.

The Commission felt that an insurance scheme was the best mechanism for administering contributions to a compensation fund since there was already in place a system for handling payments under insurance policies.

The Decontamination Insurance scheme is currently under consideration and has not yet been established. Nevertheless this potential scheme along with the existing EDI, shows an alternative use and potential administrative role of insurance in seeking the restoration of sites under a joint compensation fund.

Annex D

US Experience

The US Experience

The US experience [1] provides a good example of how historic pollution has presented insurers with a series of claims from polluters which could prove to be a large financial burden on the insurance companies. The situation is not yet clear because the majority of the insurers' costs have been on litigation over disputes between the insurers and the insured over financial responsibility for the pollution.

The process began in the mid-1980s when policyholders started filing suits to force their insurers to pay for cleanup required in some cases by the government. Insurers also received claims by people who lived near the polluted sites for bodily injury.

The liability faced by the insurance industry stems largely from the property insurance sold decades ago to big businesses, including chemical and fertilizer makers who have subsequently contaminated soils and groundwater.

Insurers generally argued that the policies they sold did not cover environmental claims and have thus vigorously litigated policyholders' claims.

Many of the environmental reserves insurers have made to date have been simply to pay for litigation costs, not cleanup. 88% of cash paid out by insurers on Superfund-related claims from 1986-1991 was spent on defending policyholders and on litigation with policyholders to decide on cleanup responsibility. The high proportion of outlays spent on coverage disputes and defence costs reflects the fact that litigation precedes cleanup. Once remediation is underway to a fuller extent this proportion can be expected to fall. [2] Indeed, there is much uncertainty over future litigation costs. Amy Bouska of the actuarial firm Tillinghast has speculated (in testimony to Congress in 1990) that insurers' litigation costs could fall in a range as wide as $30 billion to $300 billion (based on overall cleanup costs of the Superfund program estimated at $100 billion to $700 billion). [3]

Recently, as many cases near trial stage after years of investigation, a number of out of court settlements have been reached. Such settlements can provide a framework for insurers to calculate their potential payouts.

Another repercussion of the heavy financial burden of these environmental claims is that the rating agencies and regulators are pressurising the insurance industry in general, to come up with at least a ballpark estimate of the compensation problem which is estimated to be between $30 and $100 billion for the US insurance industry.

(1) Leslie Scism, The Wall Street Journal Europe, July 14-15, 1995.

(2) James Capel, US Environmental Liabilities - who insured who 1946/69

(3) James Capel, US Environmental Liabilities - who insured who, 1946/69

There are two consequences of 'finding' these potential liabilities. One is external and one is internal to an insurance company. The first is the company's reputation based on its ability to pay. The second, which is related, is the company's financial status and need to build up its reserves to cover these new liabilities.

Alan Levin, a managing director of Standard & Poor's Ratings Group, heads an insurance-rating unit that has lowered the claims-paying-ability ratings of numerous insurers in 1995, partly because of the burden they face from pollution claims. He states that "We don't pretend to know what the correct number is, but we do believe that, within a reasonable range of estimates, we can identify what the exposure is for both the industry and for many companies."

Aetna Life & Casualty Co. agrees with this and has valued its additional environmental liability at around $1 billion. In response they have decided to increase their pre-tax reserves by $750 million - nearly tripling its environmental reserves to $1.2 billion. It is also purchasing a reinsurance policy of $335 million which will provide it with additional protection. Such financial investments severely affected Aetna's 1995 earnings, leading to a reported loss of $488 million, after tax.

This period of environmental claims has come at a time of strong competition within the insurance industry. Environmental liability payments cannot be held accountable for the losses now being experienced by the insurance companies but it is adding to the financial strain of covering reserves, particularly for some of the weaker companies.

Annex E

Characteristics of the Insurance Industry in Different Countries

This Annex provides background information on the size and characteristics of the insurance sectors for the main countries investigated. The parent insurance markets are shown to indicate the relative sizes the environmental markets are operating within. Also the size of the insurance sector shows how many potential insurance players there are for the environmental insurance market.

Insurance Markets in EU Countries

Country	Total insurance premia as % of GDP	Number of insurance companies
Germany	7	798
UK	12	828
France	8	599
Italy	3	274
Netherlands	8	491
Spain	4	408
Belgium	5	266
Sweden	6	na
Austria	6	na
Denmark	5	235
Norway	5	na
Ireland	9	97
Portugal	4	85
Greece	2	151
Luxembourg	6	73

UK

The UK insurance industry is the largest in Europe. Gross premium income for both General liability and Employers' liability policies in 1993 was 3.4 billion ECU (£2.86 billion). General Liability policies account for about 60% of this total.

There are several hundred insurance companies. However, four major companies (General Accident, Commercial Union, Royal and Sun Alliance) dominate the sector. They account for 60% of the total insurance market in the UK. (1)

Insurance companies all have General Liability (GL) policies and now some have introduced specific Environmental Insurance Liability (EIL) policies. The market for EIL is in its infancy, even though the first firm started

(1) This refers to these companies' shares of total premia for all insurance policies including General Liability, Employers liability, motor insurance, household and other insurance policies.

operating five years ago. There are only five UK-based insurers now offering specific EIL policies but it is thought that less than 50 policies have actually been written (with a total premia of less than 0.6m ECU (£0.5 million), compared to several hundred thousand GL policies with premia totalling 950m ECU (£790 million). It appears that most UK industrial companies think that GL policies cover their needs, and have not yet identified their uncovered liabilities.

Germany

The German liability insurance market's premium income in 1993 was 5.5 billion ECU (10,124 million DM). Commercial liability insurance accounts for about 60%. Overall profits are small.

The German liability insurance market for industrial risks is dominated by a group of ten insurers.

Premia income for EIL (UHG) policies is 382 million DM per annum. This is around 5% of total general liability premium income.

Italy

The Italian insurance market is small both in absolute terms (compared to other European countries) and relative to national economic levels.

Liability premia income is the lowest in Europe except for Greece. Out of the 300 insurance companies in Italy, 15% of the insurance companies are branches of foreign companies and 30% of the national companies are directly controlled by foreign companies. So there is a large international influence in the Italian insurance sector. 190 insurance companies provide liability insurance.

Spain

Competitive forces in Spain have led to a concentration in the insurance industry in Spain. Between 1980 and 1987 the number of insurance companies decreased by 30%. This trend is still continuing currently. As of 1994 there were 436 insurance firms in Spain. Six of these are reinsurers. 88% of the insurance companies are Spanish with the rest being under foreign ownership.

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Implications for Small and Medium Sized Enterprises

March 1996

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CONTENTS

1 INTRODUCTION

A firm's strategic response to liability and compensation systems for environmental damage depends upon a number of company characteristics such as size, nature of production, technology, resources and management style. SMEs are not only small in size but have their own distinct structure and business approach. [1] Limited access to resources makes SMEs slow to deal with environmental concerns. However, SMEs can be flexible and innovative.

The report has three main components:

The first part examines the critical sectors where SMEs have a particularly relevant share of total activity. *Annexes B and C*, and the accompanying *Appendix A*, provide detailed statistical information on different sizes of SMEs' share of specific industrial sectors' employment for EU15 countries (where possible). *Section* 2 summarizes these findings and identifies the sectors of industry in specific countries where SMEs predominate and hence which will be most affected if SMEs incur disproportionate additional costs from an environmental liability system.

Section 3 identifies how specific elements of an environmental liability system may particularly affect SMEs.

Section 4 discusses how certain costs associated with an environmental liability system will impact upon SMEs.

[1] The definition for SMEs used in this report is firms with 1-499 employees.

2 THE IMPORTANCE OF SMES

2.1 CHARACTERISTICS

SMEs are not simply smaller versions of large companies. SMEs have certain intrinsic features, notably limited access to capital, technology and information, rendering them vulnerable to their economic and regulatory environment. These characteristics increase levels of uncertainty for SMEs in handling environmental issues and reduces their capability to face a high amount of litigation in court.

SMEs are often not aware of their environmental impact and do not implement environmental management systems as extensively as do many large companies. While micro enterprises (under 10 employees) do not usually have significant environmental impacts, a SME's impact can be proportionally greater than its size and SMEs' collective impact can be considerable. Given their lack of awareness of environmental issues and relatively low media profile, SMEs may cause environmental damage as a result of ignorance.

SMEs are now being prompted to alter their environmental management practices because of their position in the supply-chain of production. As the majority of SMEs are situated mid-supply chain, they have to meet the demands of larger customers. As environmental strategies are implemented by larger companies, these companies are also requesting suppliers to meet environmental standards, mostly for their products, but also for their production processes. In some cases, SMEs can respond flexibly and innovatively to these requests.

2.2 CONTRIBUTION TO EU ECONOMIES

SMEs play an economically important role in European economies. They make up the bulk of firms, employ the majority of workers in the private sector and generate the greatest proportion of revenue. In the 12 EU Member States, SMEs account for approximately 70% of private sector employment and turnover. SMEs are a key element of European competitiveness and a crucial source of new employment.

The following groupings of European countries [(1)] can be identified in respect of the share of employment made up by small firms (less than 100 employees):

- less than the EU12 average - Belgium and Germany;

[(1)] Data were not available for Ireland or Greece.

- approximately the EU12 average (49-55%) - France, Luxembourg, the Netherlands and the UK;

- higher than the EU12 average - Denmark, Spain, Italy and Portugal.

Therefore, any effects on SMEs will be more pronounced in the countries in the last group compared with the other two groups.

2.3 PERCENTAGE OF SMES IN SELECTED SECTORS OF INDUSTRY

Sectors with higher compositions of SMEs will be more affected by the reactions of SMEs to environmental liability system provisions than sectors with low numbers of SMEs.

Table 2.3a ***Comparison of SME Contributions to Industry Sectors in Selected Countries (approx. % of employment of each sector)***

Industrial Sector	France	Germany	Italy	Spain	UK
Chemical	N/A	20	60	80	30
Minerals and Oil Refining	N/A	20	N/A	20	N/A
Food, Drink and Tobacco	75	80	80	80	35
Timber and Wood Furniture	90	90	99	99	75
Manufacture of Paper Products	80	65	80	90	60

Note: N/A = not available
Source: Annex C (Tables 3.1a, 3.2a, 3.4a, 3.5a and 3.6a)

Table 2.3a above shows that the paper products sector and the timber and wood sector have consistently high proportions of SMEs across the countries and will be extremely sensitive to SME levels of productivity and profitability. The chemicals sector has a much lower level of SME employment, except in Spain where SMEs still predominate. Therefore, the chemicals sector may be less adversely affected by problems for SMEs of a stricter environmental liability system.

3 IMPLICATIONS OF ENVIRONMENTAL LIABILITY SYSTEMS FOR SMES

3.1 INTRODUCTION

There are cases of SMEs being responsible for significant pollution incidents. The firm interviews found cases of mainly minor incidents involving little environmental damage, but some significant accidents were also mentioned. SMEs could be even more polluting than large companies because of their higher density in some local areas.

Currently, under national environmental liability policies, there are few special provisions made for SMEs. However, there are components of an environmental liability system which may disproportionably affect SMEs.

3.2 JOINT AND SEVERAL LIABILITY

Under joint and several liability, any polluter may be held liable for the entire restoration cost and then seek compensation from other responsible parties, regardless of their degree of involvement. This could lead to two different consequences for SMEs:

- SMEs will face the risk of being held liable for pollution damage costs, considerably in excess of their financial resources. This will be extremely difficult to plan for, and could be financially damaging.

- SMEs may avoid payments if the plaintiff decides to sue a responsible party with the largest financial assets rather than the major source of pollution. Large corporations will bear the burden of this 'deep pockets' effect, although the large corporations can then try to seek compensation from SMEs for their share of the cost of the environmental damage.

Joint and several liability promotes litigation between disputing potentially responsible parties. The costs of this litigation can be proportionally higher for SMEs than the larger firms disputing the claims, relative to their turnover and financial reserves.

3.3 FINANCIAL LIMITS ON LIABILITY CLAIMS

Predetermined financial limits for liability claims reduces uncertainties for SMEs and facilitates financial planning. However, the maximum amount could still be too high for some SMEs, thus producing an advantage solely to larger firms. These limits can affect insurance levels which can already be costly for SMEs. Moreover, it could lead to artificial constructions, like large, hazardous firms creating small firms with a view to limit their liability risk.

SMEs' limited financial capability may need to be separately considered, and financial claim limits set in relation to their turnover. However, this would leave more of the damage unrestored.

3.4 *BURDEN OF PROOF*

Strict liability requires the defendant to prove his innocence. Such a system could be particularly problematic for SMEs. They would have to acquire information about the pollution problems in order to find evidence to disprove the pollution claim. Lack of in-house technology will make the acquisition of proof over pollution particularly difficult.

3.5 *RETROACTIVE LIABILITY*

Retroactive liability will increase uncertainty for all firms. Uncertainty over historic pollution may be particularly high for an SME because it is often not aware of pollution problems that they caused decades ago. Lack of awareness is sometimes due to inappropriate management systems and low levels of record keeping in SMEs.

Retroactive liability could prove financially damaging to SMEs as it will expose potentially large pollution incidents. There was a case where a small firm had previously contaminated a portion of groundwater. The court decision was that the company was not liable. However, if retroactive liability had been valid and the company declared guilty, the consequent compensation payment would have led to its bankruptcy.

3.6 *PARTICULAR CONCERNS FOR SMEs*

3.6.1 *Cost of Due Diligence*

Insurance companies and banks may require site audits before providing insurance or a loan. Audits are costly and are required by both financial backers and future insurers as part of due diligence during mergers and acquisitions, and possibly also when loans are sought. The additional costs to pay for legal advice and to carry out audits to verify the existence of hidden liabilities can be a large burden and inhibit SMEs expanding through acquisition strategies.

There are different types of audits which can be carried out:

- Compliance audits are used to check the compliance with environmental regulations. They are frequently just desk based.

- Due diligence audits are used for mergers, acquisitions and disinvestment. They involve at least a preliminary site visit and, if necessary, a site investigation. The purpose is to identify hidden environmental liabilities and then assess their magnitude. They can typically cost between 2,500 and 6,500 ECU.

- Management system audits focus on the analysis of management systems, examining company environmental policy, the development of environmental programme and the preparation of adequate pollution prevention procedures and systems. This type of audit is more detailed than the others. Certification for EMAS involves one type of integrated environmental audit. The costs of measures involved in achieving EMAS certification range from 12,500 to 100,000 ECU. SMEs will be at the lower end of this range.

The cost of an audit depends on the level of detail required, the size of operations to be audited, the complexity of the production processes and the maturity of the audit market. Some economies of scale exist for audits but the audit cost per output unit will certainly be higher for smaller firms.

There are also costs associated with adopting pollution prevention measures after a site assessment. A due diligence site investigation may be an SME's first environmental assessment; it may identify significant measures needed to be adopted before financing or insurance is granted, if at all.

3.6.2 *Risk Management Capability*

Risk management is difficult for SMEs for two reasons. Firstly, due to lack of environmental monitoring, SMEs may not be aware of current environmental liabilities. They will need to pay to carry out site inspections to ascertain environmental risks. In contrast to large firms, SMEs do not tend to have already established environmental risk assessments and management systems in place so that implementing such systems will entail an additional and costly task for them. However, such assessments can also identify efficient pollution prevention options for the small firms some of which may be economically beneficial through, for example, savings in raw materials and energy.

Secondly, SMEs are more vulnerable to environmental risks since they are not as diversified as large firms; frequently their activities relate to a single product or process. Damage caused by one process may therefore have a significant impact on their total costs. SMEs will be more exposed in case of an incident and so have to be more careful in managing risk; yet they have limited management capability for prevention.

3.6.3 *Access to Finance*

Liability risks could lead banks to take a more conservative approach to valuing fixed assets as collateral for loans. SMEs usually have less internal financial capacity or other ways of raising financing than larger firms and banks tend to require small firms to provide collateral for loans. Therefore, environmental liability systems might restrict SMEs' borrowing capacity which would result in lower investment.

Compulsory financial security provisions would particularly affect small firms who would be in most need of a bond by an outside financial institution. Compulsory financial security could severely reduce the investment capability of small firms.

3.6.4 *Cost of Insurance*

SMEs have a greater need for insurance than many large firms. They do not have the possibility to share and pool risk among different products or sites within their ownership, which larger companies can do to their advantage. Also, SMEs, due to their size, have little opportunity for self-insurance. Therefore, any attempts to increase the environmental liability insurance market needs to take into consideration the high cost of insurance to SMEs.

The problem is that insurance premia for SMEs can be very high. This is because premia include a fixed cost which will be relatively higher for SMEs than larger companies, in relation to firm turnover. The fixed transaction costs include site assessments and implementation and administration of policy and handling claims. The transaction costs typically range between 25 and 40 percent of the insurance premium.

Compulsory insurance may have a large impact on SMEs. Firms which cannot afford to reduce environmental risks sufficiently will not be offered insurance and will be forced to close.

However, future specialisation in the insurance market, where some companies target SMEs, may lead to some reduction in premia for SMEs. The development of the insurance pools may also be advantageous. The insurance pools can develop policies suited for SMEs and support SMEs through disseminating information.

3.7 *SPECIAL PROVISIONS FOR SMEs*

So far, national liability systems have few special provisions for SMEs. Some exceptions exist as in the UK where, under the Water Resources Act, small incidents are not pursued for recovery costs.

The cost of compliance of environmental legislation can be very high for SMEs, due to limited resources and a lack of economies of scale. However, if SMEs are polluting then they should be made to pay for clean up. It is not necessarily desirable to make special exemptions that reduce payment obligations of SMEs. Moreover, the risk assessment and management systems that firms implement in response to environmental liability systems can lead them to identify economically worthwhile measures (eg savings in raw materials and energy).

Possible areas of assistance to SMEs could include: reducing uncertainties to help with financial planning; perhaps reducing excessive financial obligations to prevent closures; and facilitating access to finance and insurance to ensure potential for investment and financial protection.

Specific measures which would particularly assist SMEs in these areas of uncertainty, excessive cost and financing are·

- Taking the burden of proof off SMEs;
- Setting financial limits for claims;
- No compulsory financial security for insurance;
- Supporting risk assessment eg through subsidising site audits.

However, the first three of these would result in accordingly higher burdens on victims or the environment.

ANNEX A

NACE INDUSTRY SECTORS INCLUDED IN THIS REPORT

NACE Class	*DEFINITION*
1 Energy and water	
11	extraction and briquetting of solid fuels
12	coke ovens
13	extraction of petroleum and natural gas
14	mineral oil refining
15	nuclear fuels industry
16	production & distribution of electricity, gas, steam, hot water
2 Extraction & processing of non energy producing minerals and derived products; chemical industry	
21	extraction and preparation of metalliferous ores
22	production and preliminary processing of metals
23	extraction of minerals (other than metalliferous and energy producing); peat
24	manufacture of non-metallic mineral products
25	chemical industry
26	man-made fibres industry
3 Metal manufacture; mechanical, electrical and instrument engineering	
31	manufacture of metal articles (except mech., elec., instruments, vehicles)
32	mechanical engineering
33	manufacture of office and data processing machinery
35	manufacture of motor vehicles, parts and accessories
36	manufacture of other means of transport
4 Other manufacturing industries	
41/42	food, drink & tobacco industry
43	textile industry
44	leather and leather goods industry (except footwear and clothing)
45	footwear and clothing

46	timber and wooden furniture
47	manufacture of paper & paper products; printing and publishing
48	processing of rubber & plastics
49	other manufacturing industries

Annex B

SMEs in European Countries

This Annex B presents data on the importance of SMEs in different European countries.

Data Sources and Methodology

Data for the quantitative sections of this report were supplied by the *European Statistical System on SMEs* [(1)], a joint initiative of DG XXIII at the European Commission and Eurostat. Where possible, all 15 Member States of the European Union are considered. However, due to the recent incorporation of Sweden, Austria and Finland, there are significant difficulties in comparing data because of diverse data collection and classification conventions. Unless otherwise stated, European level observations refer to the year 1990 and therefore the new countries are not included in these statistics.

Within the industrial sector [(2)], i.e. the segment of the economy which is most directly implicated in pollution control measures, the NACE classification system was used (as established by Eurostat in 1970). Where national classification systems do not correspond with the NACE system, the difference is noted. *Annex A* contains a complete list of relevant NACE 2-digit codes and their definitions.

Data sources vary in their use of "total" or "paid" employment; the former includes self-employed and unpaid family workers while the latter is normally implied in references to number of employees. Due to the schematic nature of the quantitative analysis presented below, such differences in country data sets have been ignored.

Enterprises can be classified as micro, small, medium and large according to the number of employees. The most commonly used classification for SMEs, according to Eurostat/DG XXIII [(3)], broadly uses the term SME for firms with under 500 employees. This can be further subdivided as follows:

- micro (under 10 employees)
- small (10-99 employees)
- medium (100-499 employees).

In the detailed sectoral analysis section of this study, medium-sized firms are further subdivided into two groups (100-199 and 200-499). The large firm segment is also included, for comparative purposes, and is made-up of all firms with 500 employees or more. It is important to keep in mind that this subdivision is purely a convention and does not necessarily correspond to common practice among EU countries where multiple definitions are found, depending on the context. Turnover, balance sheet total and degree of financial autonomy are also potentially valid criteria but uniform data is not

(1) Data up to 1991 supplied on diskette, latest release in June 1995.

(2) According to NACE 2-digits classification, the industrial sector includes the energy and water,, the extraction and processing and the manufacturing sectors.

(3) See Enterprises in Europe - Third Report (Volume 1/Descriptive Analysis), European Commission-Eurostat, Luxembourg, 1994

currently available. For further information on data compilation conventions and methodology, please refer to footnote 2 (pp. xxvi-xxviii).

Comments on Methodology

The relevance of SMEs for environmental damage is unknown because existing data about quantitative emissions do not enable conclusions to be drawn on the relationship between per-unit emission and company size.

On the basis of existing information, we have tried to assess as far as possible the relevance of SMEs for pollution. For this purpose, employment data by company size are analysed in the following paragraphs, suggesting that this data can approximate SME's contribution to total emissions. Calculations are then made under the assumption that similar technologies are applied in the firms of each sector, and that pollution is proportionate to the number of people employed.

Under these assumptions, figures on employment shares that will be presented henceforward can be considered to represent pollution shares. Turnover or value added figures cannot be used for this purpose because much data is lacking or not comparable between the different countries.

Overview of Structural Statistics

In 1990, the economies of the 12 EC Member States contained about 14M enterprises and employed 64% of the active population (i.e. employed plus unemployed) of 92M persons. Of these, 99.8% were SMEs (1-499 employees), accounting for 69% of private sector employment and turnover.

Table B1: EUR12 Enterprises by Number of Units, Employment and Turnover (1990)

ENTERPRISE TYPE (NO. EMPLOYEES)	*% FIRMS*	*% EMPLOYMENT*	*% TURNOVER*
micro (<10)	93	32	24
small (10-99)	<7	25	27
medium (100-499)	0.5	15	20
large (500+)	<0.1	28	29

The micro sector (under 10 employees) accounted for approximately 93% of all enterprises, small firms (10-99 employees) under 7%, and medium sized units about 0.5%. While large firms (500+ employees) numbered 12,000 (less than 0.1% of firms), this segment accounted for a significant share of total employment and revenues. The situation is summarised in *Table B.1*.

The four main EU economies, Germany, France, the UK and Italy, together account for 67% of European enterprises and 75% of total employment. Spain accounts for 17% and 11% respectively; Belgium, Denmark, Portugal, and Luxembourg together make up most of the remainder (10% enterprises, 8% employment). Germany, with a tendency towards larger firms, has the highest share of employment (23%) while the number of enterprises is 15%

of the EUR12 total. Conversely, Italy has 21.5% of EUR12 firms but comes third in share of employees (15.7%).

A similar picture is displayed when average employment per enterprise is considered. The average for the EUR12 is 12 employees. Italy has the lowest number of employees with 7, followed by the UK, Portugal and Spain (8, 9, and 10 employees per firm respectively). Germany, Belgium, France, Denmark, Luxembourg and The Netherlands have above average employment per firm, ranging from 13 to 18 persons for Germany and The Netherlands respectively, with the other countries placed within this range.

Table B.2: Private Sector Employment by Firms' Size in Europe (1990)

	Micro (<10)	Small/Med (10-499)	Large (>500)	Unemployment rate %
EUR12	30.3	39.4	30.3	8.3
B	17.0	47.7	35.3	7.6
DK	31.6	49.1	19.3	8.1
D	18.3	45.6	36.1	4.8
GR	-	-	-	7.0
E	45.8	38.9	15.3	16.1
F	28.0	41.0	31.0	9.0
IRL	-	-	-	14.5
I(1989)	42.5	37.8	19.7	10.0
L	15.1	40.6	25.5	1.7
NL	-	-	-	7.5
P	24.3	54.7	21.0	4.6
UK	27.1	39.1	33.8	7.0
FIN	18.6	43.6	37.8	3.4
S	-	-	-	1.5

Taking the European SME sector in the widest sense (all firms with under 500 employees), 99.8% of companies fit into this category, accounting for around 69% of total employment and turnover. The situation for individual countries within the EUR12 ranges from 80% employment (Denmark, Spain and Portugal) to 63% in Germany and 66% in both France and the UK (see *Table B.2*). Looking at the weighting of small firms (<100 employees) in terms of share of total employment, EU countries can be split into three groups, relative to the average for EUR12:

Less than EUR12 average (<49%) - Belgium, Germany, Austria and Sweden;

About EUR12 average (49-55%) - France, Luxembourg, The Netherlands, and the UK;

Higher than the EUR12 average (60%+) - Denmark, Spain, Italy, and Portugal.

The Industrial Sector

Within the industrial sector, the segment of the economy which is most directly implicated in pollution control measures, the NACE classification system was used. 37.2% of total employment (accounting for 17.5% of European firms) and 41.1% of revenues fall into NACE categories 1-4, which represent the industrial sector.

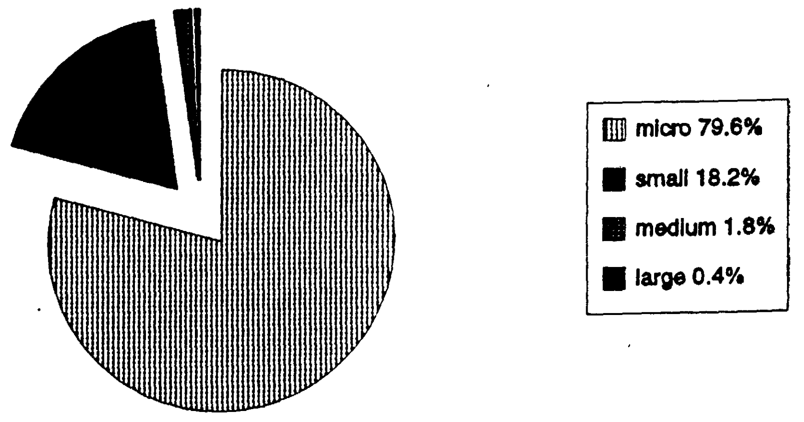
The country breakdown is presented in *Table B.3* for the share of industry in the whole economy. *Figures B.1* and *B.2* illustrate the breakdown in terms of company size for EUR12 as a whole. Micro enterprises figure much more heavily outside the industrial sector, i.e. in the construction, distribution and other service sectors [(1)]. SMEs, however, are relatively less significant in these other sectors in terms of number of enterprises (20% for industry, 5.0-7.4% for the other sectors) although the difference is less marked in terms of share of total employment (46.5% for industry; 43.4-45.9% for the others).

Table B.3: Share of Industry in the Whole Economy by Country, 1990

	% ENTERPRISES	% EMPLOYMENT	% TURNOVER
D	16.3	47.4	45.9
P	20.8	45.5	34.1
S	18.9	42.7	36.0
DK	18.2	38.3	30.9
FIN	20.6	37.9	38.2
E	21.6	37.4	-
EUR12 avg.	*17.5*	37.2	*41.1*
I	-	35.0	-
F	15.5	34.9	38.2
B	13.4	33.1	39.6
NL	5.8	28.2	30.4
UK	11.1	28.2	-
L	6.3	26.3	-

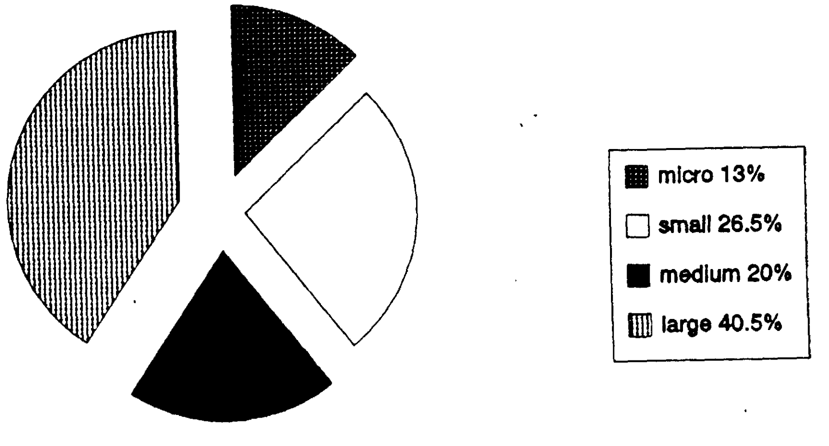
(1) Micro enterprises figure much more heavily in the construction, distribution and other service sectors than in the industry sector, namely ranging from 93-95% units and 40-51% employment compared with 80% units and 13% employment for industry.

Figure B.1: Breakdown of Industrial Enterprises by Number (EUR12, 1990)



Source: FEEM, elaboration from Eurostat data

Figure B.2: Breakdown of Industrial Employment (EUR12, 1990)



Source: FEEM, elaboration from Eurostat data

Germany and Portugal have higher percentages for the industrial sector, compared with the general classification. Germany has a 17% share of EUR12 industrial firms and 28% of industrial employment (cf. 23% overall). For Portugal, the industrial sector figures are 5.3% firms and 3.6% employment. France, Italy, Denmark and Luxembourg exhibit similar shares for industry whereas in the UK and in Belgium, industry features less due to the importance of the service sector in these countries.

Table B.4 shows the relative importance of industry among EUR12 countries. It can be seen that Germany and France have relatively higher shares of industrial employment than number of firms whereas in Italy, the UK, Spain and Portugal the situation is reversed. This is also reflected in a ranking of the main European economies by size class for Industry (NACE classes 1-4). Italy comes first in the micro and small segments in terms of number of firms and employees. Germany is first for all criteria in the medium and large firms segment. France comes second for all variables in the medium segment. The UK is third in medium but second in the large segment.

Table B.4: Share of Each Country in EUR12 Industry (1990)

	% ENTERPRISES	% EMPLOYMENT
D	16.7	28.0
UK	16.7	18.6
I	21.8	15.7
F	11.8	14.8
E	16.0	9.1
B	2.6	2.6
P	5.3	3.6
DK	2.1	1.7
L	0.1	0.1
Others	6.9	5.9
Total	100	100

The overall importance of industry in the various size classes is compared to the USA in *Table B.5*. In terms of number of units, the European industrial sector has a stronger weighting than the USA in the micro size class only. However, with regard to share of total employment, industrial micro and SMEs in EUR12 play a relatively more significant role than in the USA, where large firms account for the majority of industrial employment (over 60%).

Table B.5: Size Class Breakdown for Industry, USA and EUR12 (1990)

	MICRO (<10)		SMALL (10-99)		MEDIUM (100-499)		LARGE (>500)	
	%units	**%empl.**	**%units**	**%empl.**	**%units**	**%empl.**	**%units**	**%empl.**
EUR12	69.9	10.8	27.2	27.2	2.6	20.4	0.6	41.6
USA	56.4	3.4	35.5	18.4	5.4	15.9	2.7	62.3

Annex C

SMEs in Sectors in European Countries

COUNTRY SECTORAL ANALYSIS

This Annex C presents data on the importance of SMEs in various sectors in different European countries. The principal analysis is based on *share of total employment*, rather than number of enterprises or turnover per category, as this was considered to be the most transferable criterion across differing national situations. Other information is provided where necessary.

Data were provided by the *European Statistical System on SMEs.* The year 1991 is used where possible and unless otherwise stated in the tables. All Italian data are for the year 1989. German data up to 1990 refer to the former Federal Republic of Germany (including West Berlin); thereafter unified data are used. Certain comparisons and breakdown analyses are not possible due to overlapping sectoral classifications adopted by some national statistical bodies. Neither Greece nor Austria, for example, provide data on micro enterprises. Italy does not provide data on zero employees enterprises, which are represented by independent professions. Sweden has combined data for NACE 1 and 2 for micro and small firms categories.

Industry Overview in Terms of Employees

Looking at the NACE industry sectors 1-4 (see *Annex A*), the energy and water sector (NACE 1) is predominantly made up of larger firms, in terms of share of total employment, for all European states (see *Table C.1)*. The percentage of employment in enterprises with over 500 employees ranges from over 90% in France, the UK and Portugal, to about 80% in Germany, Italy and Spain and to 40% in Ireland, Austria and Finland (see *Appendix A Table A.1*).

The extraction and processing sector (NACE 2) is still predominantly made up of larger firms. However, this predominance is not as wide as in the first sector. The percentage of employment in firms with over 500 employees ranges from around 65% in Germany, the UK and Belgium, to around 30% in Italy, Spain and Portugal, to only 20% of Greece. On the other hand, there is a light prevalence of employment in enterprises with 10 to 200 employees in Italy (44%) and Spain (43%) and a more marked prevalence in Ireland (60%) (see *Appendix A Table A.2*).

As regards the metal manufacturing sector (NACE 3), it is not possible to find a common element which characterises most of the European countries. On one hand, there is a clear prevalence of employment in larger firms in some States, like Germany (60%), Sweden (55%), the UK (52%) and France (52%). On the other, there is a predominance of employment in SMEs in Italy and Spain. There are some countries, namely Portugal and Denmark, where both SMEs and larger Companies account for around 50% of employment (see *Appendix A Table A.3*).

The other manufacturing sector (NACE 4) is predominantly made up of SMEs for all European States, except for the UK (larger firms: 55%). The percentage of employment in enterprises with 10 to 99 employees is around 35-45% for most of the countries. In Italy, there is a clearer predominance of

SMEs i.e about 50% of employment is found in firms with 10 to 99 employees, employees in micro firms are 25% of the total, and firms with 100 to 499 employees account for 16% oi the total (see *Appendix A Table A.4*).

Looking at the overall NACE industry sectors 1-4, it is easier to comprehend the distribution of firms by country. Employment in larger firms with over 500 employees is predominant in the UK (58%) and in Germany (52%), and is also important in Austria (43%) and Belgium (42%). On the other hand, employees in SMEs are prevalent in all the other European Countries. In Italy (44%) and in Spain (37%) there is a prevalence of small firms with 10-99 employees. Including micro enterprises in the SMEs definition, all the European Countries, except for the UK and Germany, present a prevalence of employment in smaller firms in the industrial sector.

Table C.1: Total Industry (NACE 1-4) Country Sectoral Analysis (1991)

	NACE 1-4 Industrial sectors, number of employees														
	BELGIUM	DENMARK	GERMANY*	GREECE	SPAIN	FRANCE*	IRELAND*	ITALY **	LUXMBG	NL*	PRTUGL	UK	AUSTRIA *	FINLAND	SWEDEN ***
<10	52394	67792	546428	n.a.	703154	518386	9251	896170	1639	53966	78708	670589	n.a.	42680	98523
10-99	205115	168058	1850116	111554	1009667	1182149	77372	2269188	8040	475914	321395	581631	203326	87590	115345
100-199	74312	59237	749135	34818	222169	415089	49049	418107	4468	355325	134109	377025	106690	15573	46378
200-499	113221	74013	1062143	59341	297563	2303266	82580	457118	11924	362888	173190	505511	19721	34745	137819
>500	316967	135710	4646756	57584	472187	1962858	55256	1164745	15954	n.a.	217991	2925526	253042	64798	214355
								0							
total	762009	504810	8874578	263297	2704740	6381748	273508	5204328	42025	1248082	925393	5040282	582679	245366	612420
percentage values															
<10	6,88	13,43	6,16		26,00	8,12	3,38	17,20	3,90	4,32	8,51	13,30		17,39	16,09
10-99	26,92	33,29	20,85	42,37	37,33	18,52	28,29	43,60	19,13	38,13	34,73	11,14	34,90	35,70	18,83
100-199	9,75	11,73	8,44	13,22	8,21	6,50	17,93	8,03	10,63	28,47	14,49	7,48	18,29	6,35	7,57
200-499	14,86	14,66	12,19	22,54	11,00	36,09	30,19	8,78	28,37	29,08	18,72	10,03	3,38	14,16	22,50
>500	41,60	26,88	52,36	21,87	17,46	30,76	20,20	22,38	37,96		23,56	58,04	43,43	26,41	35,00
sum	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

NOTES
* 1990
** 1989
*** employment size-classes: 1-19;20-99

Source: FEEM elaboration on Eurostat data.

Overview of Germany, Italy, Spain and the UK

This section reviews the characteristics of SMEs in the industrial sectors, focusing on individual countries. Looking at NACE industry sectors 1-4 and using the above mentioned analysis, we have considered the firms' quantitative distribution in four countries, namely, Germany, Italy, Spain and the UK. *Tables C.1 - C.4* present data on the shares of total employment by firms of various sizes in the main sectors in each of these countries.

Germany

In Germany, the energy and water sector's employment (NACE 1) is predominantly concentrated in larger firms (83%). For example, the percentage of employment in enterprises employing more than 500 persons in the extraction and briquetting of solid fuel sector (NACE 11) is 98%, and in the mineral oil refining sector it is greater than 80%.

The extraction and processing sector (NACE 2) is made up predominantly of employment in larger firms, i.e. 69%. In sector NACE 25, the chemical industry, employment in larger firms accounts for 78% of total employment.

The NACE 3 sector, metal manufacture, shows a prevalence of larger firms, 60%. Conversely, employment in the manufacture of office and data processing, of motor vehicles, and of other means of transportation sectors (NACE 33, 35 and 36), ranges from between 77% to 92%. The German manufacture of metal articles (NACE 31) is predominantly represented by employment in SMEs. When one includes micro firms in the definition of SMEs, these firms account for more than 70% of employment, similar to Italy and Spain where more than 90% of these firms account for total employment. In the UK, these firms account for 60% of employment. For NACE 3, Italy and Spain are characterised by a large share of persons employed in SMEs, the UK the lowest share, and Germany is in between.

With regard to the other manufacturing industries sector (NACE 4) it is not possible to find a clear predominance in the firms quantitative distribution. The small firms section is slightly prevalent, namely, 34%. In the food, drink and tobacco industry, the leather, the footwear and clothing sectors (NACE 41/42, 44 and 46) the prevalence of small firms ranges from 40% to 49%. Only the processing of rubber and plastics sector (NACE 48) exhibits a large share of larger firms, 43% (see *Appendix A Table A.5*).

Italy

In Italy, as in most European Countries, the NACE 1 sector is predominantly made up of employment in firms with above 500 persons, i.e. 75% of total employment in the sector. Conversely, the extraction and processing, metal manufacture and the other manufacturing sectors (NACE 2, 3 and 4) are characterised by fewer smaller firms. In the NACE 4 sector, 47% of firms have between 10-99 employees; 20% of firms have less than 10 employees; 20% of firms are medium sized; and 10% are larger firms.

The extraction and processing and the metal manufacturing sectors present similar distributions of employment in SMEs and larger firms. In NACE 2, employees in enterprises with 10 to 99 employees account for 35% of the total and the larger firms account for 32% of the total. SMEs' employment, including micro firms, accounts for around 70%. It is worth noticing that the share of employment in larger firms in the chemical Italian industry sector (NACE 25) is 40%, nearly half the size of the German one, whereas small firms alone (10 to 99 employees) account for 28%.

In NACE 3, 34% of firms have between 10 to 99 employees and 33% of firms have more than 500 employees. SMEs total, including the micro firms, account for more than 65%. The manufacture of metal articles and the mechanical engineering sectors have a prevalence of small firms, 49% and 43% respectively, the highest share in the European countries. The other activities (the manufacture of office and data processing, of motor vehicles, and of other means of transport sectors) are predominantly made up of larger firms. The percentage of firms with greater than 500 employees is more than 70%.

The other manufacturing industries sector presents the highest prevalence of employment in smaller firms in Europe. The enterprises with 10 to 99 employees account for 47% of employment, where SMEs total, including micro firms, represent more than 90% of employment in the sector. Micro firms are widely diffused (26%), especially in the timber and wooden furniture sector (NACE 46) where they account for 46% (see *Appendix A Table A.6*).

Table C.2: Germany - Shares of Total Employment (1990)

GERMANY	micro (<10)	small (10-99)	medium (100-199)	medium (200-499)	large (>500)	TOTAL	Total employment
1. Energy and Water	1.11	5.56	3.38	7.11	82.84	100	476,006
2. Extraction & processing...	2.76	12.90	5.93	9.65	68.76	100	1,243,916
3. Metal manufacture	4.00	17.07	7.63	11.33	59.98	100	4,508,564
4. Other manufacturing industries	12.34	33.78	11.91	15.78	26.19	100	2,646,092

Source: FEEM elaboration on Eurostat data

Table C.3: Italy - Shares of Total Employment (1990)

ITALY	micro (<10)	small (10-99)	medium (100-199)	medium (200-499)	large (>500)	TOTAL	Total employment
1. Energy and Water	5.55	5.10	3.27	6.70	79.35	100	207,527
2. Extraction & processing...	13.80	34.84	8.71	10.67	31.95	100	762,770
3. Metal manufacture	12.59	33.57	9.53	11.03	33.25	100	1,619,000
4. Other manufacturing industries	26.31	46.58	8.72	8.39	9.98	100	2,182,621

Source: FEEM elaboration on Eurostat data

Table C.4: Spain - Shares of Total Employment (1991)

SPAIN	micro (<10)	small (10-99)	medium (100-199)	medium (200-499)	large (>500)	TOTAL	Total employment
1. Energy and Water	4.47	10.10	5.26	9.39	70.80	100	129,132
2. Extraction & processing...	13.69	32.63	10.98	16.35	26.35	100	480,168
3. Metal manufacture	22.38	34.07	6.87	9.46	27.22	100	933,954
4. Other manufacturing industries	32.07	39.60	7.48	9.00	11.86	100	1,317,714

Source: FEEM elaboration on Eurostat data

Table C.5: UK - Shares of Total Employment (1991)

UK	micro (<10)	small (10-99)	medium (100-199)	medium (200-499)	large (>500)	TOTAL	Total employment
1. Energy and Water	1.14	1.84	1.74	4.71	90.57	100	418,484
2. Extraction & processing...	5.14	12.89	6.71	10.32	64.94	100	665,668
3. Metal manufacture	10.67	20.51	7.59	9.35	51.89	100	2,187,954
4. Other manufacturing industries	18.35	19.38	7.33	9.80	45.13	100	2,169,147

Source: FEEM elaboration on Eurostat

Spain

In Spain the percentage of employment in larger firms in the NACE 1 sector is 71%, the lowest of the four examined countries. In the extraction and processing sector (NACE 2), employment in enterprises with 10 to 99 employees is 33%, ranging from 14% in the extraction and preparation of metalliferous ores sector (NACE 21) to above 55% in the extraction of minerals sector (NACE 23). Larger firms account for 26% of employment. The chemical industry sector (NACE 25) presents a similar distribution for the five size categories, with a slight prevalence (29%) of firms with 10 to 99 employees.

The metal manufacture sector (NACE 3) is predominantly made up of employment in SMEs. When one includes micro firms, SMEs' employment is more than 70% of the total. With regard to the manufacture of motor vehicles and other means of transportation sectors (NACE 35 and 36), there is a prevalence of larger firms, 49% and 67% respectively.

The other manufacturing industry sector (NACE 4) presents an clear predominance of employment in SMEs. Including micro firms, SMEs account for around 90%. For example, the percentage of larger firms in the timber and wooden sector (less than 1%) is negligible and is the lowest of the four European Countries (see *Appendix A Table A.7*).

These findings about the Spanish sectoral distribution, show similarities with Italy, i.e the same prevalence of SMEs in the same industrial sectors, and differences with Germany and the UK.

UK

While Spain and Italy present a large number of persons employed in SMEs, this is not the case in the UK. The UK is made up predominantly of larger firms in all the industrial sectors. In the NACE 1 sector, firms with at least 500 employees account for 91%; in NACE 2 these firms account for 65%; in NACE 3 for 52%; and in NACE 4 for 45%, the highest share in all European countries.

The chemical industry sector (NACE 25) is predominantly made up of employment in larger firms (69%) but the German share is still the highest. SMEs, micro firms excluded, account only for around 25%.
The percentage of employment in SMEs in the NACE 4 sector is not as high as in the other European countries. For example, micro firms account for 18%, SMEs for around 30% and, conversely, larger firms present the largest share, accounting for 45%. The UK is the only European country where the food, drinks and tobacco (NACE 41/42) and the textile industries (NACE 43) are predominantly made up of larger firms: firms employing more than 500 employees account for 64% and 54% of the total respectively (see *Appendix A Table A.8*).

Polluting Industries

This section aims at describing the profile of SMEs in eight polluting industrial sectors, focusing on the five largest European countries: France, Germany, Italy, Spain and the UK and comparing, where possible, with the EUR12 countries average.

Comparable European data are only available at NACE two digits level and even at this level there are many gaps or non comparable figures. In the context of this constraint, we selected the sectors most sensitive to environmental liability policy. Selected sectors are very similar to industries affected by UHF in Germany.

The industrial sectors analysed are:

- chemical
- mineral and oil refining
- extraction and preparation of metalliferous ores
- production and preliminary processing of metals
- food, drink and tobacco industry
- timber and wooden furniture
- manufacture of paper products
- processing of rubber and plastics.

For each of these sectors and for each country, a brief review and an accompanying table is provided, indicating shares of total employment.

The Chemical Sector

It is worth noticing the chemical industry sector (NACE 25), as it is subject to risk from several types of environmental damage.

Table C.6 shows that in Germany, the sector is predominantly made up of larger firms, i.e. around 80% of employees are employed in firms with more than 500 employees. The same occurs in the UK where around 70% of employees are in larger firms. Conversely, Italy and Spain present a prevalence of SMEs in the chemical sector; SMEs account for around the 60% in Italy and for 70% in Spain.

Taking into account the total number of employees per country, other considerations follow. The total employment in the chemical sector in the UK, in Italy and in Spain is similar (between 200,000 to 260,000 employees). Conversely, in Germany the chemical sector is larger, employing about 620,000 persons. French data are not available.

Table C.6: The Chemical Sector (NACE 25), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	n.a.	0.98	5.54	9.38	4.05	3.36
small (10-99)	n.a.	7.19	27.81	29.31	10.16	14.42
medium (100-199)	n.a.	4.83	10.68	15.46	6.06	8.04
medium (200-499)	n.a.	8.58	13.43	23.02	10.76	13.89
large (>500)	n.a.	78.41	42.54	22.83	68.97	60.30
TOTAL	n.a.	100	100	100	100	100
total employment	n.a.	615,161	244,356	193,036	290,980	1,987,012

* EU-12 average data on NACE 25/26.

The Mineral and Oil Refining Sector (NACE 14)

Total employment numbers in the five countries are similar, potentially permitting comparison between the firms' distribution but the data are not readily comparable and much data is unavailable, except for Spain and Germany.

Table C.7 shows that Spain and Germany both have a prevalence of larger firms with more than 500 employees, namely 81% and 83% of the total employment share.

Table C.7: The Mineral and Oil Refining Sector (NACE 14), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	n.a.	0.69	n.a.	0.31	n.a.	3.65
small (10-99)	n.a.	4.43	n.a.	1.92	n.a.	3.91
medium (100-199)	n.a.	4.98	n.a.	3.57	n.a.	2.46
medium (200-499)	n.a.	8.98	n.a.	10.88	n.a.	8.69
large (>500)	n.a.	80.92	n.a.	83.32	n.a.	81.29
TOTAL	n.a.	100	n.a.	100	n.a.	100
total employment	24,457	20,291	22,617	11,749	n.a.	334,813

* EU-12 average data on NACE 13/14.

Extraction and Preparation of Metalliferous Ores Sector and the Production and Preliminary Processing of Metals (NACE 21/22)

Data for NACE sectors 21 and 22 have been aggregated in *Table C.8* because disaggregated data are available only for some of the countries analysed. German extraction and preparation of metalliferous ores, and the production and preliminary processing of metals sectors present a clear prevalence of employment in firms with more than 500 employees (around 83%).

The Spanish case is different, with the larger firms accounting for 55% of total employment in the sector, which is less than the German share, even if it represents almost half the employment distribution.

Table C.8: The Extraction and Preparation of Metalliferous Ores and the Production and Preliminary Processing of Metals (NACE 21/22), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	1.02	0.56	5.98	7.17	3.73	2.65
small (10-99)	8.60	5.84	22.14	16.61	9.06	10.75
medium (100-199)	5.00	4.44	6.72	7.87	6.86	5.79
medium (200-499)	11.04	6.76	10.21	15.14	9.54	9.48
large (>500)	74.33	82.40	54.95	53.51	70.81	71.33
TOTAL	100	100	100	100	100	100
total employment	115,882	305,396	159,407	91,404	142,156	950,100

The French, the British and the Spanish cases present a prevalence of employment in larger firms. In France and the UK, 75% and 71% of employees respectively are working in large firms.

The Food, Drinks and Tobacco Industry

Looking at the food, drinks and tobacco industry sector, the total employment numbers seem to be different across countries (see *Table C.8*). France and Germany, have a similar number of total employees, namely 604,824 and 733,694 respectively. Italy, Spain and the UK have 339,414, 388,464 and 453,980 employees respectively.
When one includes micro firms, SMEs account for around 75% of employment in France and more than 80% in Germany.

The UK shows a clear prevalence in employment in larger firms which account for more than 64% of total employment, while in Italy and Spain they account only for 20%.

This confirms the British trend; i.e even in this NACE 4 manufacturing sector, where all the other countries in Europe present a prevalence of SMEs, the UK still has most employees in larger firms.

Table C.8: The Food, Drinks and Tobacco Industry (NACE 41/42), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	27.56	17.62	22.12	26.98	9.89	19.73
small (10-99)	24.59	40.15	35.38	31.64	10.45	28.94
medium (100-199)	10.05	10.29	9.55	7.64	6.84	9.65
medium (200-499)	11.98	13.31	10.41	13.62	8.78	12.68
large (>500)	26.82	18.62	22.54	20.12	64.04	29.01
TOTAL	100	100	100	100	100	100
total employment	604,825	733,694	339,414	388,464	453,980	3,232,487

The Timber and Wooden Furniture Sector

The timber and wooden furniture sector presents a prevalence of SMEs in all the European Countries (see *Table C.9*). For the EUR12 countries average, employment in SMEs accounts for more than 90%. In the UK, SMEs account for 75% of the total compared with around 90% in Germany, more than 92% in France and 97-99% in Italy and Spain.

Table C.9: The Timber and Wooden Furniture Sector (NACE 46), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	25.80	20.61	45.90	50.02	28.92	33.44
small (10-99)	44.22	41.14	44.89	44.11	30.53	42.32
medium (100-199)	12.20	11.29	5.31	2.98	9.11	8.31
medium (200-499)	10.37	13.50	2.89	1.93	7.78	7.24
large (>500)	7.41	13.46	1.01	0.96	23.65	8.69
TOTAL	100	100	100	100	100	100
total employment	203,950	361,526	330,790	235,898	276,973	1,709,646

The Manufacture of Paper and Paper Products Sector

Table C.10 shows that France, Italy and Spain present a predominance of SMEs; they account for 77% in France, 81% in Italy and more than 90% in Spain. SMEs are prevalent in Germany and the UK too, but to a lesser extent. In Germany, SMEs account for 66% and in the UK for 57%.

Table C.10: Manufacture of Paper and Paper Products (NACE 47), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	14.67	8.96	19.00	27.32	20.75	16.38
small (10-99)	35.19	28.52	42.84	42.13	21.91	31.36
medium (100-199)	10.09	11.98	9.09	9.88	5.56	9.58
medium (200-499)	17.57	16.51	10.06	10.84	8.60	13.56
large (>500)	22.54	34.03	19.00	9.82	43.17	29.12
TOTAL	100	100	100	100	100	100
total employment	331,241	575,269	241,137	183,905	544,669	2,256,870

The Processing of Rubber and Plastics Sector

Table C.11 shows that, in Germany, larger firms account for 43% of total employment in the sector.

In the other four European Countries SMEs are prevalent but to different extents. The biggest share is in Italy where around 85% of employees are employed in SMEs. In Spain, SMEs, including micro firms, account for about 70%. In France and Germany SMEs, including micro, account for 67% and 58% of SMEs respectively. In contrast, the UK shows a prevalence of larger firms, which account for 55% of total employment.

Table C.11: The Processing of Rubber and Plastics Sector (NACE 48), (1990)

	FRANCE	GERMANY	ITALY	SPAIN	UK	EUR12 avg.
micro (<10)	4.53	3.78	11.48	16.15	10.21	7.74
small (10-99)	26.11	26.07	48.20	35.85	10.78	28.88
medium (100-199)	10.82	11.81	11.75	8.80	9.45	11.76
medium (200-499)	15.14	15.64	11.99	8.26	15.02	14.15
large (>500)	43.40	42.71	15.58	30.94	54.54	37.47
TOTAL	100	100	100	100	100	100
total employment	218,201	383,928	193,384	74,976	242,781	12,838,28

Comparing to the European 12 Countries average, it is worth noticing that Italy and Spain present, as usual, a much wider prevalence of employment in SMEs than all the other Countries.

European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Compensation Funds

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CONTENTS

1 INTRODUCTION

A significant proportion of environmental damage costs are not financially covered by a responsible party (polluter or insurer) under existing environmental liability systems. These include situations where: the responsible party cannot be identified because, for example, the responsible party has gone bankrupt; an identified party is incapable of making the required compensation payments. Compensation payments may also only be made in part, if financial limits are imposed on payments under an insurance policy. Several European countries as well as the US and Japan now have established compensation funds to finance these gaps of accountability in the liability system. The funds raise finances for the specific purposes of compensation or restoration of environmental damage. Within a fund there are many options to raise, administer and allocate finances. Each element can have important implications for the role the fund eventually plays.

1.1 OBJECTIVES

The objectives of this topic paper are to:

- identify when it might be appropriate for a compensation fund to cover environmental damage
- summarize the major characteristics of the various funds to identify the main options available for policy makers when developing a compensation fund system
- compare the effectiveness of the existing compensation funds
- assess the specific elements of existing compensation funds to identify lessons for the EC regarding the use of different arrangements for a compensation fund.

1.2 RESEARCH METHODS

A two stage research process was carried out. All current reports on compensation funds in France, Sweden, Netherlands, Japan and Germany were reviewed. Then interviews were carried out with members of the ministries of environment in the Netherlands and Japan.

Compensation systems are complements to, and not a substitute for, liability systems. They are used to cover environmental damage for which a liability system cannot find a responsible party or the responsible party cannot pay. It therefore can act as a 'safety net' for victims who otherwise would have not been able to seek compensation. The essential principle of a compensation fund is that damage is remedied or victims compensated, financed from a fund which in turn is financed by a collective group of polluters rather than by the general population (through general taxes) or by the victims (where damage go uncompensated).

In doing so funds can also function as a warning system, since claims to the fund could alert the government to the need to develop policy in other areas of environmental liability. Increased claims would show increased pollution, increased gaps in the existing liability compensation system or that criteria allowed for claims to be made were too broad leading to too many claims being made.

The possible circumstances where gaps might arise and a compensation fund is appropriate include:

- Where no liable party can be identified.
- Where the liable party no longer exists or is not sufficiently solvent.
- Where a large number of polluters and/or victims are involved and the transaction costs of proving liability would be high.
- Emergency cases where there is an urgent need to restore damage quickly due to direct danger to health or state of the environment or viability of local enterprises.
- Where insurance is not available to cover environmental damage. This may include ecological damage since insurers have stated that they are unwilling to insure damage due to uncertainties concerning their valuation. It might also include environmental damage that is self-insured in cases where the self-insured firms become bankrupt.

These circumstances occur with enough frequency that significant amounts of damage accumulate which are not compensated. The environmental insurance market, for instance, currently accounts for less than 1% of environmental damage costs in European countries (see *topic paper 3 on insurance*).

Hence there are large outstanding environmental damage costs not covered within environmental liability systems. The issue therefore, is to ascertain the feasibility and desirability of the scope and mechanics of compensation funds for dealing with these outstanding environmental damage.

Conflict in the Role of Funds

There is, however, a fundamental problem with the role and construction of a compensation fund. Due to a fund's role of providing compensation or cleanup when the responsible party cannot be identified or cannot pay, a conflict may arise between the goals of the government and the interest of firms.

Governments wish to use compensation funds to:

- ensure all damage is restored;
- ensure victims are compensated;
- minimise claims on the public purse;
- be able to intervene with a fund if remediation is too slow or transaction costs are too high.

These goals lead to funds being raised from a collective group of polluters instead of individual responsible parties.

Firms in general do not prefer this means of payment and compensation. Firms:

- accept the polluter pays principle (PPP) but do not want to pay for other peoples' (especially competitors') pollution;

- need efficient incentives for pollution prevention.

The pooling mechanism for raising finances to pay for compensation or cleanup may not achieve the necessary incentives for firms to increase pollution prevention and may go against the PPP. Examples of these problems can be seen in the compensation funds detailed in the following section.

Such conflicts may limit the capacity of a fund to raise finances and thus restrict its ability to fulfil its role in compensating outstanding damage.

3 ASSESSMENT OF EXISTING COMPENSATION FUNDS

This section reviews experience with various compensation funds in EU countries and Japan where they are most developed and assesses their desirability and efficiency to identify lessons regarding compensation systems.

3.1 CRITERIA FOR APPRAISING COMPENSATION SYSTEMS

The precise functions, goals and reasons for operation of each fund have to be identified in order to make assessments about their effectiveness and success.

Criteria for assessing options for financing the compensation funds include:

- Efficiency and effects on firms' incentives - does the financing mechanism provide an incentive for firms to implement prevention measures?
- How firms are likely to respond to the financing of the system.
- Reliability and uncertainty over the level of funds needed and the contribution rate.
- Transaction costs of raising the revenue and administering the fund.
- Polluter pays principle - that the costs of restoring the environmental damage are borne by the firms causing the damage and not the government.
- Effectiveness of the compensation fund in remedying the environmental damage costs and compensating victims

3.2 FUNDS IN SELECTED COUNTRIES

This section carries out a comparative analysis of experience of existing compensation systems in terms of the elements of compensation systems outlined in the terms of reference. The analysis covers funds in European countries, as well as Japan where there is a well established compensation fund.

3.2.1 France

Goals

The purpose and scope of compensation funds in France are to cleanup contaminated land at orphan sites. Contaminated land has been identified as a large environmental problem. It was estimated in 1994 that comprehensive cleanup of the sites would cost 100 million francs [(1)] in total.

In an effort to offset pressure by government for cleanup of their own contaminated land sites many of the largest companies in France joined together in the early 1990s to form a trust fund to contribute to the cleanup of orphan sites.

Financial and Administrative Arrangements

The first, private trust fund was composed of, and privately administered by, around 60 companies. In 1992, 25 million FF were made available for orphan site cleanup. This only rose to 29 million FF by 1994 when the program was eventually curtailed. Because the fund was set up to relieve pressure from the Government on polluting firms to clean up their own contamination the level of the fund was not based on the level of cleanup needed but the minimal levels polluters thought was acceptable to keep the Government satisfied.

However, participation in this fund did not achieve the initial goal of easing government pressure. Companies were still being pressured by the government to clean up their own sites. This led to a lack of interest by the companies involved and they eventually decided not to divert more resources to cleaning up orphan sites. [(2)] This led to the termination of the fund.

To replace the dissolved fund the government expanded the 1992 Law 92-646 by introducing a 20 FF per tonne landfill tax on municipal waste. Then the 1995 Law 95/101 extended the scope of this tax to include industrial and hazardous waste and raised the tax to 25 FF per tonne. This established annual finances for a publicly administered compensation fund. The taxes for this fund raise a total of 65 million FF per year. [(3)]

The tax is to be raised by 5 FF each year until 1998. By 1998 the tax level will be 40 FF per ton. It will then remain at this level thereafter in the following years [(4)]. A 40 FF per ton tax would lead to a nominal increase to 104 million FF [(5)]. This would then attain the estimated 100 million FF needed per annum to cleanup contaminated sites.

In order to administer the tax for the fund the government set up ADEME (Agency for Management of Environmental Waste and Energy), a government agency. The agency will administer the funds to clean up [(6)] 669 orphan sites which have been identified as critically contaminated.

(1) Pierre Bechmann, Partner, Clifford Chance Environment Group, Paris, "France: Development in Contaminated Land Programme" 5th Environmental Insurance Conference, Lloyds List Press, 1995.

(2) Pierre Bechman

(3) Pierre Bechmann

(4) UK Waste Management Ltd (1995), Response to the UK Government's Consultation Paper on a Landfill Tax.

(5) This is calculated on the assumption that the tax base will be the same size.

(6) UK Waste Management Ltd, Response to the Government's Landfill Tax Consultation Paper, 1995

Results

No sites have so far been cleaned up because the fund has started so recently.

Conclusion

Industry does not have much of an incentive to administer and contribute to the compensation fund.

A landfill tax may be a suitable method of raising finances to support an orphan site compensation fund.

It is too early to determine if this nationally run contaminated land cleanup program will be effective.

3.2.2 *Sweden* [1]

Goals

In Sweden a person who has suffered an injury or damage to his property cannot obtain compensation under the 1986 Environment Damage Act if it is not possible to ascertain who is responsible for the damage or if those responsible are insolvent. In order to overcome the problem of having unidentifiable or insolvent polluters the government decided to set up a fund system.

The fund is a safety net with the claimant having first to try to claim compensation from the responsible parties wherever possible. It also has a limit for how far back it will accept claims. For property damage it only deals with disturbance occurring after July 1989 when the provisions regulating the insurance scheme took effect.

Financial and Administrative Arrangements

A unique compensation system has been established using the insurance sector. Initially the government wanted to set up a government fund, financed by taxes and levies on certain hazardous substances. However industry resisted such taxes. The solution was to set up an insurance scheme, The Environmental Damage Insurance, regulated by amendments to the Environmental Protection Act, ss 65-69 (1988:924) and in the Ordinance on Environmental Damage Insurance (1989:365). The legislation came into force in July 1989. The subsequent insurance fund was called the Environmental Damage Insurance Fund (EDIF). It is run by a consortium (Miljoskadekonsortiet) consisting of five insurance companies.

The insurance is compulsory for companies who carry out activities hazardous to the environment, defined by the requirement of a permit or an

[1] R Lundstrom, Scandinavia: A New Driving Force for Environmental Liability in the EU, 5th Environmental Insurance Conference, 1995.

application under the Environment Protection Act or according to the directives issued under the Act. Those companies performing such activities are obliged to contribute to the compensation fund through additional insurance levies on premia approved by the government. However, by targeting only certain types of firms for additional insurance premia, contributors to the Fund relate fairly well to the original industries that caused the damage. There is no incentive for pollution prevention within this system as such pollution prevention measures do not lead to a decrease in the additional insurance premium.

Compensation is paid out on a claims made basis. The financial limits paid by this consortium are 580,000 ECU (SEK 5 million) for bodily injury compensation and 5.8 million ECU (SEK 50 million) for property damage per claim. A total of 23 million ECU (SEK 200 million) can be claimed for in one year for any type of damage. The compensation payments for claims are drawn from reserves of 14 million ECU (SEK 120 million) which have been paid into the scheme between 1989 and 1993.

Results

However, by February 1993 the Consortium only received 27 claims. None of the claims made were deemed compensatable under the insurance scheme. As of this year, therefore, no compensation payments have yet been made.

Due to this zero outlay of funds the purpose of the fund was called into question and in 1992 a government commission was established to evaluate the scheme. This concluded that despite the lack of compensation payments made, the fund plays a critical role in filling serious gaps in the cleaning up of, and compensating for, environmental damage. The Commission also recommended an extension of the EDI in the form of a separate Decontamination Insurance for a new area called 'assistance costs'.

'Assistance costs' are to clean up sites where commercial operations are halted due to insolvency so that hazardous waste and other material such as process chemicals are left behind. The EDI does not cover costs of such disposal or decontamination. They so far have been financed by appropriated funds administered by the Swedish Environment Protection Agency. However, the increased number of bankruptcies in recent years has created an urgent need for more funds.

The Commission felt that an insurance scheme was the best mechanism for administering contributions due to its financing, loss adjustment and administration characteristics and since there was already an insurance system in place. An existing insurance system allows the use of the already established administrative system for collecting premia and thus can reduce transaction costs.

Conclusion

The fund reduces administration costs by using an existing system of collecting finances to collect additional finances for a compensation fund. However, so far, the Swedish fund has not compensated any claims.

3.2.3 *Netherlands* [1]

In the Netherlands there are two compensation funds operating. One is for contaminated soil restoration and one is for air pollution damage compensation.

Soil clean up

The fund for soil cleanup falls under the 1992 Soil Remediation Law. The government determined that it was unjustifiable to make companies pay for clean up of contamination problems about which the companies were unaware when the contamination took place. Therefore clean up of contamination prior to 1975 is being paid by the state, financed by general taxes. So far the cost is approximately 145 million ECU per year, achieving benefits of clean soil valued at approximately 4.8 million ECU per year.

Air pollution fund

The Air Pollution Fund is also required by law. Its role is to be a net to catch problem cases that slip through civil law regulation. The Fund is to complement civil law by compensating for damage caused by sudden air pollution incidents causing unacceptably high damage when: there are no liable parties; the identified liable parties do not exist any more or are not sufficiently solvent to finance damage restoration; the transaction costs of securing liability payments would be very high (decided in a subjective manner); and there is no insurance coverage.

The government first seeks to make liable parties pay for cleanup. If this cannot be done then the fund will attempt restoration. If restoration cannot occur then the fund provides compensation. The fund covers compensation for; health, crops, car coatings, cattle and buildings. Compensation claims, however, are mostly for damage to crops and car coatings (80 to 90% of the claims).

The fund initially raised capital from taxing fuel used by companies (and thus air polluters). In 1992 the government moved away from this and started raising funds from general taxation. At present the taxes raise the annual sum of 2.4 million ECU. This amount is based on the average annual value of claims from the previous five years' record of claims. So current needs are not based on total restoration costs but on past claims on the Fund. The funds are administered by the Minister of Environmental Management, with the annual capacity of the fund being held at the Dutch Bank.

(1) Source:interview with Ministry of Environment, Netherlands

Priorities are given for claims for restoration of all damage irrespective of costs. However the possibilities for restoration are limited (due to irreversible damage eg crop death) and only 20% of the payments are used for restoration costs. The rest of the claims, when damage cannot be restored, go to compensation payments.

There are three administrative costs associated with this compensation system:

- The organisational and administration costs are 70,000 ECU per year or 3% of annual Fund capacity.

- The assessment costs for claims carried out by experts amount to an additional 48,000 ECU per year or 2% of the Fund capacity.

- Legal costs amount to approximately an additional 24,000 ECU or a further 1% of the Fund capacity. These costs are the results of two activities: the owner of the Fund (ie Dutch authorities) taking a claiming party to court; recourse by the injured party taking the Fund to court to settle a claim when disagreement occurs over the allocated amount decided by the Fund.

Claims over the last 5 years have on average been 2.4 million ECU per annum. Transaction costs identified above account for 0.15 million ECU (6% per annum of fund capacity). So 9 million ECU has gone to compensate injured parties and 2.2 million ECU to restoring damage over the last five years.

This fund plays a valuable role in providing on average 2.4 million ECU per year in compensation, mainly for private property damage which otherwise would have gone uncompensated or which would have entailed large transaction costs under an environmental liability system.

3.2.4 *Japan*

Goals

The Pollution-Related Health Damage Compensation and Prevention Law was enacted in 1973 to compensate residents whose heath has been damaged by pollution. This is in addition to compensation payable to victims by polluters under civil law.

Its major goal is to provide an administrative, non-judicial system of compensating victims of environmental pollution. The Central Advisory Council on Environmental Pollution Control Measures argued that to require each victim seeking compensation for health injuries to file a lawsuit in court would be too burdensome. Thus, the Council recommended an extra-judicial, administrative structure to oversee compensation payments. [1]

[1] Michio Hashimoto, The Pollution-Related Health Damage Compensation Law

Under the Pollution-Related Health Damage Compensation and Prevention Law there are two types of human health damage which can be compensated under the funds:

- Class 1 is exposure to significant atmospheric pollution which frequently causes a major disease such as chronic bronchitis, but where the relationship between the disease and its possible pollution source is not obvious. It is this type of damage which takes up nearly all of the fund's resources.

- Class 2 is exposure to the significant atmospheric pollution or water pollution which causes particular disease damage from specific pollution incidents. This includes for example, Minimata disease. The relationship between pollutants and disease should be clear. The instances where the fund is used are extremely limited because usually all expenses for compensation is collected directly from the liable companies.

Within these areas of damage the Fund covers accidental, gradual, cumulative and past (retroactive) pollution problems.

Class 1 Damage: Chronic Health Damage from Air Pollution

Financial and Administrative Arrangements

In order to pay for the claims allowed under the above provisions the government raises funds on an annual basis. The Law attempts to fund the entire costs of the compensation program, except for administration. For Class 1 areas the Law imposes 80% of the financial burden on sulphur polluting firms based on the estimate that they contribute to 80% of air pollution. This is in the form of a pollution levy for factories discharging SO_2 at levels exceeding the standard specified by the Law.

The remaining 20% of the total collected funds for compensation is financed by the national tax on the purchase of new cars. This national tax was not increased to provide for the Fund but part of the existing amount is diverted into the Fund.

The 80:20 split has been fixed since 1973 despite increases in the number of cars and the decrease in industrial contribution to pollution, which has changed the percentage industry contributes to air pollution.

The industry tax is proportional to the excess emissions produced above a specified standard for new and existing plants. This potentially could act as an incentive to industries to lower pollution to produce emissions below the set level and thus avoid paying into the Compensation Fund.

Companies with factories in urban areas pay more tax than sites in rural areas. This is based on the fact that the urban areas are more polluted and more populated and have higher incidents of bronchitis. More polluted cities are taxed more than less polluted cities. In 1985 the unit levy for Osaka was 25 ECU (3,300 yen) per SO_x Nm^3. The levy for Tokyo was 15 ECU (2,000 yen) per SOx Nm3 and non-designated areas eg rural areas only had levies of 1.5 ECU (200 yen) per unit.

These tax rates have led to levels of compensation of 688 million ECU (90,891 million yen) per year in 1995. This is lower than the peak amount of claims of 751 million ECU (99,197 million yen) in 1985, but much higher than the initial level of claims of 152 million ECU (20,053 million yen) in 1975. However, the tax rates are not fixed and are based on the required capacity of the Fund. This is determined retrospectively, based on the compensation requirements during the year. The amount of taxes are then levied accordingly to attain the paid out level. As of 1994 there were 78,682 patients receiving compensation payments for medical care. So average claims benefits per year as of 1995 were 8,744 ECU per person.

In order to organise and administer these large inflows and outflows of the fund a special government organisation was set up. This is called the Pollution-Related Health Damage Compensation and Prevention Association. This allocates funds to the local Prefectural governments which then distributes payments to the patients. The responsibility for certifying claims falls on Local Authorities. They certify claims of persons if they have lived in the polluted area for over three years and have evidence of bronchitis (as verified by a doctor).

Results

The compensation amounts increased annually at a substantial rate until 1988. At this point the government changed the claims policy for the fund. It was decided to allow no more patients suffering from SO2 related diseases to claim compensation payments. But annual compensation payments to existing sufferers is continued. There was a small subsequent reduction of payments between 1994 and 1995, reflecting existing patients either recovering and thus not requiring further compensation, or patients dying.

The decision taken in 1988 to halt further claims was based on a weakness in the compensation system. The fund was initially set up in 1973 due to the excessive industrial pollution and poor air quality. In the 1980s industry made concerted efforts to reduce pollution. The claims, though, kept increasing up until 1988 because of the lag time for consequences of pollution to manifest itself and for injured parties to become aware of the possibilities to claim for compensation.

So despite the heavily polluting industries of the 1970s having significantly reduced emission levels through pollution control, by the late 1980s, the industry was being obliged to increase their financial contributions to a growing fund. Therefore industry began to complain because they were caught in a situation where after increasing expenditure for pollution control they were still having their taxation rate increased to match the growing amount of claims.

Therefore the scheme was not providing the correct signals for industry to adopt pollution prevention measures. Industry would not be deterred from polluting as the Fund pays for damage caused by both past and present pollution and both collective and individual actions to reduce pollution did not seem to reduce their contributions to the fund.

At an individual level, even if an individual firm's total payment went down because of reduced emissions, if the Fund's claims increased then total tax needs also went up as the Fund is financed on a needs basis. The individual tax rate would then rise accordingly as the tax was apportioned between all industrial firms.

At a collective level the incentive to reduce pollution was reduced because of the lag time of the manifestation of polluted related diseases.

A weakness of a needs based fund where financing is related to the number of claims and not the amount of pollution the supposed polluters are producing is that the polluters are given perverse signals about the effects of adopting pollution prevention measures.

Conclusion

The fund was very effective in raising finances and compensating victims.

This is facilitated when there is one specific polluting substance such as SO_2 clearly causing the damage, even when there are multiple polluting sources.

The fund ran into problems because of the time delay in pollution damage manifesting itself approximately 10 years after the pollution was at its peak. So claims were increasing as pollution levels decreased. Because the fund was claims based the system led to perverse signals for industry; despite reducing pollution, industry's contributions to the compensation fund increased.

3.2.5 *Germany*

Germany has developed three different types of compensation systems for restoration of contaminated land. They are a tax system, a licensing system and a co-operation system. *Table 3.2a* summarises the main features of these compensation funds. Each fund is operated at a regional level in order to ensure that the financing of the cleanup is transferred to the groups with a supposed connection to the pollution.

The Funds are used when:

- the polluter cannot pay;
- individual civil liability does not work;
- public liability does not collect sufficient financial resources for restoration.

Tax System

The tax system is in operation in Hessen. It is small and collected 50 million DM between 1990 and 1992, procured by a waste tax calculated on the basis of the amount of private household waste. The tax was raised equally by the land and provincial governments. Despite the regional scale this method does not have a direct financial link with polluters as waste production does not correspond to causing past damage.

Licensing system

A compensation system based on licenses for handling special wastes is based in the Northrhine-Westphalia (NRW) area. The Fund raises money through diverting 70% of fees raised from licenses required in NRW. The licenses are necessary to get permission to handle special waste. The revenue from the license payments, which will reach 50 million DM, is then handed over to the Land. The Land then transfers the necessary financial resources to the public-law corporation established by the Fund to deal with restoration of contaminated sites.

By 1993 the Fund had performed 2,000 remedial actions supported by 308 million DM.

Whilst collecting funds for restoration, this financing system does not achieve other economic and environmental goals. The licensees do not suffer from the cost of license as they pass the additional cost on to the waste producer. However, the cost is not sufficient to act as a financial incentive for waste producers to reduce waste through preventative measures and thus avoid the license cost. Furthermore the waste producers are not responsible for past land contamination.

Co-operation system

Co-operation systems involve the sharing of costs of environmental restoration between industry and government. There are several different co-operation systems in different regions in Germany, operating at a small scale, collecting approximately 5-15 million DM per year. Industry contributes to these schemes because by doing so the federal state government delays legislation initiatives for pollution which could be more expensive for industry than current arrangements.

One of these co-operation models is operated in the Bundesland Rhineland-Palatinate area to deal with inherited environmental problems mainly from a small group of chemical companies. It was initially only used when the polluters were found liable but could not pay the whole amount required. The fund acted as a financing bridge for restoration needs.

The restoration operation is based on the co-operation between enterprises and regional administrative bodies. They become partners with equal rights by agreements which are legally non-obligatory. The procedure usually starts with the establishment of a private corporation solely for the restoration procedure.

In 1986 the federal state government, the regional administration bodies and regional industry concluded an agreement of co-operation. They set up a private corporation (called GBS) which was responsible for the implementation of the restoration.

After polluters are sought for payment for cleanup, the remaining costs of eliminating environmental damage are paid equally by the Land and GBS. By 1990 the Fund capacity was 50 million DM with industry paying 6.25 million DM through an extra charge on the taxes on special waste.

The federal state government tried in 1993 to include funding for cases where no liable party could be found. This meant that the fund would not only act as a financing bridge for restoration needs but also finance the cleanup of orphan sites, previously excluded from its scope of responsibilities. Industry consequently cancelled the co-operation agreement because they felt this expanded scope of activity would impose too great a responsibility on the Fund and thus ultimately too large a financial burden on them. The cancellation of the agreement by industry meant the termination of the fund.

Table 3.2a Summary of Compensation Fund Systems in Germany

Lander	Restoration expenditures (DMs)	Environmental Benefits	Participants	How administered	How financed: source (and level in DMs)	Comments
Hessen	50m (between 1990 - 1992)		Lander/ provincial Govt		Household waste tax	
Northrhine-Westphalia	308m up to 1993, of which 70% (216m) for restoration work	2,000 remedial actions		Public corporation	Charge on licences for special waste disposal (50m)	No effects on prevention
Bundesland Rhineland-Palatinate	50m		Few local chemical cos, federal and state govt	Co-operative corporation	Charge on special wastes (6.25m)	Industry cancelled agreement because govt extended fund to pay for cases where no liable firm could be identified
Bundesland Hessen	50m for 3 years			Co-operation	Charge on disposal of problem wastes	Co-operation agreement later cancelled when government imposed a tax on special wastes to finance restoration of past pollution

4 EVALUATION OF COMPENSATION FUNDS AND THEIR ELEMENTS

This final section summarizes the major characteristics of the various fund to identify the main options available for policy makers when developing a compensation fund system. The options are then analysed in light of the appraisal criteria to yield lessons about the scope and form of compensation funds. Where a best choice option is not straightforward or apparent, the various relationships and influential factors are discussed.

4.1 FUND RESULTS

Table 4.1a summarizes the scale of funding of the various funds.

Table 4.1a Finances and Payments of Funds (ECU)

	Level (ECU)	Compensation	Comments
France	10M/yr	target of 669 sites - none cleaned so far	too early to tell
Sweden	14M cumulative	no claims paid so far	despite no zero outlay the government felt it fills gaps
Netherlands (soil)	145M/yr	4.8M/yr restored	
Netherlands (air)	2.4M/yr	2.4M/yr	small but needs based so appears to have a limited role to play
Japan	688M/yr	79,000 patients in 1994 collecting 688M/yr	collects a large amount of finances
Germany	<27M/yr	2,000 remedial actions	

The Netherlands' soil fund raises a large amount but its results have been relatively small. The German fund has been active, carrying out cleaning up a total of 2,000 remedial actions by 1993. In the US experience shows that the cleanup process of contaminated land can be extremely slow, largely due to lengthy litigation processes, disputing financial responsibilities of parties, which delay the implementation of clean-up measures.

With air pollution compensation funds the financial contributions after transaction costs (administration and litigation) go directly to victims. Both the Japanese and the Netherlands funds raise finances retrospectively on a needs based system. In this way all validated compensation claims are satisfied by the funds. The Japanese fund raises the largest amount of funds for compensation purposes. It provides victims with, on average, 9,000 ECU per year.

4.2 *Fund Options*

The elements in the existing funds are compared below.

Role

There are two main systems in operation to cover:

(i) **Diffuse pollution from many sources.** Examples include: compensation systems for claims made from sufferers of air pollution. The damage can either be to health (covered in the Japanese compensation fund) or private property (crops and car coatings covered in Netherlands' compensation fund).

(ii) **Orphan Sites.** This includes: restoring contaminated land sites. French and German funds target orphan sites. These funds are used as liable parties no longer exist or are not sufficiently solvent to finance cleanup.

There is also a compensation system in Japan for dealing with large accidental pollution cases, eg the Minimata case. In Japan the compensation fund pays compensation when there are high costs from environmental damage and companies would otherwise face excessive liabilities. This fund is also used for water pollution incidents. For example, funds were allocated to cover claims from the Minimata disease incident.

The Swedish system is more general and claims can be made for any type of injury and damage to property. This would include air and soil pollution.

The role of all of these funds is to fill gaps and act as a safety net either for damage compensation claims or restoration actions.

Source of Funds

Collecting financing is a critical issue because:

- The extent to which the fund can restore environmental damage and compensate victim depends on the level of funds that are collected.
- The *source* of financing dictates who is held accountable for the cleanup carried out by the compensation fund.
- The *type* of financing will give different signals to industry.

The types of financing in operation are:

- insurance premia (Sweden)
- general tax (Netherlands)
- air pollution tax (Japan)
- fees from licenses for waste (Germany)
- landfill tax (France)

An insurance premium surcharge acts like a tax on the companies targeted for the surcharge.

The air pollution tax is effectively an extra emissions charge on the parties causing the damage compensated by the fund. Fees from licences from waste and the landfill tax also both create an extra charge for waste producers. Like the air pollution tax, this creates an incentive for firms to reduce their generation of these pollutants which can be indirectly related to the environmental damage costs.

If the tax on polluting industries is proportional to the amount each company pollutes then an incentive measure is introduced for companies to adopt measures to reduce the emission of the charged pollutant. This type of tax is only possible if the polluting substance causing the damage settled by the fund can be identified, such as the sulphur dioxide emissions causing bronchitis in Japan.

A compensation fund can provide perverse signals to industry when claims do not change in proportion to pollution prevention expenditures. This may happen when damage occurs or becomes evident some time after the pollution incident. When this situation arises industry will not only have little incentive to increase pollution prevention expenditures but will wish to reduce pollution prevention expenditure because such expenditures do not appear to lead to a reduction of pollution tax (fund contributions). This occurred in Japan where the financial contribution by industry to the fund rose in spite of industry's substantial pollution control expenditures. Claims increased due to the time lag in the worsening of health of the victims after the pollution occurred so that claims actually went up after pollution had decreased. As a result of industry complaints about the rising contribution, the Government decided in 1988 to allow no additional patients to claim compensation from air pollution related illnesses.

Administration

The possible arrangements in existence to organise fund activities are:

- central government body (Netherlands, France, Japan)
- regional government (Germany)
- private sector
    - insurance sector (Sweden)
    - polluting firms (France)

These bodies take care of raising finances and distribution of funds and execution of actions.

Funds can be administered at a national scale, as in France, the Netherlands, Japan and Sweden, and down to a regional and local scale as in Germany.

The scale at which a fund is operated will affect which government department is responsible for the fund and the sources of the finances. It also can affect where fund money can be allocated. Regional governing bodies will have more control over cleanup within their region under a regional fund than equivalent regional governments will have under national funds.

However a national level fund enables the use of national taxes and national institutions to collect the financial contributions to the fund.

In the US, the Superfund reform package laid out by the EPA proposes to move towards decentralization and localisation of the administration of Superfund. States will have more authority in the allocation of funds and communities will have more involvement in the whole process.

In France the privately run compensation fund had a short life as companies had little incentive to contribute voluntarily to the fund. In Germany the fund involving private company contributions also broke down when the fund attempted to widen its scope and thus increase the financial responsibility of its private members.

There is also the option to have cooperation between public and private agents such as in Germany and Sweden. In Sweden, the existing administrative structures for collecting insurance premia were used to levy contributions to the fund. In Germany, by getting industry to contribute to the fund the public authority reduced the need to raise finances through alternative taxation.

Limits on Claims

Financial limits can be imposed for every claim or on the total amount that can be claimed per year per person.

Sweden has limits on payments per year. However like many other funds due to its lack of activity (in this case, lack of claims compensated) the effectiveness of this policy cannot be determined.

Japan laid down guidelines as to how much benefit could be claimed for different ailments per person.

4.3 *LESSONS LEARNT*

Using the criteria for appraising compensation systems the most commonly used options are presented below with their strengths and weaknesses.

Role

A key issue is low to design a compensation fund that can play a valuable role in remedying environmental damage, compensating victims who otherwise could not find a liable party.

- Past Problems

Contaminated land funds raise financing from existing industry, such as the waste sector in France and Germany, to restore historic pollution problems in the form of orphan contaminated sites. Over time the firms who caused the pollution cannot now be identified or have become insolvent. Compensation funds therefore provide a financing bridge between current polluters and past pollution. The current polluters however did not cause the past pollution which is being cleaned up. This type of approach conflicts with the polluter pays principle and fails to create incentives for future prevention.

- Multi-source Pollution Funds

A fund for air pollution damage compensation appears appropriate in certain circumstances. There is considerable difficulty for injured parties to prove precise causality of damage to a polluting party (such as a factory). Proving which industrial sector causes the damage is easier than pin-pointing the individual factory emitting the damaging substance. Also in many cases there will be more than one factory contributing to the pollution damage. Whenever there are multiple parties liable for damage, a compensation fund is more appropriate than individual action as a fund has the capacity to raise compensation from the collective parties involved (for example taxing a sector of industry). Japan's fund is a good illustration of the way a fund for multi-source pollution can function using the government to tax polluting industry. Financing the fund by an emissions tax creates incentives for preventing future emissions of the taxed pollutant (eg SO_2 waste level) and is consistent with the polluter pays principle.

The Japanese fund also shows the problems faced by funds when the damage covered manifests itself after a long lags. When it takes years for pollution to cause damage a situation arises when claims can be increasing even though industry has reduced pollution levels. In Japan, despite sulphur emission levels having dropped since the 1970s, claims kept rising in the 1980s. Eventually the government, in 1988, had to halt additional claims being made due to industry complaints about the increased taxation rates arising from the increased claims.

A broadly based fund could also be used in restoring ecological damage to the unowned environment, where the damage is caused by many polluters and remediation would benefit a large population.

Scale

A local compensation fund will benefit the industry paying for it as it cleans up the local area, which can then attract investment into the area.

However, outside Germany the trend is to establish a special body under the central government which can then utilize nationally raised funds (taxes) to carry out national cleanup or compensation payments.

Source of Funds

There are two main options for financing funds which are:

- from public funds financed by general taxation - not in line with the polluter pays principle;
- restricting taxation to the sector causing the pollution. In this situation the tax should be proportional to the amount of pollution the industry is producing.

A taxation system to raise funds for compensation payments can provide incentives for companies to adopt measures to reduce levels of charged pollution if the tax levied is based on the level of a firm's pollution (such as sulphur emissions or waste production). The reduction of pollution levels by Japanese industry in the 1970s because of the sulphur emissions tax is an example of how this system can work.

The funds show that this is possible, to some extent, for air pollution but not contaminated land. This is because air pollution emissions from factories can be monitored and because the taxed emissions can to some extent be linked to the environmental damage. Thus this combines a compensation fund to remedy the environmental damage costs with a market based instrument such as a pollution change to finance the fund. In cases where the type of pollution (eg SO_2) causing the damage is less clear such pollution related taxes may be difficult to impose.

For restoration of contaminated sites, connecting polluters to the damage to be cleaned up is even more complex. Orphan sites exist specifically because the polluter cannot be found. Often the industrial sector responsible, such as mining, has since decreased in size. Other taxable sectors, such as the waste sector, taxed in Germany and France for compensation funds, are not the sectors which caused the environmental damage.

An alternative to raising financing for compensation funds is to fund cleanup through normal exchequer funds, where the final use of the funds is not earmarked at the time the funds are raised. Taxes would be pooled and the remediation measures would be part of other governmental environmental protection expenditures.

Administration

The breakdown of the two funds (in France and Germany) which relied on the active involvement of industry suggest that a compensation fund should be organised by a public body. Levying contributions to a compensation fund is an area which needs public authority involvement because firms are unwilling to volunteer to contribute to a compensation fund. Using existing national systems and institutions for collecting the taxes or charges to finance the fund can reduce the costs of administering the fund.

However, industry's cooperation not only increases the amount of funds which can be raised but can reduce administration costs for the government, where the contributions can be based on an existing administrative system (eg insurance premia in the case of Sweden).

Claims

The scope of claims has an important effect on the effectiveness of a fund. The conditions for the validity of a claim need to be accurately defined but not too limited. Japan's compensation fund had so many claimants that it became financially burdened and had to restrict further claims. Sweden's compensation fund on the other hand defined what it considered a valid claim in such a limiting manner that few claims were made and so far none have been deemed valid.

4.3.1 *Overall Conclusions*

Advantages

The advantages of compensation funds are that:

- A fund provides a mechanism for cleaning up environmental damage and/or compensating victims of environmental damage which otherwise would not be covered under a liability system.
- Funds may intervene when remediation is too slow.
- Funds may avoid complicated cases of litigation between multiple parties and victims. The Netherlands uses funds when transaction costs would be too high.

Limitations

The limitations of a compensation fund are:

- Industry will resist additional costs through compensation fund levies, where it appears that they are paying for significant amounts of other firms' pollution.
- Under a compensation fund system the polluter pays system is not adhered to and the mechanisms of finance do not lead to efficient incentives for firms to adopt pollution prevention measures and reduce their environmental liabilities. With a compensation fund the polluter, or even the same polluting sector of industry, often does not pay for the restoration of the damage it caused. In Germany and France the waste sector is targeted for payment to the funds. The waste sector, although a polluter in its own right did not contribute to the environmental damage the compensation funds are restoring.

- Even when polluters are targeted to contribute to funds it is difficult to ascertain levels of pollution and thus proportional payment. In Japan it was possible to introduce a pollution tax because, with the air pollution fund, there was an identifiable single polluting substance and industries emitting the substance were identifiable.

- Compensation funds can give perverse signals to industry when claims made to the fund do not change in proportion to pollution prevention expenditures. This may happen when damage occurs some time after the pollution. This occurred in Japan where the situation developed that the financial contribution by industry to the fund rose in spite of substantial pollution control expenditures. Claims increased due to the lag time before the deterioration in the health of the victims became evident after the pollution occurred so that claims actually went up after pollution had decreased.

- There is potential for the 'safety net' role of a fund to be abused because victims seeking compensation may make a claim to a fund instead of the polluting parties because the fund may be an easier option for compensation than trying to prove damage (especially from air pollution) from individual factories.

Scale

Available evidence would suggest that funds are better implemented at smaller scales such as regional or national as opposed to EU-lèvel because:

- Smaller scales allow funds to isolate the tax base to the polluting sectors of industry and facilitate the polluter pays principle which is desired by industry. Industry is unwilling to contribute to compensation funds and pay for other people's pollution. This unwillingness would be presumably even more intense if the fund was for polluting industries in other countries.

- Using existing national systems and institutions for collecting the taxes or charges to finance the fund can reduce the costs of administering the fund.

- Verifying and administering claims at the local level already establishes local involvement and is more likely to lead to the adoption of cost-effective restoration standards. EU-level organisation would increase the amount of administration needed for a fund to in order to connect authorities at each different scale of organisation.

However, it is not possible on the basis of this broad review to answer fully many questions related to the effectiveness of compensation funds, such as the optimal scale of a fund. It is also not evident whether there are economies of scale with transaction costs so that administration costs decrease with funds of a larger scale.

In addition to a large variety in the financial capacity of funds there is also a large variety evident in the structural arrangements of the funds in each country. Methods of financing, fund administration and types of damage covered varies across the countries depending on national characteristics, such as a government's views on the sources of finance for remedying and compensating environmental damage. This variety would also suggest the appropriateness of nationally based funds as opposed to an EU-wide compensation fund.

Annex A

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European Commission DG XI

Economic Aspects of Liability and Joint Compensation Systems for Remedying Environmental Damage:

Review of Economic Implications of Superfund in the US

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CONTENTS

1 INTRODUCTION

This *Topic Paper* has been prepared to complement the European country studies in understanding the economic aspects of environmental liability systems. In 1980, the US federal government introduced Superfund - a significant environmental liability system. Therefore the US has fifteen years of implementation experience (both public and private) from which we can extract valuable information regarding the costs of the current programme, potential further costs, distribution of costs amongst different economic sectors and areas for savings through various reform alternatives.

1.1 AIMS

The aims of this working paper are to:

- Obtain concrete information from actual cases to inform analysis of economic implications of alternative elements of environmental liability policies in the EC;
- Highlight lessons for EC policy making.

1.2 RESEARCH UNDERTAKEN

The review covers reports from the following sources:

Environmental Protection Agency (EPA)
Resources for the Future (RFF)
American Academy of Actuaries (AAA)
RAND, The Institute of Civil Justice
Chemical Manufacturers Association (CMA)
Environmental Law Review (ELR)

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), otherwise known as Superfund, was established in 1980 and subsequently reauthorised in 1986 and 1990. It will be reauthorised again at the end of the 1995 and is thus undergoing reform. Table 2.2a outlines the main features of CERCLA and compares them with the Council of Europe's Lugano Convention [1].

CERCLA gives the Environmental Protection Agency (EPA) the power to identify and compel cleanup (upon proof) of the nation's worst hazardous waste sites, defined as those on the National Priorities List (NPL).

Table 2.2a ***Summary Table of Key US Liability Provisions (Compared to the Lugano Convention)***

Policy Element	CERCLA	Lugano Convention
Type of damage covered	Damage to owned and unowned environment	Damage to people, property and the environment
Scope of environmental damage covered	Contaminated soil and groundwater	All
Type of pollution covered	Cumulative Historic pollution Current pollution	Accidents, gradual, cumulative and past pollution
Use of cost-effectiveness in defining level of damage restored/ compensated	No significant risks for health or environment for any end use Not use cost-benefit criteria Nine criteria, incl cost (as secondary)	Min threshold Reasonable and cost-effective restoration
Scope - activities covered	All activities handling the waste (see below)	All dangerous activities
Strict liability	Yes	Yes
Channelling of liability	Current and past owners and operators of sites, and generators of waste Transporters who chose the disposal site; Lenders (if repossess secured assets or if involved in operations) Parent companies	To operator of dangerous activity

[1] Council of Europe (1993) **Draft Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment.** Council of Europe, January 1993.

Policy Element	CERCLA	Lugano Convention
Joint and several vs proportionate	Joint and several, and then costs allocated in relation to parties' relative contribution (Gore factors)	Joint and several unless operator proves only caused part of damage
Financial limits	No	No
Burden of proof	EPA to prove prima facie case (low proof threshold); Defendant then to disprove claims and prove their eligibility for limited defences	Facilitate proof
Defences	Narrow, Act of god, Act of war, Discharge caused by third party Where innocent new owner made all appropriate enquiries prior to purchase	Yes
Action rights	Government agencies Not non-governmental parties	Interest groups
Compulsory insurance/financial security	No compulsory insurance but compulsory financial guarantees	Yes but only where appropriate
Retroactive liability	Yes	Waste disposal sites
Limitation period for victim's right to sue after damage is evident		6 yrs up to 30 yrs

3 ECONOMIC IMPLICATIONS OF SUPERFUND

3.1 OVERALL ECONOMIC IMPLICATIONS OF SUPERFUND

This section summarises the key cost and benefit issues consequent to Superfund legislation. Large variety of estimations exist due to different projections over the size of the cleanup problem and different methodologies in formulating costs. *Table 3.1a* attempts to highlight the key findings from recent studies analysing Superfund costs, using unit site estimates.

Table 3.1a Summary of Studies of Superfund Costs Under the Current Program

Studies' Conclusions	Review Group's Comments
Total Number of Sites: The estimated number of non-federal NPL sites ranges from about 3,000 to 4,500.	Recent placement rates are not consistent with the number of sites estimated by the studies. The Review Group believes that the ultimate numbers of non-federal sites is more in the order of 2,000.
Cost per Site: The estimated midpoint of total (undiscounted) cleanup cost per site ranges from about $35 million to $50 million.	Based on 2,000 sites, the Congressional Budget Office (CBO) study suggests average cleanup costs of $40 million per site. About 40% of this, or $17 million, is attributable to operations and maintenance, the most uncertain element of site cost.
Total Ultimate Cleanup Cost: The estimated midpoint of (undiscounted) total cleanup cost ranges from about $150 billion to $165 billion.	The above two comments suggest that the cost of the non-federal sites will be less than $100 billion.
Annual Cleanup Cost: The estimated midpoint of total annual cleanup costs, including transaction costs is approximately $2 billion (0.03% of GDP).	The Review Group believes that the estimates of annual cleanup costs are reasonable.
Annual Transaction Cost: The estimates of annual transaction costs are relatively uniform and are about $900 million.	The Review Group believes that while transaction costs may increase initially, they are likely to decrease over the next ten years as more sites are cleaned up and the amount of litigation begins to decrease.

Source: American Academy of Actuaries, Studies of Superfund Costs and Reform. The Review Group refers to the group of authors who researched and compiled this report. The study summarises the finding from reports from the following authors (which are believed to include all the key and up-to date reports on the economic aspects of Superfund): University of Tennessee; 1993 Treasury Proposal; Congressional Budget Office; Office of Management and Budget; Best Week; General Accounting Office; The Brookings Institute and Resources for the Future; Congressional Budget Office Testimony; Superfund Reform 95; National Environmental Policy Institute and the Chemical Manufacturers Association.

3.1.1 *Costs*

Overall, it is estimated that the total amount of money spent on Superfund since 1980, including settlement costs of Partly Responsible Parties (PRPs), is in excess of $25 billion. (1)

The University of Tennessee has updated the calculated cost estimates for total cleanup costs for the remaining sites. They calculate that cleaning up the remaining 1,350 sites under current standards will amount to $52 billion. This could drop to $35 billion if less stringent standards are imposed on cleanup levels. (2)

These figures need to be reviewed in light of the magnitude of the US economy and expenditures on federal environmental regulatory programs. The average annual total cleanup costs is estimated to be approximately $2 billion which is only 0.03 percent of US GDP (3) and only 1.5 percent of the $135 billion (4) spent in the US per year to comply with all federal environmental regulations (this includes both EPA and private industry costs).

Restoration Costs

There has been huge controversy over the large and increasing annual costs of national site cleanup. Site restoration is often carried out by the EPA and the cost is then recouped through compensation settlements from the responsible parties. Key financial statistics of the programme include:

- The total cumulative value of settlements (since 1980) between responsible parties (RPs) and the government at (NPL) sites is $8.3 billion. (5)
- EPA and Congressional Budget Office (CBO) estimated the average cost of cleaning up a single NPL site at $25 million, in 1993. (6) Probst et al. estimated a slightly higher cleanup cost of $29.1 million, in 1994.
- Cleanup costs per site can vary widely for different types of industrial problems, ranging from $170.4 million for mining sites to $12.7 million for asbestos sites.
- The costs are so high because of the stringent cleanup standards imposed by the EPA. Sites must be cleaned up to standard levels and requirements laid down by Applicable or Relevant and Appropriate Requirements (ARARs) and not based on individual site specifications and land uses.

(1) Probst et al. Footing the Bill for Superfund Cleanup. Who Pays and How?, The Brookings Institute and Resources for the Future, 1995.

(2) University of Tennessee, 1995 (figures in nominal terms)

(3) GDP in 1993 was $6378 billion, The Economist

(4) figure in Probst et al., RFF, 1995, p11.

(5) Probst et al. RFF, 1995, p24.

(6) Erin McNeil, EESC Issue Paper,p59 December 1993

The implications of such costs are that there is a large incentive for RPs, particularly PRPs, to try and avoid being held accountable for the remediation costs, which leads them into litigation.

- The cleanup cost can be broken down by stage and operation of the cleanup process as follows: $4.2 million for site studies; $22.0 million for the cleanup actions (which are based on a remedial action at the site); and operations and maintenance (O&M) activities costing $2.9 million (10 percent of site remediation cost). (1) There is current debate over these figures, particularly the O&M costs. The CBO 1994 study (2) estimates O&M costs as $15.2 million (41 percent of site cleanup cost). The O&M costs are currently the most uncertain element in ultimate cleanup costs. This is because few cleanups have been completed and therefore there is still little experience with these costs. (3)

- One main difference between cost estimates (in different studies) is whether future cleanup costs are discounted or left in a nominal state. The difference is substantial with discounted costs ranging from 40-65 percent of nominal costs, since the cleanups are expected to be paid out over a long period of time. (4)

Transaction Costs

Due to the incentive for firms to debate compensation costs in court, transaction costs involved with site remediation have been extremely large and one of the most highly criticised components of the Superfund program.

- The RAND survey (of 5 PRPs) found transaction costs averaged 21 percent of total firm outlay. The split between transactional and remedial expenditures was reasonably consistent across these firms, ranging from 15 to 31 percent. The bulk of these transaction costs was for legal representation. (5)

- At a single site, there are at least five separate tiers of litigation/settlement, namely, negotiation 1) between EPA and Partly Responsible Parties (PRPs) 2) among settling parties 3) between settling parties and those disputing the settlement 4) between PRPs and their insurers and 5) between insurers and reinsurers. At each site there may be many PRPs, all of whom hire lawyers and technical experts to represent their interests. In addition to legal costs, PRPs often conduct their own risk assessments or site evaluations to provide an independent assessment of the EPA's work.

- Transaction costs as a percentage of total cleanup costs appear to fall as sites move through the remedial process. This is because the initial

(1) This operations and maintenance cost represents the net present value of future operations and maintenance costs at a site, Probst et al. RFF 1995, p36.

(2) Congressional Budget Office (1994) **The Total Costs of Cleaning up Nonfederal Superfund Sites.**

(3) AAA, p2

(4) AAA, p2

(5) Acton et al., Superfund and Transaction Costs, The Experience of Insurers and very Large Industrial Firms, RAND, the Institute for Civil Justice, 1995.

litigation processes between parties over responsibility are concluded at the beginning of the remediation actions. This suggests that as more of the nation's inactive sites move to the later stages of the cleanup process, transaction cost shares will fall. [1]

- In the US, under joint and several liability regimes, transaction costs as a percentage of total cost (sum of cleanup and transaction costs) increase significantly with the number of responsible parties at each site. 60 percent of all NPL sites have 10 or fewer responsible parties. For one party, transaction costs were only five percent and for 2-10 parties transaction costs contributed 20 percent to total costs. Fewer than 15 percent of the sites have more than 100 responsible parties. Sites over 50 parties had transaction costs of 30 percent of total cost. The average transaction cost is 21 percent of total costs. [2]

- *Table 3.1.2b* presents estimates of projected transaction costs by industry sector for the ten year period 1994 to 2003. This shows a fairly uniform distribution in the extent of transaction costs in total cleanup costs, for each sector. In terms of annual costs, the estimates of transaction costs for the industries are:

    - Mining has $46 million in transaction costs per year (21% of total cleanup cost)

    - Lumber has $21.8 million in transaction costs per year (18%)

    - Chemicals and allied products has $97.6 million in transaction costs per year (20%)

    - Petroleum refining and related industries have $22.0 million in transaction costs per year (23%).

    - The electronics sector (excluding computers) has $12.4 million in transaction costs per year (18%). [4]

3.1.2 *Costs for Specific Industries*

Costs are broken down between costs for direct liability and taxes for the Superfund's Trust Fund.

Remediation Costs for Direct Liability

- Industries' facilities account for 38% (431/1134 sites) of National Priorities List Sites (non-federal). [4]

[1] RAND, Superfund and Transaction Costs, p61.

[2] Probst et al.,RFF,1995, p46. Taken from the RAND report.

[4] Probst et al.,RFF,1995,p49, percentages calculated from tables 3.4 and 3.3

[4] Probst et al, RFF, 1995, p36.

- Average cleanup costs per site are available for several of the industry sectors:

  - Wood preserving sites average $40.6 million.
  - Waste oil site average $32.3 million.
  - Electrical sites are estimated at $26.4 million.
  - Mining sites are $170.4 million.
  - Chemical manufacturing sites are $41.1 million. [1]

Under the current financing set-up the annual responsible party cleanup costs, by industry, are estimated as follows:

Table 3.1.2a ***Current Annual Cleanup Costs by Sector of Industry***

	Mining	Lumber	Chemicals	Petroleum	Electronics
Annual party clean up costs (million $)	174	98	394	75	58
Cleanup costs as a percent of total industry cleanup costs	11.2	6.2	35	4.8	3.7

Source: Probst et al., RFF, 1995.

Below are projected future cleanup expenditures for selected industry sectors.

Table 3.1.2b ***Projected Cleanup and Transaction Costs, by Sector of Industry 1994 -2203 (in Billions of Dollars)***

Stage	Mining	Lumber	Chemicals	Petroleum	Electronics
Cleanup expenditures	1.7	1.0	3.9	0.8	0.6
Transaction expenditures	0.5	0.2	1.0	0.2	0.1
Total costs	2.2	1.2	4.9	1.0	0.7
Transaction as % of total costs [2]	23.0	18.0	20.0	23.0	18.0

Source: Probst et al., RFF. Based on cleaning up remaining NPL sites over the defined period of time.

[1] Probst et al., RFF, 1995, p36.

[2] This line shows large variation from current percentages, see transaction section above

Costs as a Percentage of Industry Profits

Table 3.1.3c summarizes the extent of liability for the individual sectors with respect to their financial size.

Table 3.1.3c ***Industry's Annual Liability as Percentage of Value Added***

	Mining	Lumber	Chemicals	Petroleum	Electronics
Liability as percent of value added	0.7	0.5	0.4	0.3	0.1

Source: Probst et al., RFF, (Liability includes cleanup and transaction costs)

- After taxes in 1991, the mining industry had annual losses of $300 million. In 1990, a much better year for the industry, after-tax profits were $1 billion, of which annual cleanup and transaction liabilities represent a significant share (22 percent in 1990 (220/1000)).

- The chemical industry's cleanup costs are a much smaller percentage of their after-tax profits. In 1991 the chemical industry reported after-tax profits of $21 billion, more than sixty times the profit of the mining industry. So even though in absolute terms the chemical industry is burdened with $492 million for cleanup this is a relatively small bite into industry profits.

- The petroleum industry's leading twenty firms had net income in 1991 of $13.2 billion, down from $16.7 billion in 1990. Thus $97 million of cleanup costs for the whole industry is less than one percent of the annual net income (after-tax profits) of these twenty firms.

There are several interesting points to note with regard to understanding these cost figures:

- The costs of Superfund may already be incorporated into the share value of firms. Share-price reductions depend on the extent to which investors already know about the number of Superfund sites to be cleaned up by responsible parties and thus are planned expenditures.

- Some firms within industry sectors will be badly hit and suffer more than the industry in general appears to be suffering.

- These figures do not take into account the possibility for companies to recoup losses through passing on costs to the consumer through price increases. The extent of 'pass through' will depend on the competitive structure of the market.

- Probst et al. assume that it is the shareholders of the companies affected that would bear the brunt of cleanup and transaction cost liability.

Trust Funds

In addition to the direct liability costs there is another $1.6 billion being added to cleanup efforts from the Trust Fund per year. It is this split between sources of cleanup financing which is most commonly disputed in the US as most polluting agents want a larger fiscal role for the Trust Fund, thus reducing their direct liability costs. At present the Trust Fund contributes to 27 percent of cleanup costs.

The Trust Fund is a compensation fund. It is used to finance site studies when identified responsible parties refuse to pay. It finances cleanup at sites where RPs are not identifiable or are insolvent (ie orphan sites). It can also be used to speed up site cleanups and then recover expenditures from compensation costs retrieved from PRPs.

The design of the Trust Fund attempts to charge industry sectors differently. The fund is financed from four sources of taxation:

- The tax on domestically produced and imported oil raises around $570 million per annum (37% of Fund).

- A similar tax on feedstock chemicals raises about $245 million per annum (16% of Fund).

- The corporate environmental tax raises about $460 million per year (26% of Fund). This is broken down by sector of industry as follow:

    - Manufacturing (52%); Services (3%); Finance, Insurance and Real Estate (17%); Construction (0.7%); Retail Trade (5%); Agriculture, Forestry and Fishing (0.2%); Transportation and Public Utilities (16%); Wholesale trade (3%); and Mining (2%).

- General revenues (no definition for this) fluctuate around $250 million per year (18% of the Fund).

The summation of all these sources of revenue total the Trust Funds resources at approximately $1.6 billion per year. (1)

The cost burden on industry from these taxes is minimal, resulting in a price increase (for outputs) of a fraction of production costs, amounting to less than 0.0005% for almost all industry sectors. (2)

(1) These figures are for 1990. Figures taken from "Assigning Liability for Superfund Cleanups, An Analysis of Policy Options, RFF Report by Probst and Portney.

(2) Probst et al. input-output model calculations, p77.

However, Probst et al conclude that the taxes are a highly ineffective system for raising revenues due to the high collection costs (administration in calculating out amounts) and the low amounts of revenue collected.

3.1.3 *Benefits*

Environmental Benefits

There were 1,320 sites on the NPL at the end of the 1993 fiscal year (which accounts for 14 out of the 16 years of Superfund operation):

- 617 (47 %) were in the site study or design phase with no cleanup activity taking place.

- Only 52 sites (4 %) had been deleted from the list - that is the EPA had determined that no further cleanup action was needed at these sites as they were deemed cleaned to required standards. Another 15 sites had been deleted by 1994. This highlights the slow rate of progress.

- At 166 sites (13 %) remedies had been completed, although many of them may require further long-term treatment, such as pumping contaminated groundwater or periodic monitoring to ensure that contamination does not migrate off-site.

- At 393 sites (30 %) cleanup activities were initiated.

Thus, at the end of the 1993 fiscal year fifty percent of all NPL sites had not yet been the subject of long-term cleanup, with more than 40 percent being subject to removal actions. [1] Removal actions are temporary cleanup actions, such as top soil containment and removal, usually carried out for sites in urgent need of cleanup, as a first measure provision before permanent treatment can be carried out.

Even these small numbers overestimate the amount of action taken. The US General Accounting Office reported in 1993 that only 60 percent of the sites deemed to have completed remedies (166) were actually subject to remediation. At 19 percent of these sites studied, the EPA determined that only a removal action was needed to address an immediate threat and no cleanup action at all was needed at another 21 percent. [2] Therefore, under 10 percent of all NPL sites have actually been cleaned up.

Preventative Benefits

There are also current and future benefits from avoided pollution due to private sector actors being deterred from causing further pollution. This though is hard to quantify and verify.

(1) Probst et al., RFF, 1995, p18.

(2) Probst et al., RFF, 1995, p19.

3.2 *ECONOMIC IMPLICATIONS OF KEY PROVISIONS IN SUPERFUND*

Specific components of an environmental liability system can have two main economic effects. They can alter the total quantity of money spent on cleanup, through number of sites and level of cleanup achieved; and they can alter who pays for the cleanup, which is a distributional and equity issue. These two effects have implications for the efficiency and effectiveness of the program through affecting propensities for cooperation among industry and coordination of cleanups.

One of the major factors affecting total cleanup costs (as opposed to who pays for cleanup) is the required standards of cleanup imposed under the regulations of Superfund. Different types of end goals for site restoration have huge cost implications:

- CERCLA describes what criteria the EPA is to use to clean up sites. The goals of the program are to achieve permanent solutions, preferably involving treatment processes, as opposed to containment of hazardous substances.

- The levels of cleanup are based on health standards and risk assessments. CERCLA requires the EPA to follow a set of state and federal regulations before selecting site remediation standards to comply with the required health standards. These are known as "Applicable or Relevant and Appropriate Requirements" or ARARs. ARARs vary across states leading to different levels and costs of clean-ups.

- In general many believe that compliance with ARARs is one of the major factors leading to high clean up costs, although consistent data regarding the determinants of the costs of clean-up are not available. (1)

- The Chemical Manufacturers Association produced a report (by Brattle/IRI), estimating cleanup costs for a sample of sites (already cleaned) using reduced stringency in cleanup standards, and compared them to existing EPA site restoration levels. CMA proposed that these lower levels of restoration were acceptable to health and environmental requirements. The figures show substantial room for cost savings. It was found that 35 percent cost savings could be attained on site cleanups using their alternative set of criteria. At an average of $26 million per site this works out on average to a saving of $9 million per site. The significant difference in their remediation solutions was that CMA suggested temporary over permanent solutions. (2)

- At one site with metals contamination in both soil and groundwater CMA proposed a soil cover solution as opposed to the EPA proposal for soil excavation and offsite disposal. The CMA claimed that soil remediation

(1) Probst et al., RFF, 1995, p16.

(2) Brattle/IRI report for CMA, Assessment of Cost Savings Resulting from Implementation of the CMA Remedy Selection Approach

under buildings was not necessary because the foundations act as a cap. The CMA solution is only 20 percent of the EPA expenditure for this site ($0.35 million compared to $1.8 million). At another site, (an abandoned metals mill) close to a national forest the CMA proposed excavation, onsite disposal and multi-layering capping as opposed to the EPA's measures of excavation, offsite reprocessing, reclamation and disposal of residuals. The alternative measures by CMA amount to $3.32 million in contrast to $6.21 million spent by the EPA on the more comprehensive cleanup measures.

- It is difficult to discern how 'clean' the alternative proposed measures are and thus how plausible are the CMA's suggested cost savings. It is also difficult to discern the validity of their claim that their alternative measures entail no increased environmental damage.

- The other specific component that affects total cleanup financing is the number of sites placed on the National Priorities List (NPL). There are numerous projections of how many sites should be and/or will be eventually cleaned up. Each of these have associated cost estimates. The University of Tennessee made cost calculations based on 3,000 sites to be cleaned, whereas CBO 94 and RFF studies both estimated that 4,500 sites would be cleaned. However, these will both probably turn out to be over-estimates as the reform provisions (discussed below) propose to cap the increase in sites to only 100 additional sites over the next three years.

3.3 *Overall Economic Implications of Superfund Reforms*

In the light of CERCLA reauthorisation planned for the end of 1995, major reform proposals are being produced by many different agencies and departments of the government involved with the Superfund program. These policy papers and ensuing debates provide a unique opportunity to further explore the dynamics and economic implications of the individual components of the US liability system.

In June of 1995 Senator Bob Smith, Chairman of the Subcommittee on Superfund, Waste Control and Risk Assessment, released an outline/blueprint of the upcoming Superfund Reform, which is probably very close to what we can expect to see introduced in the Senate, but still no guarantee of what will pass into law.

The outline identifies six provisions for change:

- Increase the contribution of local communities in facility remediation planning by establishing Community Response Organisations (CROs).

- Increase the state involvement in, and authority, over cleanups. States can be delegated by the EPA to supervise site cleanups. Once a state receives its certification from the EPA, the state will have exclusive authority for implementing and enforcing the federal Superfund program. The states will still receive financing from both PRPs and the Trust Fund.

- Change the number of sites on the NPL. A flexible cap is suggested which will allow the addition of only 30 sites per year for the next three years and then stop further increases. [1]

- Alter the levels and standards of site cleanup. Emphasis is put on cost-effective cleanup which allows for flexible solutions which are not necessarily permanent. Interim actions such as containment will now be considered. It calls for the elimination of ARARs. Current and future land and water use are to be considered when planning the levels of remediation. "The objective is protection of human and health and the environment from realistic and significant risks through cost-effective and cost-reasonable remedies."

- Scope of liability is to become more limited:

    - Retroactive liability is only to operate post-1980. Contamination actions occurring both pre- and post-1980 will be apportioned according to the amount of damage caused after 1980.

    - Proportionate liability is to be imposed so that no person shall be held liable for more than the share of removal, response or natural resource damage ("NRD") costs attributable to that person's conduct. An independent allocator will determine the appropriate level of liability of each party currently liable. The following factors are to be considered when determining the persons' proportionate share of liability: 1) the degree of involvement of each party in the generation, transportation, treatment, storage, or disposal of the hazardous substances; 2) the toxicity of the substances involved; 3) the mobility of the materials; 4) the degree of care exercised, taking into account the hazards posed by the material; and 6) the degree of cooperation with federal, state and local officials. Orphan shares - attributable to insolvent firms or unattributable parties - shall be paid by the Trust Fund.

    - Lender liability will be amended to limit potential loss through property acquired through foreclosure or property held due to exercising financial control pursuant to credit agreements.

- Natural Resource Damage which deal with natural resources as opposed to health and property damage will be amended so that damage shall only be recoverable for actual injury to measurable, and ecologically significant functions of publicly used environment. The recovery costs will be limited to cost-effective restoration or resource replacement and not merely resource replication. This means that with the exception of direct monetary damage resulting from a lost use of the natural resource, there shall be no recovery for lost use or non-use damage to the environment at the time of the conduct giving rise to the damage.

[1] This is a much lower number than was expected and will make many studies' total cleanup costs significant overestimates as they are based on 2,000-4,000 sites being eventually on the NPL.

These reforms, if instituted, will have significant effects on the cost burdens of industry. They will affect:

- The share of costs borne by industry directly as opposed to the use of Trust Fund resources.
- The total cost of cleanup depending on types of remediation implemented.
- The proportion of transaction costs as a percentage of total cleanup costs for individual sites.
- The amount of compensation costs liable for environmental damage.

Cost on Industry vs Trust Fund

The elimination of retroactive liability for pre-1980 site contamination reduces the financial burden to responsible parties and increases the share of cleanup costs to be borne by the Trust Fund. Under the current provisions the Trust Fund covers 27 percent of the remaining cleanup. Probst et al. calculate that if only multiparty sites pre-1980 cleanups are covered by the Trust Fund, the Trust Fund will have to cover 70 percent of all remaining cleanup costs. This comes to $16.4 billion (0.25 % of GDP). The increase in government-implemented cleanups is also expected to result in a $2 billion increase in the total cleanup bill since public sector cleaning is considered to be less efficient than private sector cleanup because the private sector parties have greater financial incentives to clean up the sites at a lower cost. If pre-1980 sites for which a single party is responsible are also included then these figures will be even higher. The changes will also be greater if natural resource damage are included.

Thus, industries with greater direct responsibility for cleanup will be greatly advantaged by this scheme as the Trust Fund taxes the breadth of industry. The Trust Fund taxes, however, are not evenly collected across the sectors, so an increase in them will have different implications for different sectors of industry.

More Cost-effective Cleanup

Flexible cleanup levels would be based on cost-effective action. The cleanup selection process proposed was based on site-specific risk assessment (as opposed to ARARs) with regard to actual and planned uses of the land and water resources. They also include containment as a possibility and not just treatment. The methodology of this Congressional reform appears similar to that proposed by CMA and discussed in *Section* 3.2.

By changing the end results demanded in cleanup actions the reforms can substantially reduce average site cleanup costs and thus total Superfund costs, at least in the medium term. Annual costs will not necessarily reduce as more sites can be cleaned up if lower levels of clean up per site are required. Long term cost also may not reduce as eventually temporary and interim arrangements will need to be converted into permanent solutions. The CMA study believes that if site specific cleanup requirements are carried out that a cost saving of 35% can be reacned on site cleanup costs (*see Section 3.2 for further details*). The University of Tennessee has also made projections about cost savings from less stringent levels of cleanup (of unspecified standard). They calculate a 33% cost saving as remaining cleanup would drop from $52 billion to $35 billion.

Lower Transaction Costs

The elimination of pre-1980 retroactive liability and the consequent transfer of financial responsibility results in a reduction of transaction costs. Estimated annual transaction costs as a percentage of total site costs are estimated by Probst et al. to fall from 16 percent under the current law to 7 percent under the reform. However, the savings are only due to the fact that Trust Fund payments circumvent responsible party disputes. Figures show that industry does not get more efficient in its transaction dealings and that industry transaction costs fall only because total industry cleanup costs fall. Under the altered retroactive liability scheme, firm transaction costs as a proportion of their cleanup costs would only fall from an average of 21 percent to 19 percent, according to Probst et al. However, Probst et al. calculate that no cost savings will result overall from this alternative strategy. In fact, because government cleanup is less cost efficient than private sector cleanup transferring of responsibility to the Trust Fund results in an estimated increase of $2 billion to the total remaining cleanup bill (which is $52 billion according to the University of Tennessee).

The modification of other aspects of the liability system will also impact on transaction costs. The implementation of proportionate liability will (supposedly) replace joint liability and thus reduce the desire or the opportunity to dispute site responsibility. This is one of the major contributions to transaction costs. The degree of change will depend on whether parties need to prove extent of contribution to damage.

Valuation of Natural Resource Damage

The limiting of Natural Resource Damage (NRD) to cost-effective solutions for measurable damage could lead to reduced compensation requirements by responsible parties. In light of the complexities of resource valuation, estimating resulting changes to compensation payments in this area is extremely difficult.

3.3.1 *EPA Proposed Reforms* [1]

The EPA, in the light of the forthcoming reauthorisation and after two years of research, also detailed the following conclusions for an improved Superfund policy. These are three-fold::

[1] EPA Press Release, October 2nd 1995.

- Cost-effective site cleanups (whilst still protecting health);
- Reduce litigation and increase fairness;
- Increase information and community involvement in decision making processes.

Cost-effective site cleanups (whilst still protecting health)

EPA concluded that all types of cleanup actions should be combined with site-specific risk assessments and processes should be streamlined to shorten cleanup period. EPA propose to set up an EPA National Remedy Review Board to ensure costs are appropriate to the cleanup needs (establishing "rules of thumb" for consistency). EPA also conclude that some sites should be kept off the NPL to aid redevelopment as there are negative economic aspects to being denoted a NPL site.

Reduce litigation and increase fairness

To reduce litigation and increase fairness, EPA conclude that:

- The compensation fund should pay for cleanup costs attributable to insolvent parties "orphan shares".
- Double the number of "small party" entities who would be exempted from the liability provisions. These are small businesses or citizens who contribute to pollution at Superfund sites in a small way (de minimis) but get sued by larger polluters in an attempt to delay site resolutions.
- Ensure that settlement funds are dedicated to specific sites by placing them in site-specific accounts.
- EPA will reward cooperative parties by significantly reducing EPA oversight of their cleanup activities.

Increase information and community involvement in decision making processes.

To increase information and community involvement in decision making processes, EPA conclude that there is a need for:

- Providing clearer information on remedy selection decisions through simple summary sheets available to communities and industry, explaining the relationship between risk and cost.
- Promoting consensus in choosing cleanup options by developing and initiating pilot projects in which EPA empowers and assists citizens, PRPs and other stakeholders in devising a mutually acceptable cleanup plan.
- Increase state involvement in remedy selection.

Budgetary Matters

At present, federal spending for Superfund is running at $1.5 billion a year from the Superfund Trust Fund. The House Appropriations Committee, which has jurisdiction over the federal spending incurred by the Superfund program, recently voted to allocate only $1 billion to Superfund spending in the Financial Year 1996. They allowed that a revision would be possible if a reform bill is passed. However, due to pressures to balance the budget this year the allocation may only rise to $1.2 billion. With retroactive liability being called into question, financing will become even more critical.

Debate is ensuing over the need to increase tax funding to account for the lost revenue from responsible parties or if it can be paid for out of the planned savings through different remedy selection (lower cleanup standards) or through reduced transaction costs. [1]

The CMA estimates that with the stated revisions taking place ie repeal of pre-1981 retro liability and taking on orphan sites previously paid for by other responsible site parties under joint and several liability, annual Superfund spending will need to be about $2.5 billion. Even if this is only roughly accurate a "funding gap" is evident (of around $1-1.5 billion). [2]

The CMA has called upon the insurance industry to make a financial contribution to the Superfund Trust Fund in order to help cover this funding gap. CMA argued that insurers would gain enormous savings from the removal of retroactive liability as they would be relieved of a massive backlog of insurance claims from policyholders held responsible for cleaning up such sites under existing law. This is also based on the fact that in 1994 the insurance industry "volunteered" to pay $800 million a year into a proposed Environmental Insurance Resolution Fund (EIRF) included in the 1994 Superfund reform bill (which ultimately failed to get through Congress). CMA argues that the insurance industry should be willing to make the same amount of contribution this year as well. [3] The insurers though have vigorously rejected the CMA proposal, arguing that, far from gaining any windfall from retroactive liability repeal, they would simply be relieved of a burden for which they do not consider themselves responsible. [4]

[1] Environmental Law Review Volume 23, July 1995, p13

[2] ELR023 July 1995, p13

[3] ELR023 July 1995, p13

[4] views of the American Insurance Association (AIA) in ELR023 July 1995, p13

This brief reviewing highlights the following conclusions, insights and issues for the development of environmental liability systems in Europe.

Organisation

The liability system instituted in the US is inherently slow as case specific financing arrangements compounded by highly bureaucratic processes in the coordination of cleanups lead to lengthy disputes and site cleanup.

In the US the average time of restoration from time of site identification to final remediation action is 11-15 years. The initial stages are especially arduous. EPA site studies require a thorough investigation of site contamination and a comprehensive analysis of possible remedial action, the need to coordinate with the appropriate state agencies and the need to address the concerns of local citizens regarding methods of cleanup. (1) These stages need to be completed before the remediation is initiated and the process needs to be streamlined.

Cleanup procedures

One weakness of Superfund has been the lack of clearly defined end goals. Initial standards required total environmental restoration without sufficient reasoning supporting such a decision. There is a need for explaining what is trying to be achieved by the cleanup standards selected. This can be achieved through setting out procedures for assessing risks and determining cost-effective cleanup. These can act as both guidelines and justifications for action.

Interim cleanup processes called 'removal actions' in the US have been viewed by many as one of the key successes of the Superfund program. These are useful options to remedy urgent problems and speed up cleanup processes.

Serious consideration is now being given to the adoption of cost-effective criteria for the cleanup of sites that take account of the possible use of the site (a fitness for use criteria), the costs of cleaning up a site to its original condition and the additional benefits of such clean up of a site to its original condition compared with its best alternative use. It is thought that this will reduce overall costs and add flexibility to site cleanup needs and thus be more attractive to industry. Cost-effective reform preferences of the Federal Government are for the lowest cost alternative that adequately protects human health and the environment considering both short and long-term costs. (2)

(1) Probst et, op cit, p21

(2) Part of the Reform of Superfund Act (ROSA) of 1995

Site selection

Sites placed on cleanup lists can have their economic value altered as interest in future redevelopment possibilities declines due to fears that future cleanup costs to be incurred on the site will probably be high. In poor urban areas in the US this is now a topic of concern. Attempts are being made to be more selective in putting such sites on the NPL.

Joint and several liability

Joint and several liability provisions were received badly by industry in the US. Industry consistently has stated that it would be more willing to finance liability schemes if they are seen to be fair and correlate closely with the polluter pays principle. If there are multi-parties involved in settlements instead of joint liability procedures of charging only one responsible party, all PRPs should be named in the initial settlement negotiation when possible. The US now proposes instituting proportional liability.

Financing

It is important to develop appropriate financing schemes so that cash flow for cleanups is not problematic. In the US the cleanup has been delayed because the EPA has suffered from lack of available resources for further cleanups whilst it awaits repayments from industry.

Companies appear willing to accept polluter pays principle if it is consistently used. It is important to demonstrate that money put out by a company goes to cleanup their share of the environmental remediation costs in a cost-effective manner (eg by setting up site-specific accounts for settlement funds) and that the company's money is not used to clean up the damage costs of others.

A link should be made between the agent who pays for site remediation and the agent that earns revenue from the increase in value for the property upon its sale. For instance if the EPA cleans up a site with Trust Fund money and in so doing so increases the site's value, provisions should be made so that EPA can claim back some of the cleanup costs through an increased sale price. Conversely it is not fair for a seller of a site to receive a low price for a known contaminated site and then have the EPA make them liable for cleanup through retroactive liability.

Financial incentives should be set up for PRPs to accept cleanup responsibility. The EPA is now considering introducing a new accelerated cleanup tax credit of 50 percent for PRPs that conduct cleanups. [1]

[1] EPA press release 29/9/95

Public image

One negative point voiced over Superfund is its limited results - as represented by the small amount of sites cleaned up.

Proponents of Superfund draw attention call issue to its potential effects in preventing pollution by deterring firms from contamination sites in future. Identifying and measuring the benefits of an environmental liability system should include (where possible) its effectiveness in deterring future pollution.

The lack of good information in the US about site conditions and cleanup options has often led to cynicism and mistrust of the Superfund program. This is particularly disappointing as the policy is supposed to be for the good of the people. Information is thus important in developing public support for any such program.

APPENDIX A

DETAILED COUNTRY SECTORAL ANALYSIS

Table A.1 - NACE 1: Energy and Water country sectoral analysis (1991)

NACE1															
Energy &Water															
	BELGIUM	DENMARK	GERMANY*	GREECE	SPAIN	FRANCE*	IRELAND*	ITALY **	LUXMBG	NL*	PRTUGL	UK	AUSTRIA *	FINLAND	SWEDEN ***
<10	124	53	5284		5767	2285	133	11519	61	114	69	4766		828	13391
10-99	1236	226	26464	1000	13037	7224	1671	21932	406	660	369	7689	203326	2995	508
100-199	824		16095	236	6787	1858	1925	6794	256		0	7275	106590	1673	15989
200-499	2472	0	33862	265	12121	12386	45662	13958	927	7563	0	19721	19721	4032	94932
>500	32868	0	394301	3311	91420	245271	30321	164666	0		29112	379033	247011	5812	
sum	37524	279	476006	4812	129132	269024	79712	218869	1650	8337	29550	418484	576648	15340	124820
<10	0,33	19,00	1,11	0,00	4,47	0,85	0,17	5,26	3,70	1,37	0,23	1,14	0,00	5,40	10,73
10-99	3,29	81,00	5,56	20,78	10,10	2,69	2,10	10,02	24,61	7,92	1,25	1,84	35,26	19,52	0,41
100-199	2,20	0,00	3,38	4,90	5,26	0,69	2,41	3,10	15,52	0,00	0,00	1,74	18,48	10,91	12,81
200-499	6,59	0,00	7,11	5,51	9,39	4,60	57,28	6,38	56,18	90,72	0,00	4,71	3,42	26,28	76,06
>500	87,59	0,00	82,84	68,81	70,80	91,17	38,04	75,23	0,00	0,00	98,52	90,57	42,84	37,89	0,00
sum	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

NOTES
* 1990
** 1989
*** employment size-classes: 1-19;20-99

Source: FEEM elaboration on Eurostat data.

Table A.2 - NACE 2: Extraction and Processing country sectoral analysis (1991)

NACE2															
Extraction and processing..															
	BELGIUM	DENMARK	GERMANY*	GREECE	SPAIN	FRANCE*	IRELAND*	ITALY **	LUXMBG	NL*	PRTUGL	UK	AUSTRIA *	FINLAND	SWEDEN ***
<10	3732	4151	34350		65726	29260	1011	105309	86	3858	8971	34205		3145	13391
10-99	21985	11917	160479	17488	156677	110981	9858	277516	1188	23771	37732	85820		8544	
100-199	13746	7006	73711	5663	52727	46879	16261	66473	1715	127831	16982	44666		..	
200-499	25266	9711	120087	14287	78519	92806		81401	4670		23841	68696		..	
>500	102219	17317	855289	10198	126519	356982		243766	10504		28522	432281		..	
sum	166948	50102	1243916	47636	480168	636908	27130	774465	18163	155460	116048	665668			
<10	2,24	8,29	2,76	0,00	13,69	4,59	3,73	13,60	0,47	2,48	7,73	5,14			
10-99	13,17	23,79	12,90	36,71	32,63	17,42	36,34	35,83	6,54	15,29	32,51	12,89			
100-199	8,23	13,98	5,93	11,89	10,98	7,36	59,94	8,58	9,44	82,23	14,63	6,71			
200-499	15,13	19,38	9,65	29,99	16,35	14,57	0,00	10,51	25,71	0,00	20,54	10,32			
>500	61,23	34,56	68,76	21,41	26,35	56,05	0,00	31,48	57,83	0,00	24,58	64,94			
sum	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00			

NOTES
* 1990
** 1989
*** employment size-classes: 1-19;20-99

Source: FEEM elaboration on Eurostat data.

Table A.3 - NACE 3: Metal manufacturing country sectoral analysis (1991)

NACE3															
Metal manufacturing															
	BELGIUM	DENMARK	GERMANY*	GREECE	SPAIN	FRANCE*	IRELAND*	ITALY **	LUXMBG	NL*~	PRTUGL	UK	AUSTRIA *	FINLAND	SWEDEN ***
<10	12374	23212	180179		209010	145919	2941	203923	342		16990	233491		15695	46087
10-99	60880	66968	769412	16408	318184	466114	21302	805600	3259	132331	58341	448660		34647	62774
100-199	21421	25369	344166	3810	64152	159318	10107	154444	1020	227494	24508	165991		13900	28522
200-499	33251	28910	510694	8249	88360	96609	15691	178621	3416	227494	28802	204577		21696	42887
>500	124479	49696	2704113	19699	254248	927232	15908	538363	1442		54045	1135235		58986	214355
sum	252405	194155	4508564	48166	933954	1795192	65949	1880951	9479	587319	182686	2187954		144924	394625
<10	4,90	11,96	4,00	0,00	22,38	8,13	4,46	10,84	3,61	0,00	9,30	10,67		10,83	11,68
10-99	24,12	34,49	17,07	34,07	34,07	25,96	32,30	42,83	34,38	22,53	31,94	20,51		23,91	15,91
100-199	8,49	13,07	7,63	7,91	6,87	8,87	15,33	8,21	10,76	38,73	13,42	7,59		9,59	7,23
200-499	13,17	14,89	11,33	17,13	9,46	5,38	23,79	9,50	36,04	38,73	15,77	9,35		14,97	10,87
>500	49,32	25,60	59,98	40,90	27,22	51,65	24,12	28,62	15,21	0,00	29,58	51,89		40,70	54,32
sum	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00		100,00	100,00

NOTES
* 1990
** 1989
*** employment size-classes: 1-19;20-99
~no data for 100-199 (only 100-499)

Source: FEEM elaboration on Eurostat data.

Table A.4 - NACE 4: Other manufacturing country sectoral analysis (1991)

NACE4															
Other manufacturing															
	BELGIUM	DENMARK	GERMANY*	GREECE	SPAIN	FRANCE*	IRELAND*	ITALY **	LUXMBG	NL*~	PRTUGL	UK	AUS *	FINLAND	SWEDEN ***
<10	36164	40376	326615		422651	340922	5166	574419	1150	49983	52678	398127		22992	39045
10-99	121014	88947	893761	76658	521769	597830	44541	1164140	3187	319152	224953	19462		41404	52063
100-199	38321	26862	315163	25109	98503	207034	20756	190396	1477		92619	159093			1867
200-499	52232	35392	417500	36540	118563	280524	21227	183138	2911		120547	212517		9017	
>500	57401	68697	693053	24376		433373	9027	217950	4008		106312	978977	6031		
sum	305132	260274	2646092	162683	1161486	1859683	100717	2330043	12733	369135	597109	1768176		73413	92975
<10	11,85	15,51	12,34	0,00	36,39	18,33	5,13	24,65	9,03	13,54	8,82	22,52		31,32	42,00
10-99	39,66	34,17	33,78	47,12	44,92	32,15	44,22	49,96	25,03	86,46	37,67	1,10		56,40	56,00
100-199	12,56	10,32	11,91	15,43	8,48	11,13	20,61	8,17	11,60	0,00	15,51	9,00		0,00	2,01
200-499	17,12	13,60	15,78	22,46	10,21	15,08	21,08	7,86	22,86	0,00	20,19	12,02		12,28	0,00
>500	18,81	26,39	26,19	14,98	0,00	23,30	8,96	9,35	31,48	0,00	17,80	55,37		0,00	0,00
sum	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00		100,00	100,00

NOTES
* 1990
** 1989
*** employment size-classes: 1-19;20-99
~ no data for 100-199

Source: FEEM elaboration on Eurostat data.

Table A.5 - Germany: Shares on total employment at NACE 2 digits (1990)

GERMANY	micro	small	medium	medium	large	TOTAL	Total employment
	(< 10)	(10-99)	(100-199)	(200-499)	(> 500)		
1. Energy and Water	1,11	5,56	3,38	7,11	82,84	100	476006
11	0,01	0,19	0,28	0,76	98,78	100	178066
12							
13							
14	0,69	4,43	4,98	8,98	80,92	100	20921
15							
16	1,85	9,10	5,26	11,06	72,73	100	277019
2. Extraxtion & processing...	2,76	12,90	5,93	9,66	68,76	100	1243916
21	0,66	5,84	4,44	6,76	82,40	100	305397
22							
23	8,22	30,44	9,40	14,43	37,51	100	323368
24							
25	0,98	7,19	4,83	8,58	78,41	100	615161
26							
3. Metal manufacture	4,00	17,07	7,83	11,33	59,98	100	4508564
31	9,55	32,75	12,94	16,49	28,28	100	858732
32	2,66	20,84	10,91	16,45	49,14	100	1147439
33	3,27	7,95	2,37	6,21	80,20	100	141071
35	0,39	2,58	1,76	3,38	91,90	100	811898
36	1,67	7,76	5,42	8,10	77,14	100	124598
4 Other manufacturing industries	12,34	33,78	11,91	15,78	26,19	100	2646092
41/42	17,62	40,15	10,29	13,31	18,62	100	733694
43	3,23	21,70	14,38	23,69	37,00	100	218832
44	10,39	48,53	18,73	22,35	0,00	100	25012
45	12,51	35,91	13,91	16,59	21,08	100	274060
46	20,61	41,14	11,29	13,50	13,46	100	361524
47	8,96	28,52	11,98	16,51	34,03	100	575269
48	3,78	26,07	11,81	15,64	42,71	100	383928
49	17,28	38,36	13,92	17,77	12,66	100	73773

Source: FEEM elaboration on Eurostat data

Table A.6 - Italy: Shares on total employment at NACE 2 digits (1990)

ITALY		micro	small	medium	medium	large	TOTAL	Total employment
		(<10)	(10-99)	(100-199)	(200-499)	(>500)		
1 Energy and Water		5,55	5,1	3,27	6,7	79,35	100	207527
	11							
	12							
	13	100					100	252
	14	41,85347	8,577619			49,56891	100	22617
	15							
	16							
2. Extraxtion & processing...		13,80613	34,84943	8,71468464	10,6717621	31,958	100	762770
	21							
	22							
	23	35,33029	64,66971				100	33334
	24	23,33991	45,53224	9,21585821	9,01656769	12,89543	100	301068
	25	5,540482	27,81127	10,6831993	13,4262272	42,53883	100	244365
	26	18,19048	81,80952				100	1050
3. Metal manufacture		12,59561	33,57931	9,53946881	11,032798	33,25281	100	1619000
	31	26,39349	48,67304	9,88170515	8,12732302	6,924443	100	456571
	32	9,871594	42,71983	14,421845	14,9878001	17,99893	100	424592
	33	8,12954	9,333488	2,45420079	9,17141782	70,91135	100	34553
	35	1,71307	10,78533	4,89049331	6,51023531	76,10087	100	211083
	36	4,364548	12,47379	3,34383198	9,10905953	70,70877	100	129223
4. Other manufacturing industries		26,31785	46,58243	8,72327353	8,39073756	9,985701	100	2182621
	41/42	22,12107	35,37597	9,55411386	10,4094115	22,53944	100	339414
	43	20,86498	46,73534	11,7294503	12,1568226	8,51341	100	390760
	44	33,86941	57,01735	9,11323999			100	69207
	45	27,52893	53,75509	7,1745744	6,90503015	4,636381	100	544994
	46	45,89619	44,89102	5,31757308	2,88702802	1,008193	100	330790
	47	19,00289	42,83747	9,0931711	10,0644032	19,00206	100	241137
	48	11,48182	48,20099	11,7486452	11,9865139	16,58203	100	193384
	49	37,34311	55,81108	6,84580544			100	65573

Source: FEEM elaboration on Eurostat data

Table A.7 - Spain: Shares on total employment at NACE 2 digits (1991)

Spain	micro	small	medium	medium	large	TOTAL	Total employment
	(<10)	(10-99)	(100-199)	(200-499)	(>500)		
1. Energy and Water	4,47	10,10	5,26	9,39	70,80	100	129132
11	0,76	10,15	7,19	10,46	71,43	100	39087
12	32,67	67,33				100	101
13	8,35	31,34	9,84		50,47	100	1270
14	0,31	1,92	3,57	10,88	83,32	100	11749
15	3,62	0,00	0,00	20,25	76,13	100	1022
16	2,97	7,71	2,49	6,54	80,29	100	55047
2. Extraxtion & processing...	13,69	32,63	10,98	16,35	26,35	100	480168
21	6,54	14,20	4,27	30,57	44,43	100	6304
22	7,19	16,73	8,11	13,95	54,01	100	85370
23	25,84	55,20	6,79	2,01	10,16	100	26945
24	20,24	41,56	8,22	11,69	18,28	100	168513
25	9,38	29,31	15,46	23,02	22,83	100	193036
26						100	
3 Metal manufacture	22,38	34,07	6,87	9,46	27,22	100	933954
31	31,67	45,90	7,19	8,82	6,41	100	404015
32	30,08	42,32	10,02	11,16	6,42	100	104683
33	4,89	7,25	4,39		83,47	100	9721
35	6,72	13,75	4,58	25,60	49,35	100	93704
36	5,79	14,76	5,24	7,46	66,76	100	63162
4. Other manufacturing industries	32,07	39,60	7,48	9,00	11,86	100	1317714
41/42	26,98	31,64	7,64	13,62	20,12	100	388464
43	18,70	41,30	13,84	14,53	11,62	100	142148
44	39,62	42,38	8,72	7,73	1,56	100	34358
45	36,56	46,78	5,66	4,53	6,47	100	215175
46	50,02	44,11	2,98	1,93	0,96	100	235898
47	27,32	42,13	9,88	10,84	9,82	100	183905
48	16,15	35,85	8,80	8,26	30,94	100	74976
49	43,52	38,57	5,13	4,49	8,29	100	42790

Source: FEEM elaboration on Eurostat data

Table A.8 - UK: Shares on total employment at NACE 2 digits (1991)

UK	micro	small	medium	medium	large	TOTAL	Total employment
	(< 10)	(10-99)	(100-199)	(200-499)	(>500)		
1 Energy and Water	1,14	1,84	1,74	4,71	90,57	100	418.484
11							
12							
13							
14							
15							
16							
2 Extraxtion & processing...	5,14	12,89	6,71	10,32	64,94	100	665.668
21	64,10	35,90				100	39
22	3,63	9,11	6,51	10,08	70,67	100	131.808
23	14,83	37,11	11,58	17,27	19,20	100	10.988
24	7,16	17,96	7,35	9,80	57,73	100	222.772
25	4,05	10,16	6,06	10,76	68,97	100	290.980
26	0,58	1,70	8,75	3,95	85,01	100	9.081
3 Metal manufacture	10,67	20,51	7,59	9,35	51,89	100	2.187.954
31	14,21	27,31	8,85	10,16	39,48	100	419.577
32	13,67	26,27	7,57	8,04	44,45	100	753.795
33	6,09	18,39	5,13	5,92	64,47	100	80.045
35	4,22	9,10	7,12	11,80	67,75	100	181.533
36	4,86	10,99	4,81	7,69	71,64	100	177.013
4. Other manufacturing industries	18,35	19,38	7,33	9,80	45,13	100	2.169.147
41/42	9,89	10,45	6,84	8,78	64,04	100	453.980
43	11,73	12,38	9,38	12,37	54,14	100	194.039
44	32,09	33,93	11,72	7,73	14,53	100	19.585
45	19,14	20,23	7,63	10,05	42,96	100	296.840
46	28,92	30,53	9,11	7,78	23,65	100	276.973
47	20,75	21,91	5,56	8,60	43,17	100	544.669
48	10,21	10,78	9,45	15,02	54,54	100	242.781
49	35,25	37,20	4,58	8,89	14,08	100	140 280

Source: FEEM elaboration on Eurostat data

Table A.9 The polluting industry, (1990)

NACE 21/22-41/42-46-47-48	FRANCE	GERMANY	ITALY	SPAIN	UK	EU12-avg.
micro (< 10)	278954	271611	304462	291724	267620	1703678
small (10-99)	421663	725258	500365	346519	289562	2839617
medium (100-199)	141450	244183	105374	68658	118112	876108
medium (200-499)	323309	322135	108611	97405	157995	1111411
large (> 500)	432865	796625	245320	170611	816963	2902119
total employment	1474279	2359812	1264132	974917	1650252	9432931
shares						
micro (< 10)	18,92	11,51	24,08	29,92	16,22	18,06
small (10-99)	28,60	30,73	39,58	35,54	17,55	30,10
medium (100-199)	9,59	10,35	8,34	7,04	7,16	9,29
medium (200-499)	21,93	13,65	8,59	9,99	9,57	11,78
large (> 500)	29,36	33,76	19,41	17,50	49,51	30,77
total	100	100	100	100	100	100

Source: FEEM elaboration on Eurostat data

Annex A

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