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## Environmental Damage and the Question of Liability

*The most effective way of preventing damage of any kind is to make the originator of the damage liable and to require him to rectify it. How can this principle, that works perfectly if a private good is damaged, be applied to the environment? Which are the advantages and limitations of a liability-based approach to environmental protection?*

Environmental policy has increasingly become a central part of economic policy, owing mainly to the growing number of cases of environmental damage and the public's heightened sensitivity towards environmental issues. In economic terms, this means an increased scarcity of the commodity "clean environment" on the supply side and a shift in preferences towards a more intact environment on the demand side. A higher price must therefore be paid for exploitation of the environment, and users are prepared to do so.

In view of these trends, various environmentally oriented measures have been introduced in the fields of public regulation, taxation and liability for environmental damage. Despite the observable impact these instruments have had in the environmental sphere, fresh environmental damage is continually occurring. Environmental instruments are clearly not able to internalise a sufficient proportion of the external costs of the burden on the environment. As environmental damage cannot automatically be traced back to the original source of the emissions, institutional arrangements are needed to enhance efficiency in this regard by ensuring that as far as possible damage is ascribed to the individual originator. However, as long as emitters are not held liable for the environmental damage they cause and, in particular, as long as they have no incentive to reduce emissions so that damage does not occur in the first place, environmental policy cannot produce satisfactory results.

The setting of ecological objectives is usually a function of the political process, although this presupposes that there can be a choice between different environmental conditions over the long term. It is essential for the

economist, too, to incorporate concrete ecological objectives into his analysis if he is to be able to identify the interventions necessary in market allocation as well as assess the efficiency with which economic policy instruments are used. The optimum use of the environment for purposes of production and consumption is often deemed to occur at the point where the cost of preventing an additional unit of emission (marginal prevention cost) equals the additional utility deriving from the environmental pollution so prevented.

Being a static approach, however, this view ignores the time dimension; emissions that cause pollution in excess of the environment's self-cleansing potential<sup>1</sup> do not simply dissipate "into thin air" but accumulate, adding up to ever greater environmental damage. The environment's function of absorbing harmful substances is linked over the long term to its self-cleansing potential, since environmental pollution cannot be "written off" and each generation allocated a specific level of environmental use. As long as the environment is able to break down emissions itself or with the aid of regenerative systems (including sewage treatment plant, for example), long-term environmental damage should not occur. In contrast to the short-term micro-economic perception of the issue, this indicates that it is not a question of choosing between environmental quality and output. Economic developments are therefore governed by the ecological situation. For that reason the price to be paid for the environmental impact of economic activity should ensure that the environment's regenerative capacity is maintained and hence that real consumption of the environment is avoided.

<sup>1</sup> The self-cleansing potential is determined by the ability of ecological systems to break down and convert harmful substances. This capacity to assimilate can be deliberately increased by creating additional artificial or natural cleansing systems (sewage plant, forests, etc.)

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The long-term aim of an efficient environmental policy must therefore be to reduce emissions to a level at which no permanent environmental damage occurs. Future technical progress might justify discounting environmental damage or the necessary clean-up costs; however, this presupposes not only that damage can be rectified more cheaply at a later date, which is quite plausible, but also that no further damage will occur in the meanwhile as a result of accumulation, which is less plausible. If the damage cannot be repaired later, in other words if it is irreversible, an option value must be calculated that takes account of the costs and benefits of present environmental consumption for future generations.<sup>2</sup> Such a calculation would not only take future preferences for granted, but would also assume that the cost of environmental destruction on the one hand and the benefits of current economic activity to future generations on the other can be weighed one against the other.

As this is not possible, reducing emissions to a level compatible with the environment's self-cleansing potential must remain the long-term aim. Only by ensuring that emissions do not exceed this level will it be possible to achieve the ecological balance established as the goal of the Federal German Government's environmental programme as long ago as 1974.<sup>3</sup>

If emissions exceed the environment's self-cleansing potential, in other words if their external effects are not fully neutralised, environmental policy instruments must be used that internalise the costs of the resulting external damage.

### A Solution Based on Liability

It is acknowledged that the most effective way of preventing damage of any kind is to make the originator of the damage liable and to require him to rectify it. This principle works perfectly if a private good is damaged. The environment is not a private good, however; although rivalry is present, the principle of excludability does not apply. Negative external effects resulting from this competition in consumption make the environment a semi-public good. The consequent scarcity of the commodity "environment" nevertheless requires rules that will lead to an optimum allocation, because this cannot be achieved by the price mechanism that operates for private goods.

One rule that takes account of the principle that the polluter pays is the liability approach, whereby each

potential polluter must himself bear the risk of causing environmental damage and be liable for any caused. The liability approach produces efficient results, in both economic and ecological terms.

Economic efficiency in the environmental field is achieved if the scarcity price of the environment enters into the emitter's calculations. The emitter will increase the use of pollution prevention technology until the marginal prevention cost is greater than the marginal cost of paying damage compensation. Competition for the environment as a production factor has the effect that products and production processes entailing a lower level of emissions gain a desirable competitive advantage over those that involve heavier pollution. This also encourages firms to undertake greater research and development in the field of pollution prevention technology. If the emitter can expect to be held liable for all damage caused by emissions from his plant, the preconditions for economic efficiency are met, as the actual price of the environment has entered into his calculations.

Ecological efficiency is achieved mainly by taking actual damage as the starting-point, and not the emissions. The least possible damage should be caused and it should be rectified so that no lasting harm results, at least over the long term. This can be achieved only by rigorously applying the liability rule, which focuses on the damage caused; only in this way can the actual state of the environment be measured and damage directly avoided or cleaned up.

### Various Categories of Damage

In introducing the liability rule in the environmental field, it should be borne in mind that it is seldom possible to establish directly who is responsible for environmental damage. However, it should not be concluded from this that the rule can be applied only to cases in which the originator of particular damage can be clearly identified without recourse to other means while all other cases are exempted. A decisive criterion for applying the liability approach is therefore whether damage can be attributed to the originator. To illustrate this, the possible types of environmental damage have been divided into a number of categories (see Table 1).

The first question to ask is whether the substance or category of substances causing the damage is known. In order to implement the liability rule, it is also essential to know the group of emitters releasing the substance. It is often difficult to identify the originator within the emitting group. Identification of the individual emitter would make it far easier to ascribe liability, but it is not absolutely necessary, as will be explained later. If the relationship between the emission and the damage is also known, in

<sup>2</sup> Cf. K. J. Arrow and A. C. Fischer: *Naturerhaltung und Irreversibilität*, in: H. Möller et al.: *Umweltökonomik*, Königstein 1982, pp. 1984 ff.

<sup>3</sup> Cf. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (ed.): *Was Sie schon immer über Umwelt wissen wollten*, Stuttgart 1987, pp. 20 f.

other words if the trail from a unit of pollutant to the damage can be accurately reconstructed, nothing stands in the way of a solution based on liability.

If all of these criteria are met, the damage falls into category I, with direct attribution to the originator of the pollution. Category II covers cases in which the trail from the emitter to the damage cannot be proven conclusively but there are justified grounds for making a presumed attribution, so that in this sense the originator is identifiable.

The conditions governing damage liability must be amended so that proof of this kind becomes possible. The burden of proof must be reversed. Traditionally it is the damaged party who must prove what substance is responsible for the damage and by whom it has been released. It is often impossible to provide such proof, so that the guilty party evades liability for the environmental damage he has caused. If environmental damage is to be uncovered, which is economically desirable, plaintiffs must have some hope of their claims succeeding. Only reversal of the burden of proof, forcing the potential polluter to prove his innocence, can create a systematic incentive to avoid damage to the environment.

If only part of the damage can be attributed in accordance with the criteria of category II, the damage falls into category III, which covers cases where at least part of the individual liability can be attributed in the same way as in categories I and II, and which are thus easier to resolve than the following categories.

If only the substance category and the emitter group are known, the case comes under category IV. Category V (non-attributable cases of damage) applies if it can only be surmised which substance or substances may be responsible. In some cases, such as general air pollution, the substance responsible often cannot be clearly determined, only assumed.

## Legal Treatment in Germany

Having explained the various categories of damage, we must now ask which cases are resolved via the liability approach (see Table 2). In Germany the Environmental Liability Law, which came into force at the beginning of last year,<sup>4</sup> reinforced the concept of individual legal liability in the environmental field and hence also gave greater prominence to the issue in the environmental debate.<sup>5</sup>

The Law marks a significant advance in environmental policy mainly by virtue of the introduction of the concept of liability based on causation irrespective of fault, i.e. responsibility for hazardous activities where damage was caused neither intentionally nor negligently (absolute liability). This means that the operator of a plant no longer has to be found guilty of a fault to establish liability; instead, the mere fact of operating a plant entails danger, which carries with it liability for any damage that may ensue.

Another advance is the introduction of the concept of presumed causation, which makes it easier to prove responsibility. In accordance with this principle, the operators of a plant are liable for environmental damage if there are justified grounds for assuming that it has been caused by their plant but there is no conclusive proof. Where environmental damage is concerned, the burden of proof therefore no longer bears solely on the damaged party. The damaged party must only provide circumstantial evidence on three counts:

<sup>4</sup> Cf. Gesetz über die Umwelthaftung, in: Bundesgesetzblatt, No. 67, Bonn 14.12.1990, and Gesetzentwurf der Bundesregierung zum Umwelthaftungsgesetz, in: Bundestagsdrucksache 11/7104, Bonn 10.5.1990.

<sup>5</sup> In this and subsequent connections, see C. Wacker-Theodorakopoulos and C. Kreienbaum: Das neue Umwelthaftungsrecht – Eine Verbesserung des umweltpolitischen Gesamtkonzeptes?, in: Wirtschaftsdienst, No. 8, 1991, pp. 423-428.

**Table 1**  
**Environmental Damage Differentiated According to Attributability to the Originator**

	Substance or substance group known	Group of emitters of a substance type known	Originators can be identified	Link between emission and damage known
I. Can be directly attributed to emitter	×	×	×	×
II. Good grounds for attributing liability	×	×	×	only assumed
III. Good grounds for attributing part of liability	×	×	in part	in part
IV. Can be attributed indirectly	×	×	—	—
V. Cannot be attributed	only assumed	—	—	—

1. he must identify the substance causing the damage;
2. he must identify a particular firm as the emitter of the substance;
3. he must be able to demonstrate that the plant in question is capable of producing the observed damage.

The Environmental Liability Law therefore relates to damage in categories I and II; category I, because the principle of absolute liability applies, and category II because proof is made possible by the concept of presumed causation.

The limited value of the Law is particularly apparent in the case of category II damage, however. In order to ensure that the Law does not conflict with existing environmental requirements and levies, the Government created the concept of "normal operating conditions" for damage of this kind. A factory is producing under normal operating conditions if it complies with official authorisations, requirements and legal provisions and if operations are running smoothly. Hence, if operating conditions are normal, it is as though the Environmental Liability Law did not exist, because presumed causation no longer applies. This circumvention of presumed causation means that category II cases arising under normal operating conditions are not covered by the German liability legislation. However, a large part of the observable environmental damage is caused during normal operating conditions and should be a central target of a liability rule.

Polluters can also escape liability if their emissions exceed the levels compatible with normal operating conditions. This is possible if a source of emissions other than the one named in the Law may potentially also be responsible for the damage in question. This applies particularly to damage in category III. For example, the existence of a neighbouring small polluter who is not listed in the Law is enough to provide an escape from the presumed causation provision, and thus to make the Law virtually unworkable.

The consequence of these arrangements is that a large number of cases of environmental damage that would be expensive to rectify are exempt from liability. The emitter's risk of being called to account for environmental damage

therefore decreases significantly. This in turn means that the state absolves the polluter of at least part of his responsibility for the environment.<sup>6</sup>

It is therefore clear that the Environmental Liability Law covers only category I emissions and category II incidents outside normal operating conditions, in other words in category II only breakdowns. Other cases of damage – II during normal operating conditions, III, IV and V – are to be prevented by indirect means, namely requirements and levies. Official requirements make the operation and level of emissions of a particular plant subject to authorisation; levies provide for an officially set charge for the release of harmful substances.

In contrast to environmental liability arrangements, requirements and levies do not focus on the regulation of environmental damage. Nevertheless, requirements do at least serve to limit damage, and any that does occur becomes the responsibility of the community at large: in other words, it is either cleaned up at the taxpayer's expense or may even be left untreated. Levies are a different matter; even if they can be prevented from flowing into general tax receipts, it is to be feared that they will be used primarily for electorally effective purposes rather than according to criteria of ecological efficiency.<sup>7</sup>

### Scope for Attributing Liability

If the liability approach is regarded as the basis for environmental action, it is necessary to ascertain the cases to which it can be applied. In the light of the categories of damage outlined above and the inefficiency of traditional instruments, the question arises whether the liability principle must, in fact, be confined to category I and

<sup>6</sup> The risk that emitters will be held liable for environmental damage of categories I and II outside normal operating conditions is to be covered by a scheme organised by producers themselves. How such a scheme will look has not yet been finally decided. Parliament has also made explicit provision for an insurance arrangement.

<sup>7</sup> The implementation of plant-related requirements is not advisable because of the distortion of competition they cause and the adverse effects they have on innovation. In the case of levies, the main disadvantage stems from the political nature of price determination. Cf. C. Wacker-Theodorakopoulos and C. Kreienbaum: Reform der Umweltpolitik im Lichte der deutschen Einigung?, in: Wirtschaftsdienst, No. 10, 1990, pp. 514 f.

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category II outside normal operating conditions. Would it not be possible to apply a liability rule to cases in the other categories as well, and thus deal with them more efficiently than with the system of requirements and levies?

If the categories or damage cases are examined one by one to determine whether liability can be laid at the door of the polluter, it is not clear why category II damage arising under normal operating conditions has been de facto excluded from liability, despite the fact that in category I the emitter would be held liable. The scarcity of the environment is not measured by whether a factory suffers a breakdown or not, but primarily by the degradation caused by on-going emissions. It therefore makes sense for normal operations also to be covered by liability arrangements, since traditional instruments lead to inefficiency.

Category III differs from categories I and II only by the fact that another source of emissions as well as that named in the Law contributes to the damage. For example, if 90 per cent of a particular form of environmental damage can be ascribed to a particular emitter with a reasonable degree of certainty, the originators should be held responsible for that part of the damage in exactly the same way as in category I or II. Proportional liability on the part of the originator on the basis of possible attribution should become an integral part of environmental policy; here too, this holds true irrespective of whether the observed damage is the result of a breakdown or normal operations.

Even category IV cases need not lead to abandonment of the liability approach, although here it is no longer possible to reconstruct the emissions chain. At present, damage is occurring that for technical reasons cannot yet be ascribed to particular polluters. In order to apply the liability approach, however, it is sufficient if damage can be attributed to the harmful substance or substances responsible. In the past, substances have been successfully identified as the cause of tangible environmental damage. For example, sulphur dioxide is held to be the main cause of the forests dying. Provided all emitters of a substance are known, they could be held jointly liable. The courts would then have to apportion liability among the individual emitters involved.

If the liability approach is extended to categories II, III and IV, emitters will be called to account for the bulk of the environmental damage caused. The risk that they will be held liable thus rises. This would induce them to produce in a more environmentally friendly way, since their calculations would now have to take account of the cost of their environmental impact, which was previously external. Whether an emitter prevents damage by investing in prevention technology or cleans up the

pollution once it has occurred is left to the emitter to decide, provided the damage is not irreversible. The emitter will then increase his prevention efforts until the marginal cost equals the marginal payments of damage compensation.

It is only in category V that the liability approach breaks down. Here it is impossible to link the substance causing the damage, i.e. the emission, with the damage itself. Since the chain of causation cannot be traced back to the emitters even indirectly, these cases can be dealt with only by setting emission ceilings, the level of which must be determined for all substances by policy decision. If damage in this category becomes perceptible to society, a tightening of the emission ceilings by the state becomes unavoidable. However, as the substance responsible cannot be determined precisely, the state can only guess which further restrictions will minimise category V damage.

## Emission Certificates

The emission ceilings traditionally used in environmental policy are highly inefficient in both economic and ecological terms, as has already been mentioned. Certification offers a better solution. Under this arrangement, every polluting firm must possess entitlement certificates for the release of each unit of the harmful substance. There is a different certificate for each group of substance, and official regional or country ceilings are set for the total emission of each substance. The certificates can be traded freely. This quantitative solution makes it unnecessary to gather information on the scarcity price of the environment at the desired environmental standard and the price is set by the market.<sup>8</sup>

Like levies, certificates ensure that the environment is not used in places where this production factor can be substituted relatively easily. Unlike levies, trading in pollution certificates entails lower transaction costs, since central price determination is not necessary, and it also shares an advantage with official requirements, in that certain emission standards can be prescribed.

Overall, a system of certificates offers considerable advantages over rigid requirements owing to the tradability of emission permits and the resulting scarcity prices for use of the environment. By comparison with the liability approach, however, certificates are not an appropriate means of achieving the set ecological objective; since such a system tackles emissions, it makes it possible to keep the level of emissions constant or even to reduce it (although this is unlikely, for it would be

<sup>8</sup> For a more detailed analysis, see the article by H. Bonus in: H.-C. Binswanger, H. Bonus and M. Timmermann (eds.): *Wirtschaft und Umwelt*, Stuttgart 1981, pp. 143 f.

difficult to achieve politically<sup>9</sup>) but it gives no indication of the actual environmental situation, which can best be measured from the damage caused. For that reason, it is preferable from the ecological point of view to adopt the liability approach as far as possible. In view of the advantages described (ceilings, tradability, possible reductions) and the fact that category V damage requires separate arrangements, certificates are a sensible complement to the liability approach.

Certificates offer additional support to the implementation of the liability approach, because they increase transparency about emissions. If each emitter must purchase certificates for his number of units of the various groups of substances and must make this information publicly accessible, it should be easier for the injured parties or the courts to ascribe presumed responsibility and to apportion liability.

### **An Insurance-based Solution**

The introduction of comprehensive liability arrangements coupled with reversal of the burden of proof and the introduction of the concept of joint liability increases the emitter's risk of being called to account. The insurance market will develop appropriate policies so that emitters can limit their liability exposure.<sup>10</sup> It is possible, however, that some emitters will misjudge their liability risk because they are less well informed than the insurance companies, and as a consequence they will not take out insurance. Information problems of this kind can be expected in the case of category IV damage, for example, as it is almost impossible for individual emitters to estimate the proportion of the damage for which they are liable, and hence to predict the apportionment to be decided by the courts. What is required is a compulsory insurance scheme that can cover the unpredictably high environmental risks individual firms cannot estimate themselves and also ensure that damage is dealt with fully. Insurance would mean that the injured parties received compensation even if the costs exceeded the firm's resources. It would also transfer the individual firm's risk to the insurer and spread the cost of damage compensation over time, in contrast to compensation met by the individual firm directly.

It is to be assumed that a wide range of environmental insurance policies will emerge and that the insurers already offering cover for certain types of damage will be able to establish a position in the market. The resulting

competition will lead to the efficient setting of premium levels. Moreover, the insurers as a whole will attempt to determine liability for damages as far as possible. Admittedly, there will be an incentive for each insurer to classify damage as indirect in as many individual cases as possible, for then all insurers will have to share the cost in accordance with the principle of joint liability. However, the interests of the insurers as a group will lead to advances in determining the causation of the damage or the originator, as this will enable them to set premiums more precisely on competitive grounds.

A frequent objection to a liability approach involving an insurance scheme is that transaction costs in attributing liability and processing cases can be extremely high if a large number of polluters are implicated. This could be the case if the group of emitters were private households, for example. It will therefore be almost impossible to avoid special arrangements in this area. A fund financed by small emitters would be conceivable; it would then meet contributors' liability if environmental damage were traced back to private households. In this way the high transaction costs due to the large number of parties involved, which could make a liability approach unworkable, could be significantly reduced.

An environmental tax would also be possible, but a fund of the kind described has the advantage that the level of the fund would be related directly to the level of damage compensation. The tax rate, by contrast, would be a political decision and would therefore not reflect the actual cost of the overall damage.

### **Encouragement of Innovation**

Unlike levies and official requirements, an insurance scheme would promote innovation. The need to pinpoint polluters more precisely would stimulate greater efforts and advances, especially in the scientific and technical fields, and would therefore probably cause individual insurers to specialise in the effects of particular substances and their prevention. The improved identification of the causes of damage would lead to a further reduction in pollution, because high emitters could be better isolated, and their insurance premiums would rise accordingly.

The insurers as a group will make every effort to foster new technical developments in environmental protection in order to prevent as many cases of damage as possible. The insurance model therefore greatly stimulates further progress, in contrast to a system of requirements, which freezes the technical status quo, or a system based purely on certificates, which only hampers innovation, at least temporarily.

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<sup>9</sup> Cf. C. Wacker-Theodorakopoulos and C. Kreienbaum: Reform der Umweltpolitik im Lichte der deutschen Einigung?, *op. cit.*, p. 513.

<sup>10</sup> *Ibid.*, pp. 516 ff.

The dynamic incentive effect of tradable licences to pollute is often mentioned in the environmental debate;<sup>11</sup> it is argued that firms will undertake research and development to try to reduce the number of certificates needed, and hence to cut costs. This claim must be put into perspective, however.

Innovation as the first use of new technical know-how arises where firms are producing efficiently at a technological frontier. Since each good can be produced in different ways, each with a different environmental impact, the firm that causes the least environmental harm can be described as an "innovative low emitter". However, the introduction of tradable certificates alters the innovation efforts of this producer. Since the use of prevention technology entails rising marginal costs, the prevention of one unit of emission costs a high emitter less than an innovative low emitter producing the same good. If certificates acquire a price owing to increasing scarcity of the environment – owing to economic growth, for example – they are traded in one direction only, namely from high to low emitters. The high emitter offers to sell certificates until his marginal prevention costs equal the price of the certificate. The low emitter purchases licences and increases the volume of his emissions accordingly. It is true that the high emitter reduces his release of the pollutant, but there is less pressure on the low emitter to

innovate, since he purchases licences to pollute. The pace of innovation therefore slows down.

Insurance against environmental damage has a further advantage over the pure certificate model, in that an on-going price in the form of an insurance premium must be paid to have an on-going right to release a harmful substance. In this way, emitters have a permanent incentive to reduce their emissions, because they can thus directly reduce their on-going costs. In this respect, insurance has affinities with levies, but insurance has the advantage that competition produces a market price that reflects the true scarcity of the commodity "environment".

Insurers will differentiate premiums on a regional basis. Premiums will be calculated on the actual risk of environmental damage; emissions from an additional emitter in an already polluted region will probably represent a higher risk than in a less threatened area owing to the accumulation of harmful substances. Premium differentiation can therefore redress regional imbalance, although the right to prohibit the establishment of an industrial plant in an area worth protecting should not be curtailed.

### An Environmental Model

A broader approach is needed to achieve the ecological objective of preventing permanent environmental damage while at the same time maintaining economic efficiency. This can be based on the certificate model, which can produce economically efficient results (thanks to the tradability of licences to pollute), limit total emissions and

<sup>11</sup> Cf. K. R. Kabelitz: *Handelbare Emissionsgenehmigungen als Instrument einer ökologisch und ökonomisch rationalen Luftreinhaltepolitik*, in: IFO-Studien zur Umweltökonomie, Vol. 4, Munich 1984.

**Table 2**  
**Examples of Different Types of Damage and Methods of Regulation**

	Examples	German law	Proposed regulation
I. Can be directly attributed to emitter	Damaged paintwork on a car as a result of a dust explosion in a particular factory	Liability of the originators	Liability of the originators
II. Good grounds for attributing liability	Toxic discharges into a lake cause damage; there are factories discharging the substances in question, so that there are good grounds for assuming that the damage is caused by the factories	Liability of the originators	Liability of the originators
III. Good grounds for attributing part of the liability	Pollution of a waterway is due in part to property owners along its banks, but also to general air pollution caused by unknown emitters	Requirements/levies	Proportional liability of the originators
IV. Can be attributed indirectly	Damage to a building that is conclusively attributable to a particular substance, but may be caused by all emitters of the substance	Requirements/levies	Proportional liability according to share of total release of substance
V. Cannot be attributed	General air pollution	Requirements/levies	Possibly state intervention



nonetheless ensure that newcomers are not denied entry to the market as a result of approval restrictions. As long as emissions exceed the environment's self-cleansing potential, however, an in-built incentive must be created to reduce harmful emissions permanently. Care must be taken to ensure that any damage that does occur is rectified by those responsible and that the situation stimulates further research. The following environmental model fulfils these requirements:

- ☐ Each emitter must purchase certificates for the release of various substances, with the total number of certificates being determined by the state.
- ☐ Certificates are freely tradable. They can also be purchased and taken out of circulation by bodies such as the state, environmental organisations or insurance companies.
- ☐ All emitters (certificate holders) must bear the risk associated with their emissions (the principle of absolute liability). They should then be held responsible for any damage attributable to a substance in a particular group and required to bear the cost of rectifying the environmental damage. If the actual source of the emission cannot be proven conclusively, each emitter should be held responsible for every instance of damage by the type of emission in question (the principle of joint liability).
- ☐ All emitters are required to pay a liability premium to an insurer for each unit of emission. The cost of environmental damage that can be attributed only indirectly will be borne by all insurers operating in this field, so that every provable case of environmental damage can be dealt with.
- ☐ An additional fund will be set up to provide innovative low emitters with an incentive to carry out further research, even if it is more costly than purchasing new certificates. The fund will be financed by a surcharge on insurance premiums. For each withdrawn certificate representing one unit of harmful substance, the innovative low emitter receives a payment above the market price of the certificate. The surcharge should also be graduated, so that for each unit of emissions saved it falls by more for a low emitter than for a high emitter, in accordance with the actual cost.

The model presented here makes sense from both ecological and economic points of view. It also creates an incentive to use advanced technology in the environmental protection field. It gives innovative low emitters using the latest production techniques the possibility of surrendering certificates in order to spur them to carry out further research, which is particularly

fruitful as it pushes out the technological frontiers. It is only this additional fund, which is financed more heavily by less innovative emitters, that provides an incentive for truly new environmental research and hence creates wide scope for natural scientists in this area.

If this model is applied to the categories of harmful substances considered above, it can be seen that the economically and ecologically more efficient system of liability can be used more intensively. Since it is not confined to pollution caused by breakdowns, all those responsible for damage in category II that can be attributed with reasonable certainty can be held liable. The originators of category III damage that can be attributed on justifiable grounds must also bear the cost, although only to the extent that the emitter group is the originator of the damage. Each polluter's contributory liability must be established as accurately as possible.

Damage in category IV is to be borne by all insurers insuring emitters of the substance in question. Damage in category V, where the substance responsible cannot be determined with certainty, cannot be resolved using the liability approach. Here it must be hoped that the system of certificates will lead to a reduction in emissions, and the attributability of this category of damage must be improved as much as possible. Only if no emitter can be found to rectify the damage does it become the responsibility of the community, in contrast to present environmental thinking, where the state intervenes at an earlier stage.

### Conclusions

The analysis of the categories of damage and the shortcomings of current Liability Law in Germany show that more can still be done in the practical implementation of environmental policy. The advantages of a comprehensive liability rule – prevention of permanent environmental damage while ensuring that the methods used remain economically efficient – justify further development of the liability approach.

Efforts to go further in this direction are evident at EC level and also in the German legislature. In the course of the parliamentary examination of the Environmental Liability Law, for example, the *Deutscher Bundesrat*<sup>12</sup> called for emitters to bear greater liability for their actions. It advocated making all emitters liable in principle, even for emissions caused during normal operations. Where the liability approach would be impractical in view of the number of emitters, polluters could be made to share liability by establishing a liability fund.

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<sup>12</sup> Cf. Unterrichtung durch den Bundesrat, in: *Bundestagsdrucksache* 11/8134, Bonn 16. 10. 1990.