Manual of European Environmental Policy

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Approaches to pollution control

Control points along the pollution pathway

Pollutants have been defined by Holdgate[1] as substances causing damage to targets in the environment. The pollutant may be emitted from a source into the environment, through which it travels along a pathway till it reaches a target or receptor. The target may be man, or animal or plant life, or an inanimate structure (e.g. the stonework of a cathedral). It follows from this definition that if the pollutant reaches no target in damaging quantities because it has been rendered harmless either by being transformed into another substance or into a form where it cannot affect the target or because it has been diluted to harmless levels, then there has been no pollution.

There are, however, different views on the understanding of 'pollution'. The most comprehensive definition in EU legislation is contained in Directive 2008/1/EC on Integrated Pollution Prevention and Control (IPPC), and its future replacement, the Industrial Emissions Directive, which defined pollution as 'the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment'. This takes the concept of pollution beyond 'substances', but limits it to human activities. In practice some pollution sources are natural, for example radon. In English there has been a tendency to distinguish between 'pollution' (causing harm) and contamination (simple presence in the environment)[2]. Thus, a substance becomes a 'pollutant' if it has an effect on the environment. This is different from the German '*Verschmutzung*', which is derived from 'Schmutz', meaning 'dirt'. This blurs the distinction of the presence of the substances and its effects[3]. Different Member States may, therefore, have varying linguistic or cultural bases for understanding pollution, which may reflect their approaches to its control.

It follows that as the mere emission of a potential pollutant to the environment does not necessarily constitute pollution, the elimination of pollution does not have to require a restriction of emissions to zero.

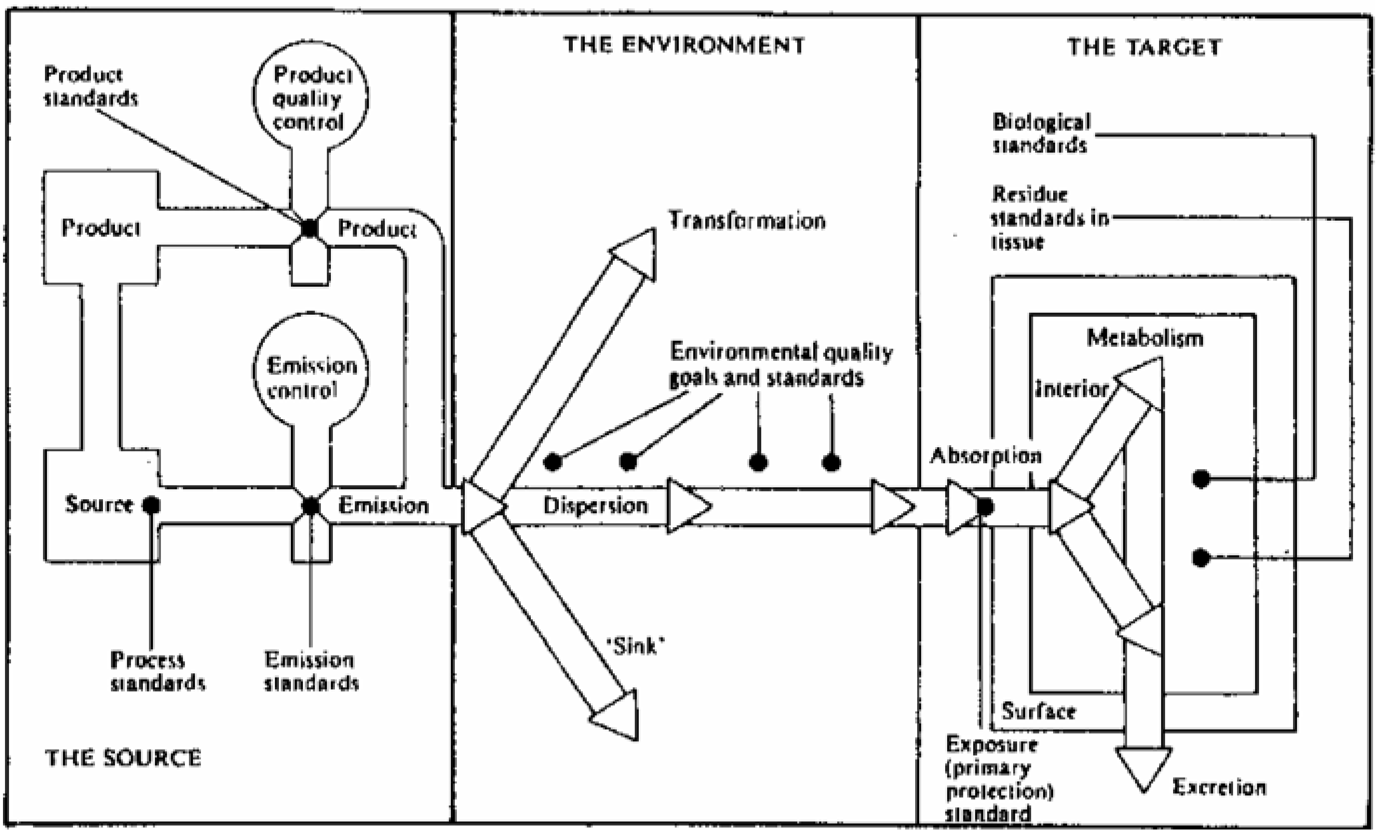
Figure 1 illustrates the journey of a pollutant from source to target diagrammatically. To quote Holdgate:

… the concentration a pollutant attains at a point is the resultant of the quantity of the input to the environment (from whatever pattern of sources, at whatever distance), the dispersion characteristics determined by the properties of the pollutant (density, solubility, diffusion coefficient) and those of the medium (current direction, rate of flow, rates of intermingling, absorption properties) and the rate of removal from the environment at all points along the pathway, whether caused by physical or biological agencies … Where emissions of a substance to the environment are tolerated, controls need to be adjusted so that targets are not unduly hazarded (just what constitutes undue hazard depends on the nature of the target and the value set upon it).

Figure 1 shows possible points along the pollutant pathway at which standards or objectives may be set as tools for control. The points may be at the source, in the environment, at or in the target itself. For the purposes of the present discussion it is immaterial whether the standards are set with legally binding force or are merely guidelines, and the words 'standards' and 'objectives' are used rather loosely and interchangeably. When it comes to controlling pollution in the real world there is a vast difference between what is legally enforceable and what is only a guide, but these differences need not concern us in this section.

Figure 1. Possible points on the pollutant pathway at which standards or objectives may be set. (Reproduced, with permission, from M W Holdgate, '*A Perspective of Environmental Pollution*', Cambridge University Press, 1979.)

Figure 3.1 Possible points on the pollutant pathway at which standards or objectives may be set (Reproduced, with permission, from M W Holdgate, 'A Perspective of Environmental Pollution', CUP 1979)



Let us take by way of example a fairly common pollutant which is known to present a hazard to human health and examine the possible tools for controlling it. Lead can reach human beings from a number of sources. Lead occurs naturally in soil and is taken up by food plants; lead is washed from the soil into river water, from where it enters into water supply and so reaches the household tap; lead is discharged to rivers from sewage works and factories; some houses have lead plumbing which may dissolve if the water has certain properties; lead could be found in paint which can be chewed by children or it can flake and be picked up and swallowed; lead is emitted into the air from lead works and can be inhaled or it can settle as dust on food or on the soil where it is taken up in food plants; lead could be put into petrol and is dispersed with vehicle exhausts throughout centres of population.

Some of these sources are natural and so difficult or impossible to do anything about, while others are clearly within the power of man to control. The pathways from the sources to the target include air, water and soil, sometimes in combination.

As part of its environmental policy, the European Community has agreed Directives which seek to control lead at a number of points along its pathways to man or other targets. Let us consider these under the headings of the different tools for control shown in Figure 1 starting at the target and working backwards along the pathways.

Biological standards

The European Commission in 1975 proposed a Directive setting lead levels not to be exceeded in the human bloodstream. In the event this proposal was modified into a Directive designed to gather information about blood lead levels in the population at large and in critical groups. The Directive did not set a biological standard in a legally binding way but set certain reference levels which indicate that too much lead is present.

The advantage of a biological standard as a tool for control is that it covers the combined effect from all sources at the point where it matters, that is, at the target to be protected. It suffers the disadvantage that it provides a signal only when the pollutant has already reached the target – possibly in excessive amounts. The Directive deals with this problem in these words:

‘When the results of the analyses indicate that the reference levels have been exceeded in one or more cases, Member States shall take action to trace the exposure sources responsible for the levels being exceeded (and shall) take all appropriate measures …

Whatever remedial measures are appropriate must be taken somewhere further back along the pathway, since it is not possible to take control measures at the target itself except by removing the target from the pathway – such as by moving children away from homes near lead smelters’.

Exposure standards

One control point further back along the pathway is the point of entry to the target. The standard here is called an ‘exposure standard’ or, in some circumstances, a ‘primary protection standard’. By agreeing a Directive setting standards for the quality of drinking water, including the maximum concentration of lead permitted, the Community has sought to ensure that the amount of lead swallowed with water is limited. Water supply can be tested and the water treatment or supply system adjusted to ensure that the standard is met. A standard where the exposure is by breathing is set in a Directive on air quality standards for lead and subsequently updated. Yet another Directive limiting the quantity of lead, among other substances, in animal feeding stuffs (Directive 74/63/EEC OJ L38 11.2.74).

Environmental quality standards

Going yet further back, standards can be set at a number of points in the pathway through the environment. One Directive sets a quality standard for surface water from which drinking water is to be abstracted. If the constituents of river water, including lead, exceed a given concentration, then that point in the river must either not be used at all for abstracting drinking water or the treatment given to it must be of a specified kind. Other environmental quality standards for water have been set by Directives, including ones for bathing water and water supporting freshwater fish and shellfish and although these could have included standards for lead they have not done so. In the case of the Directives for freshwater fish and shellfish, the targets could have been regarded as either the fish and shellfish themselves or the humans that consume them, although it emerges that the Directives are not intended primarily to protect man. The Directive on air quality standards for lead, classed above as an exposure standard, can also be classed as an environmental quality standard (since incorporated into the Air Quality Framework Directive) Another Directive sets limits on the application of sewage sludge to agricultural land when the concentration of certain metals, including lead, in the soil exceeds certain limits.

As with biological and exposure standards, the breaching of an environmental quality standard does not provide an immediate indication of the action to be taken, but serves only as a signal that the pathway to the target contains too much of the pollutant.

Environmental quality standards may be expressed numerically as concentrations of substances, for example, in water or sediments, or in air, but it is also possible to have generalized quality objectives expressed in words relating to the use of the environment. These might be that the water should be suitable for the passage of migratory fish at all times, or suitable for the abstraction of drinking water.

Critical loads

The concept of 'critical loads' for soils has been developed as a reference for policies to reduce acid deposition as a result, for example of emissions from power stations. A 'critical load' is the amount of a substance that may be deposited in a given area over a given timescale without adverse effects. It will depend on the character of the soil and so will vary from area to area. It can be regarded as a special kind of environmental quality standard. The concept of critical loads became widely accepted in the late 1980s as a means to assess pollution control options for acid deposition. It was extensively promoted by Sweden and taken up enthusiastically by the United Kingdom. It formed the basis for national emission limits for acidifying substances under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution and in the EU National Emission Ceilings Directive 2001/81/EC.

Emission standards

A pollutant may be emitted to the environment from point sources such as an outlet pipe to a river or a chimney stack to air, or alternatively in a diffused way through the ventilation system of a factory, or from the exhausts of innumerable motor cars, or again by the diffused application of a pesticide or fertilizer to land. Only where the pollutant comes from a point source is it possible to set an emission standard at that point.

Emission standards may be set individually for each discharge, or uniform standards for a particular class of discharge may be applied across a whole area or country or even the Community. Directive 76/464/EEC, as originally adopted, requires all discharges to water of certain listed dangerous substances to be subject to emission standards but does not specify numerically what the emission standards are to be. Instead, limit values (upper limits) for these emission standards were to be laid down in subsequent (or daughter) Directives for certain particularly dangerous substances set out in a List I. Directive 76/464/EEC and the daughter Directives have since been consolidated as Directive 2006/11/EC. For possibly less dangerous substances, set out in a List II, emission standards are the responsibility of the Member States and are to be set by reference to quality objectives. Since lead appears on List II and not on List I, the Community had no plans for setting emission standards for lead discharged to water, but this does not mean that Member States are not circumscribed by Community legislation. As we have seen, the Community had already laid down an environmental quality standard for surface water that is to be abstracted for drinking, and any emission standards laid down in Member States had to be such that those quality standards are met at the abstraction points.

It is only for the List I substances that the Commission was to propose limit values which emission standards are not to exceed, but even here the Directive allows Member States the alternative of setting emission standards locally so long as environmental quality standards set by the Community are met. It is this alternative that the United Kingdom insisted upon and chose to follow. By following the alternative, the emission standard will depend on a number of factors including the capacity of the receiving environment to dilute the discharge, the environmental quality that will have been prescribed for it, and the quantity and quality of other emissions to it.

Emission standards may be set numerically (either in legislation or administratively) as so many parts of a substance per million of effluent or per unit of productive output. Alternatively an obligation may be placed on the discharger to use the 'best available techniques' (BAT) for reducing emissions, and as technology and management practices improve the emission standard will be progressively tightened, such as under the IPPC Directive 2008/1/EC. Such standards will need to take account of BAT References Notes produced under the IPPC Directive as EU wide guidance. EU wide emission standards are also set out in other Directives, such as those for incinerators (see section on Waste incineration).

Process or operating standards

Within a factory emitting a pollutant to the environment standards may be set relating to production methods, either to protect workers or to ensure that the minimum amount of pollutant is eventually discharged to the environment. The IPPC Directive requires regulators to prescribe methods of operating plants to minimize emissions to the environment and the Directives on worker protection set standards to protect workers. Regulation (EC) No 1221/2009 on eco-management and audit also encourages companies to take a wider view of the overall operation of their activities to, *inter alia*, improve production methods and so reduce pollution.

Product standards

The product of a manufacturing process may itself give rise to pollution when in use, or upon disposal, in addition to any pollution that may have been caused during its manufacture. Accordingly, product standards may be set to control the composition or construction of the product. One example is the Directive setting standards for the lead content of petrol and requiring unleaded petrol to be made available. Other examples have been the earlier Directives concerned with the composition of detergents and with the construction of vehicles so as to limit emissions. If drinking water is regarded as a product then the Directive on the quality of drinking water – classed above as an exposure standard – could also be regarded as a product standard.

A special case of a product standard is a total prohibition on the use of a substance for specified purposes such as that contained in the Directive restricting the use of polychlorinated biphenyls to closed circuit electrical systems and some other limited applications.

A voluntary scheme for the award of 'eco-labels' has been introduced by an eco-label Regulation (see Eco-label) to products with reduced environmental impact. The criteria include the polluting effects of the product during use, disposal and production.

Although not strictly setting product standards, a number of Directives require certain products to be packaged and labelled in specified ways so as to minimize risks to the environment (see Chemicals and Hazardous Substances Policy). One such Directive required paints containing more than a certain quantity of lead to be appropriately labelled.

In addition to the six standards applied at the control points shown in Figure 1, other approaches to pollution control are also possible such as the two described below.

Standards for total emissions or the 'bubble'

Rather than setting emission standards for each source of pollutant from a plant it is possible to set an upper limit for all emissions irrespective of origin. This is known as the 'bubble' concept: a notional bubble is drawn around a plant or area and an upper limit is put on the total amount of a pollutant allowed to pass into the bubble. Thus if a manufacturer succeeds in reducing his diffuse discharges, he may emit more through a chimney stack and *vice versa*. The concept can be extended to an area covering several manufacturers in which case market forces may lead them to sell and buy among themselves the right to emit pollutants so long as the total does not exceed that prescribed. Thus, a new manufacturer may have to pay existing polluters to reduce their emissions in order to create the 'space' for himself. This is also known as the 'emission offset policy'. The concept can be extended to a whole country or even to the whole Community or indeed globally. An upper limit has been set for the emission of sulphur dioxide from large combustion plants in each Member State and the Community in the past set an upper limit on the total production and thus effectively the emission, of Chlorofluorocarbons (CFCs). Production of CFCs is now banned. A total emission limit for such a versatile material as lead has not so far been suggested. However, bubbles do form part of the basis for national commitments under the Kyoto Protocol to the UN Convention on Climate Change and are central to the National Emission Ceilings Directive 2001/81/EC.

Preventative controls and the precautionary principle

The approaches described above are mostly attempts to control pollution rather than to anticipate and so prevent it. Community preventative controls include one Directive, known as the 'seventh amendment', which requires the potentially toxic effects of chemicals to be identified before they are marketed so that if necessary restrictions can be placed on their use under another Directive. Another, known as the 'Seveso' Directive, requires manufacturers to identify and take steps to forestall the risks to the environment from a major accident. A

Directive on the environmental assessment of development projects requires systematic identification of the environmental effects from a planned development, including pollution, before consent for the development is given.

The EC Treaty (Article 191(2)) states that Community policy shall be based on the precautionary principle as well as on the principle that preventative action shall be taken, thereby emphasizing that there is a distinction between the two although the distinction is often hard to make. The precautionary principle was first developed in Germany[4] under the name of the Vorsorgeprinzip. There has been considerable discussion about its meaning[5], but it is usually understood to mean that when there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing action. The distinction between precautionary and preventive action is that action is precautionary if scientific certainty is lacking. Thus, the early action to restrict the use of CFCs was precautionary because it was not then certain that CFCs were depleting the ozone layer. Now that there is a scientific consensus on the subject, the ban on the production of CFCs is better described as a preventative measure (see Section 6.12). In 2000 the European Commission published a Communication on the Precautionary Principle, setting out the Commission's interpretation of the principle's use in policy development (see Overview of chemicals policy).

Environmental liability

A further policy tool to reduce pollution (or mitigate its impacts) is to impose a legal liability on companies to undertake remedial action if their activities cause pollution which results in environmental damage. This concept forms the basis for Directive 2004/35/EC on environmental liability. In proposing the Directive, the Commission argued that the introduction of an EU wide liability regime would help to underpin the Treaty principles (Article 191(2)) of prevention and that, where environmental damage occurs, ‘the polluter should pay’.

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This catalogue of available tools for controlling pollution shows that the Community has used them all – though not necessarily all of them for the example of lead that we have chosen. The use of one tool does not exclude the use of others and they are usually used in combination with one another to provide a network of protection.

This division into different categories of controls over pollution is not exhaustive and others can be devised, some of which may overlap. Three examples are given below:

The ‘substance-oriented’ approach

This approach involves taking a particular substance and considering how it may affect vulnerable targets or receptors by any environmental pathway and setting controls in these pathways as appropriate. An attempt by the Community to follow this approach was contained in the ‘Cadmium Action Programme’ (OJ C30 4.2.88) and much later in the 2005 Mercury Strategy (COM(2005)20).

The 'source-oriented' approach

This approach involves taking a particular source which may be a specific industry or industrial sector and considering all the pollutants it emits and setting appropriate controls over these. The approach can be applied to individual plants. The first action programme proposed that individual Directives should apply to particular industrial sectors (the 'sectoral approach') but rather few Directives have followed the approach, an exception being the titanium dioxide industry). The IPPC Directive (and subsequently, the Industrial Emissions Directive) establishes a requirement to set emission limits for a wide range of industrial processes. A regulator might set industry wide emission limits (e.g. if there was little likelihood of variations in local conditions) or establish these on a case-by-case basis in individual permit determinations.

The 'cross-media' or 'multi-media' or 'integrated' approach

This approach is based on the recognition that pollutants can move between different environmental media, and also that stringent controls over discharges to one medium can result in increased discharges to another medium. It is discussed more fully below.

The dispute between the use of uniform emission standards and quality standards

A dispute between Britain and the other Member States that began in the 1970s (see section on Dangerous substances in water) has usually and rightly been seen as concerned with the most practical and economic means to achieve an end on which all are agreed, but underlying it there are also differences in pollution theory. For those who believe that the purpose of pollution control is to prevent targets from being unduly put at risk, then the best points for controls are those nearest to the target. The reasons for exercising controls further back along the pathway are then practical: it simply may not be possible to exercise controls anywhere else. Viewed in this way, emission standards are merely a means to achieving quality objectives/standards which in turn are set to protect identified targets, and these emission standards need be no more stringent than required to meet those quality objectives. The emission standards will therefore quite logically vary from place to place.

For those who believe, following the precautionary principle, that man should emit the least possible quantity of pollutant, even if it is not known to be posing risks, then the point of emission is the logical point to set the controls and they should be as stringent as available technology permits: controls further down the pathway then serve only as checks that pollutants are not in fact reaching vulnerable targets, possibly from diffuse sources that are not controlled by emission standards. According to this view of pollution control, there is no objection to uniformly fixed emission standards – although there may well be objections in economic theory since 'as stringent as available technology permits' begs a number of questions and uniform standards may not result in the best use of financial resources.

These alternative views have not always been made explicit and have not always been held consistently even in one country. In Britain, air pollution control has if anything traditionally been founded in the second view, since before the introduction of integrated pollution control in 1991, there was a duty to use the best practicable means (bpm) to prevent the escape of 'noxious or offensive gases' whether damage was being done or not, and the emission standards that formed part of bpm were set nationally and applied with some consistency throughout the country. In contrast, water pollution control in Britain became firmly founded on the first view with an emphasis on achieving defined quality objectives by setting emission standards locally.

Although differences in pollution theory are important, the dispute between Britain and the other Member States over water pollution has in practice been much more concerned with administrative convenience and economic competition, both of which need a word of explanation.

The advantages of the uniform emission standards approach

The administration of centrally **fixed limit values** may well be easier than emission standards set by reference to quality objectives, firstly when granting authorizations and, secondly, when monitoring to ensure compliance. When authorizing a discharge to water using the limit value approach the presumption will be that the emission standard will equal the limit value – unless there is an obvious reason for it to be more stringent – and so the authority is spared the difficulty of calculating the emission standard by first defining a quality objective (if none already exists) and then taking into account the existing quality of the river, volume of flow, and the number, quantity and quality of other discharges. Indeed, one of the arguments against variable emission standards is that quality objectives do not provide a complete guide for allocating the total acceptable pollutant load between dischargers. When a river crosses a frontier between authorities – which may be within a Member State or may be a national frontier – the administrative advantages of uniform emission standards become greater since the tricky problem of allocating the permitted pollutant load is eliminated. When monitoring to ensure compliance it may also be easier simply to sample the actual discharge to ensure that the emission standard has not been exceeded, than to sample the environment and then try to determine which of a number of discharges was responsible for any breach.

These are the practical advantages of limit values. The economic arguments in favour are not that the approach results in the best use of economic resources, but that all manufacturers are treated equally and that therefore the conditions of competition are not distorted.

The advantages of the quality standard approach

The advantages of setting emission standards individually by reference to **quality objectives** are threefold. First, controls will be most stringent where the environment is most vulnerable. This not only ensures protection of the environment but also provides economic incentives to industrialists to locate where the environment is best able to cope with the discharge. In theory industrialists will consequently choose of their own volition, other things being equal, to locate on a large river or an estuary rather than a small tributary. (If the limit value approach is pursued single-mindedly without regard for the receiving environment, it would be possible to discharge into a small stream and to destroy all life in it while remaining within the limit value). Secondly, the monitoring of the environment which is essential to ensure that the quality objectives are being maintained, ensures that diffuse or non-point source discharges are taken into account and not just direct discharges. Thirdly, abatement will not be more burdensome than is necessary and limited financial resources can then be applied where they produce the maximum benefit.

Since Britain has short fast rivers and is washed by a turbulent and tidal sea, there has been an obvious argument of economic self-interest for Britain not to accept emission standards for water set by reference to what is necessary to protect, say, the Rhine, which drains many industrial areas and which is used as an important source of drinking water by Germans and Dutch. Since many of Britain's most polluting industries had chosen to locate on estuaries and drinking water is abstracted upstream, it could plausibly be argued that to set emission standards as stringent as those needed for a river that is to be used for drinking water is to fly in the face of the economic principle of comparative advantage: Britain for pollution purposes, it could be argued, is well favoured by geography just as for transport purposes or, more facetiously, for the purposes of growing lemons, it is disadvantaged by geography. Since Italian lemon growers take advantage of the sun that geography brings them, and grow lemons rather than engage in some other activity for that very reason, and since German industrialists benefit from proximity to continental markets as a result of geography, so also it is argued that Britain should quite properly profit from the ability to locate industries on estuaries or on the coast where acute pollution problems are less likely to arise and where the sea water can assimilate or destroy the pollutants.

Where toxic substances are persistent and can bioaccumulate the arguments for allowing less than the best discharge abatement technology are harder to sustain and it is over these substances that the dispute has centred. Not least of the difficulties has been agreeing which are the truly persistent toxic substances.

The opposing arguments for emission limit values and for quality objectives that came to a head with Directive 76/464/EEC (now Directive 2006/11/EC) have had the effect of forcing Member States into camps, with Britain often alone in one. But it would be a mistake to suppose that the two approaches are totally incompatible and that Britain and the other Member States have pursued one to the exclusion of the other. In Britain, as in other countries, policy has not always been single-minded and elements of both approaches have been used for both water and air pollution. In developing national positions for the purposes of the debate in the Community there has been a tendency – not entirely excusable, it must be said – to play down the elements that do not fit the negotiating position adopted so that a distorted picture emerges. Nationalism, even of a benign kind, and regard for the facts have never been easy bedfellows.

The debate moved on recent years. The adoption of the Quality Standards for Water Directive 2008/105/EC (together with the Water Framework Directive 2000/60/EC) leads to the repeal of Directive 2006/11/EC. Interestingly, only water quality standards remain in place. Binding emission limits will, therefore, be less prevalent in EU law. However, the broad objective of meeting Good Ecological Status under Directive 2000/60/EC combined with the need to set a wide range of emission limits for activities under the IPPC Directive 2008/1/EC integrated these approaches (see below).

Towards integration

In January 1991 the Council of the OECD (Organization for Economic Co-operation and Development) adopted a Recommendation[6,7] that member countries practice IPPC. The preamble to the Recommendation recognized that substances can move between environmental media (air, water, soil and biota) as they travel along a pathway from a source to a receptor, and that controls over releases of a substance to one environmental medium can result in shifting the substance to another medium. Guidance notes accompanying the

Recommendation explained the concept in greater detail and explain that an integrated approach involves a shift from the traditional focuses for Decision making (that is the individual media) to the substance, the source and the geographical region. It also gave examples of measures, such as issuing single permits, covering all releases, and the use of inventories of releases, which when coupled with inventories of inputs enable a 'mass balance account' to be drawn up.

The most significant source oriented development has been the IPPC Directive 2008/1/EC. This requires a permit to be issued for installations covering a wide range of industrial plants covering emissions to air, water, the generation of waste, energy efficiency and raw materials use, with the objective of minimizing impact on the environment overall. Regulation (EC) No 1221/2009 establishing a voluntary eco-management and audit scheme (EMAS) should also stimulate a more integrated approach since it requires participants to think about all the impacts of their plants. The IPPC Directive explicitly encourages operators and regulators to link EMAS to the integrated environmental assessments under the Directive.

The integration of environmental protection requirements within IPPC results in a requirement for a regulator to press for strong emission controls, while taking account of environmental quality standards. Actions which separate these two approaches are no longer appropriate. This link is made explicit in Article 10 of the Water Framework Directive 2000/60/EC, where Member States would be required to take the 'combined approach' to pollution control.

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