4.2. Environmental information: needs and gaps

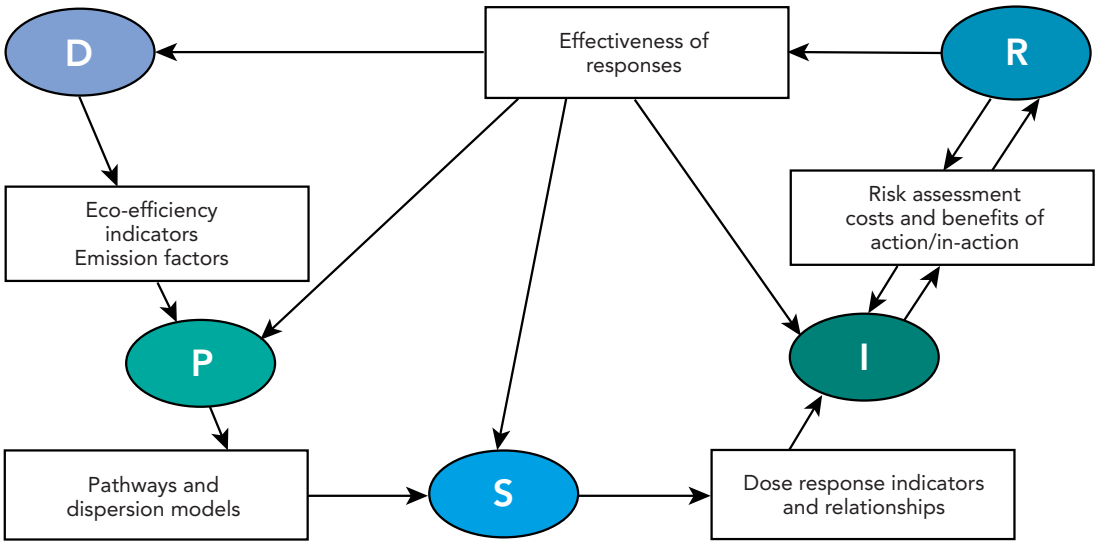
1. The issue

The preceding chapters in this report describe the current and foreseeable state of the environment in Europe as required under Article 3 of the EEA Regulation. In doing so, the report embraces methodologies for integrated environmental assessment (IEA) as encapsulated in the DPSIR framework where there is a chain of causal links from Driving forces to policy Responses, and which covers both the current and future state of environment quality, and resources, each considered on appropriate spatial and temporal scales.

The DPSIR framework is useful in describing the relationships between the origins and consequences of environmental problems, but in order to understand their dynamics and to develop tools to make environmental outlooks it is also useful to focus on the links between DPSIR elements. Figure 4.2.1 presents examples of the concepts which link the different elements of the causal chain. For instance, the relationship between the Driving forces and the Pressures by economic activities is a function of the eco-efficiency of the technology and related systems in use, with reduced pressure coming from the same amount or more of economic activity if eco-efficiency is improving. Similarly, the relationship between the Impacts on humans or eco-systems and the State depends on the carrying capacities and thresholds for these systems. Whether society 'Responds' to impacts depend on how these impacts are perceived and evaluated; and the results of 'R' on the problem depends on the effectiveness of the Response, and to which link in the causal chain the Response is mainly directed.

In this report, particular focus on IEA is given to key environmental issues and to the integration of environment-economic considerations. In doing so, information is presented within the framework of the DPSIR chain. Particular emphasis is given to the DPSIR interlinkages, to future outlooks and scenarios and where appropriate to analysis on a spatial scale. This reflects the increasing importance that policy makers and others now put on good-quality information and analysis in these areas. It is no coincidence that these areas are also where the report most lacks complete and consistent information on trends, since many of the needs have only been identified relatively recently and the frameworks for data collection are either not in place or have yet to be identified and implemented. Even in areas where monitoring activities have been in place for the past 20 years or so, such as for aspects of air quality and water quality, the right information on past trends is not always available, partly because new monitoring systems for important recently identified

Concepts linking Driving Forces-Pressures-State-Impacts-Responses (DPSIR) elements — Figure 4.2.1



pollutants are not fully operational across Europe, but also because the balance of monitoring effort in many countries is still sometimes skewed in favour of the traditional pollutants which are not the only relevant pollutants.

This potential for inefficiencies in monitoring activities together with the need for new information to address new environmental paradigms was recognised at the 'Bridging the Gap' Conference (UK/EA, 1998) on new needs and perspectives for information, which concluded that:

> *'At present some of the systems for monitoring and gathering information about the environment in European countries are inefficient and wasteful. They generate excessive amounts of data on subjects which do not need it; and they fail to provide timely and relevant information on other subjects where there is an urgent policy need for better focused information, and for consistent environmental assessment and reporting.'*

The conference recognised the need for a concerted pan-European movement involving the EEA, the European Commission and Member States:

- to streamline environmental monitoring and practices,
- to focus new information gathering on key issues and perspectives; and
- to develop indicators, which would need to be widely agreed, illuminating the significance of environmental change and the progress of sustainability.

An important part of the work concerns harmonisation of definitions, data collection methods and agreement on good reference units for reporting such as watersheds and biogeographic regions. Having the right information, however, is not only important for helping to frame and monitor policies required for improving the state of the European environment. Information is also important for changing societal behaviour and influencing in a positive way the impact society as a whole has on the environment. Getting the right information to the right people is also important for enhancing public participation in environmental activities and decision making.

This chapter presents examples of some of the most important needs and gaps in current information provision for reporting and policy making and on the current and proposed initiatives to improve information systems. The chapter also summarises the needs and provisions for public information and its role in changing consumer behaviour and facilitating participation in environmental decision making.

2. Existing information and new needs

The European Environment Agency (EEA) report in 1995 *Europe's Environment: The Dobris Assessment* (EEA, 1995) included an overview of strengths and weaknesses in environmental and related information. There has been some progress since the 1995 review but much remains to be done to achieve the EEA mandate and the goals of the 'Bridging the Gap' Conference. Nevertheless, as shown in the present report, in *Europe's Environment: The Second Assessment* (EEA, 1998), and in the OECD (Organization for Economic Co-operation and Development) and UNECE (United Nations Economic Commission for Europe) country environmental performance reviews, more use is being made of the information currently available to highlight the state of knowledge and the remaining gaps and inconsistencies.

The following paragraphs summarise the current situation on the main information strengths, weaknesses and gaps and what is being done to address some of the major deficiencies. It is not the intention to be exhaustive in this analysis rather to highlight where are the main areas where action is either underway already or should be considered in the future.

2.1. Environmental monitoring and reporting

- There have been improvements in the consistency and comparability of **atmospheric emission inventories** through continuing co-operation between the EEA, the European Commission (EU Monitoring Mechanism for greenhouse gases), EMEP under CLRTAP, the Intergovernmental Panel for Climate Change (IPCC – under UN Framework Climate Change Convention), and member countries. There still remains substantial scope, however, for countries to report these emissions data in a more consistent and timely way. Complete and timely responses from only about half of EEA countries are still common under international conventions and EU legislation. This constrains the ability of the EEA and others to produce complete

assessments and reports in support of policy developments. The issue of reporting will become more important in the next decade for greenhouse gases under the terms of the Kyoto Protocol and for acidifying gases and ozone precursors in view of the proposed EU National Emission Ceilings Directive. Data on past trends for air emissions is best for totals but limited for sectors. The situation is less well developed for the 'newer' pollutants such as heavy metals and persistent organic pollutants. Data at the more detailed level – e.g. splits within sectors – is less well developed for emissions of all pollutants. However, the recent initiatives following on from the Cardiff Council in June 1998, to develop sectoral indicators is expected to provide the stimulus for data gathering and estimations at these more detailed levels. These sectoral initiatives will also in time deliver indicators of sectoral eco-efficiency in terms of the emissions generated per unit of desired output (vehicles kms, energy consumption).

- EU Directive (96/62/EC) on **ambient air quality** assessment and management and the third EU Decision (97/101/EEC) on exchange of air quality information have been adopted. EEA has established EuroAirNet and Airbase to complement and support this legislation. The aims, in co-operation with the Commission, member countries of the European Environment Agency (EEA) and the EMEP Programme (under the Convention on Long Range Transboundary Air Pollution), are to improve the quality, consistency and timeliness of air quality data and information available at the European level. Reporting of data by countries continues to be a problem here also with again only 50% of EU countries providing complete and timely data. As for air emissions, Europe is data rich for the more traditional air pollutants e.g. sulphur dioxide, but much less so for arguably more important pollut ants for human health, such as benzene and PAHs. The information systems for these pollutants are being developed in some countries but there is still some way to go. There has also been little progress in detailed monitoring of non-methane volatile organic compounds. A substantial programme of work has been undertaken over the past 20 years to develop critical loads for acidifying compounds (sulphur, nitrogen and ammonia) to soil and water ecosystems. More information is needed, however, on dose (deposition) /response (relationships for impacts on ecosystems).

- Little is known about **chemicals** and their impact on human health and the environment. In the past, much of the monitoring effort and work on risk assessment has been focused on the *toxicity* of chemicals in the environment. Since 1981, all new chemicals put on the market in the EU have been required to undergo some pre-market toxicity testing. By the end of 1997, of the over 100 000 existing chemicals in the EU that have little or no eco-toxicity data, risk assessments had been completed for 10 of them. Overall, there is still inadequate toxicity data for about 75% of the chemical substances in use in Europe, and inadequate eco-toxicity data for 50-75% for the 2 500 priority high production volume chemicals (HPVCs) – those chemicals whose production exceeds 1 000 tonnes per year. In recent years there has been an increasing recognition of the need to shift towards monitoring and assessment of the risk of *exposure* of people and nature to chemicals. However, there is also a major lack of human health and exposure data for these HPVCs. Other information deficiencies for chemicals include: the pathways, fate and concentrations of many chemicals in the environment; the use of chemical substances and their presence in consumer products; the costs of the impacts on people and nature of exposure to chemicals including mixtures of chemicals (EEA/UNEP, 1998). Some progress is being made at EU level to develop indicators of the eco-efficiency ratios for the production/use of chemicals.

- There has been little progress in the quality of **waste** information**.** Detailed analysis is hampered by the lack of comparable statistical information across Europe. Even for municipal waste and household waste, which are normally thought of as areas with good statistics, confusion prevails. Reliable time-series of data can only be obtained with a great effort in collecting supplementary information and interpretations of the definitions used in the countries. These problems can only be overcome by harmonisation of the use of definitions and collection of data on a common

platform. Current work on a Community Regulation on waste statistics is a first step in this direction. For Life-Cycle Analysis of products there is a lack of systematic knowledge of the connection between the composition of individual products and resulting emissions from different treatment types when they end up in the waste stream. There is also a need for better transfers of information between product developers and producers and the waste management sector in order to develop a system where products and waste management fit better together.

- There is an improved culture with regard to **industrial accident** reporting and sharing the lessons learnt. The European Commission's major industrial accidents database MARS, only for EU countries, is now complemented by SPIRS (Seveso Plants Information Retrieval Systems) which will cover information related to location and amount of substances handled in each 'Seveso plant' in the EU. Under the new Seveso Directive 96/82/EEC, such information has to be included in the safety report of each 'Seveso plant'. An enormous amount of accident monitoring and environmental **radioactivity** data is now being collected across Europe which now needs to be better linked and used. There is a serious lack of information on the extent and impacts of **radio active waste** on human health and on the environment. Information about the risks and environmental impacts of **natural hazards** and interactions with human activities is not widely available.

- Information on regional **freshwater** resources and on water abstractions has improved. Methodological differences make it difficult to produce comparable data at European level on the uses of freshwater. Some progress has been made on gathering data for assessing the efficiency of water use but more needs to be done to develop comparable efficiency ratios and to understand the dynamics which contribute to efficiency improvements. There is much improved information on discharges to freshwater bodies from point sources, in part as a result of the EU IPPC Directive. There is relatively little known about the diffuse discharges to freshwater bodies from agricultural activities and their impacts on the state and quality of European freshwater bodies. There is more data available on the quality of European rivers and lakes than for groundwaters. An initial report presenting available information on groundwater quality and quantity has been made by the EEA. In collaboration with member countries and several Accession Countries, EEA is also developing EuroWaterNet/ Waterbase to help improve data comparability and provide the information relevant to the proposed Water Framework Directive. However, there is still little data on small rivers and lakes, organic micro-pollutants and metals. Information on discharges to the **marine environment** from point sources on the quality of Europe's seas remains limited but the EEA has brought together the various **marine** conventions and programmes in an Interregional Marine Forum to help improve the comparability and timeliness of information for future assessment and reporting.

- An overall framework for monitoring, assessing and reporting on **soil** issues in Europe has not been implemented, despite the multi-functional aspects of soil and the multi-impacts on this limited resource from human activities and the environment. An adequate assessment of the current state or potential risk of soil degradation in Europe is still missing, as well as comparable data on the loss of the soil resource to erosion and sealing. Basic data, such as detailed European soil maps, is still unavailable for assessment and there has been no progress in the quality and comparability of data available at the European level. There is no European-wide monitoring network for soil, although some progress has been made in some areas, such as the monitoring of forest soils. Statutory soil monitoring is carried out in a number of Member States, but rarely for the purposes of soil protection per se. There is large diversity in the design of soil monitoring schemes, the frequency of sampling, the range of parameters determined, and the methods of analysis used. There are also increasing problems of data ownership and transfer. As a result of this diversity, there is lack of harmonisation of the data derived from soil monitoring, and there is no pan-European quality control of the existing soil monitoring networks. A European inventory of contaminated sites is still lacking but requirements are being

developed. Nevertheless, the importance of the soil medium and the need for European comparable data are being recognised.

- Though **biodiversity** in Europe is better known than in many other parts of the world, many gaps in knowledge and understanding remain and require co-ordination and a multi-disciplinary approach, drawing on biologists, geneticists, agronomists, foresters, ecologists, biologists and social scientists. In particular, long-term harmonised monitoring results for natural biodiversity are lacking. For species and some habitats much data has been collected for a long time at local and national levels but a harmonised synthesis at the European level remains difficult. Inventories and mapping of species and habitats have been enhanced, notably through projects under the EU LIFE and CORINE Biotopes programmes. Through the biogeographic regions approach, future assessments of common problems and effectiveness of nature protection will cross individual borders. Access to datasets and information held by countries is improving and should do so further when the Internet-based EU Clearing House Mechanism related to the Convention on Biological Diversity is established. There has been progress in compiling information on species and habitats for Natura 2000 (the Birds and the Habitats Directives) for the EU countries and for non-EU European countries in the related Emerald Net work of the Bern Convention. Data is being used by EEA through the European Nature Information System (EUNIS) in co-operation with the Commission, the Council of Europe and international nature-conservation organisations. The best data still concerns vertebrates and vascular plants, but datasets for several invertebrate groups such as butterflies and lower plants are improving. Red lists for the same species groups now exist in most countries. So far the focus has been on state and distribution of species and habitats, but there is a need to identify bio-markers for environmental change and to monitor these to provide indications of how environmental phenomena and their interactions impact on biodiversity and on how changes in biodiversity affect the environment and society, production of biomass, CO_2 sink functions, etc.

- **For genetically modified organisms** (GMOs) there is a need for much more monitoring and research into both risk assessment approaches and scientific studies on issues such as gene flow from GM crops to wild relatives. For example, large field experiments are needed to assess the fitness of the hybrid plants over time, the spatial and temporal dispersion of the crop and weeds, and the effect of different agronomic practices on gene flow. There is also a need for studies into cumulative impacts, invasiveness of multiple releases, and herbicide intolerance in weeds, as well as monitoring for delayed and indirect impacts such as on beneficial insects.

- For **human health** issues, there are long established monitoring systems for example for urban air quality and drinking water quality. Little progress has been made in relating these monitoring data to the consequences for human health. An attempt to relate water quality to human health has been jointly undertaken by the EEA and WHO (EEA/WHO, in press). Some progress has been seen for exposure assessment, in particular population exposure to air pollution (both indoor and outdoor). However, little is known about doseresponse relationships and about the impacts on human health from exposure to mixtures of pollutants from multiple exposure routes. Some research and modelling has been undertaken in limited communities to understand better the relationships between human health and the low levels of chemicals and pollution many people are exposed to on a daily basis. These studies have shown some indication of impacts on human health and behaviour, e.g. lower sperm counts and neuro-toxic effects, but the links between multiple, low-level exposures to chemicals (including pharmaceuticals) in food, water, air and consumer products and impacts on people remain largely unexplored. Data and information is particularly needed on the cumulative chemical exposures, and related biologically effective doses, of sensitive sub-groups, such as the foetus, children, the elderly, pregnant women, and those with depressed immune systems; on the antagonistic and synergistic interactions between these exposures; and on biomarkers of exposure, of early effects and of susceptibilities, which together can help identify potential threats to sensitive

communities so that adverse impacts can be avoided or minimised.

- On environmental **noise**, there has been little progress in establishing monitoring and assessment frameworks for Europe. Little data is available and what exists is not comparable between countries. The Community Noise Strategy which will consider requirements and methodologies for such information was established only in September 1998. Several technical groups started working on various issues including the harmonisation of noise indicators and noise mapping in Member States, and the development of common prediction models. More research and information is needed on the impacts of noise on both human health and well-being. Adverse physiological, biochemical, psychological, sociological and economic consequences of exposure to noise must be critically evaluated for relevant aspects of human behaviour such as work, communication, social interaction, sleep, etc., and environmental monitoring standards and targets developed. Methods are needed to define exposure limits for different community environments and for noise impact and abatement assessment.

2.2 Environment-Economy Integration

The integration of environmental considerations into economic and sectoral decisions is a central objective of the 1992 EU Fifth Environmental Action Programme (5EAP) which gives priority to the principal economic sectors – industry, agriculture, energy, transport and tourism. The following paragraphs summarise the current situation on the main information strengths, gaps and weaknesses for integration in these sectors under four headings – environmental assessment of the sector, eco-efficiency indicators, market integration and management integration.

- For **transport**, there is relatively good information available on transport supply, demand, intensity, and prices. The main information weaknesses hampering a comprehensive *environmental assessment* of the sector are in the areas of transport noise, land use for infrastructure and settlements, access to basic services and habitat fragmentation. *Eco-efficiency* indicators have been identified under the EU Transport Environment Reporting Mechanism. Data is available for some of the indicators e.g. fuel efficiency, proportion of vehicle fleet meeting air emissions standards, but not always for all countries or on a comparable basis. Indicators of the eco-efficiency of transport by mode with respect to air emissions are being developed by Eurostat and the EEA. For *market integration*, data on the external costs to the environment of transport is available for most countries, but more information is needed on the contributions to overall costs of the different types of externalities – noise, air pollution, congestion etc. More consistency is needed on definitions and methodologies used by countries to compile estimates of external costs; also trends data is as yet not available. Some information is available on instruments such as taxes, subsidies and voluntary agreements, but little is known about the effectiveness of such instruments for alleviating the environmental impacts of the sector; trends data is also needed. For *management integration*, little is known about the extent and effectiveness of environmental impact assessments for transport projects.

- For **energy**, there is relatively good information available in most areas to support a comprehensive *environmental assessment* for the sector; the main area of weakness is waste generation. *Eco-efficiency* indicators have been developed for many years by the OECD-IEA and in various countries. A selection is to be included in the EU project on indicators for the integration of environment in energy policies, and data availability is generally good. To improve the use of market-based instruments, studies have been done on external costs of the energy sector, but no country comparison is readily available. As for transport, information will also be needed on the contributions to overall external costs of the different types of externality – climate change, air pollution, waste. On the use of taxes, subsidies and voluntary agreements some information is available, but little is known about the effectiveness of such instruments for alleviating the environmental impacts of the sector. For *management integration*, little is known about the extent and effectiveness of environmental impact assessments for energy projects.

- For **agriculture**, the available data on (positive and negative) impacts is gradually extending. It is often difficult to

separate out the specific contribution of agriculture to changes in the environment, like water stress or changes in breeding birds. The OECD has been working for many years on a core set of agri-environmental indicators. In 1999 the EU will develop a set of indicators and a reporting mechanism to follow the integration of environment in European agricultural policies. In the meantime *eco-efficiency* indicators are available at the European level comparing agricultural outputs against inputs such as fertilisers and pesticides and also water used for irrigation purposes. For *market integration*, only partial estimates are available of external costs of agriculture. Some scattered information is available on instruments such as taxes, subsidies and voluntary agreements, but little is known about the effectiveness of these instruments.

- For **industry**, there is substantial data available for *environmental assessment* of air and water pollution. The main areas of weakness are waste generation and soil contamination. *Eco-efficiency* indicators for this sector are well developed, in particular comparing output against air emissions and also against contaminant loadings to freshwater bodies and to the sea. Some data is also available on recycling rates by key industries. For *market integration*, there are no data available on external costs. As for other sectors, data will be needed on the contributions made to overall external costs of the different types of externality – air pollution, water pollution, waste generation, soil contamination. There is some information available on expenditure by industry on environmental compliance. Eurostat has a work programme in place to develop this important area further. Current deficiencies include incomplete coverage of countries and expenditure categories, and lack of time series. Some information is available on the extent of use of instruments such as taxes, subsidies and voluntary agreements, but little is known about the effectiveness of such instruments for alleviating the environmental impacts of the sector. An exception is for water discharges where there are assessments available showing the impact of charging on minimising effluent discharges. For *management integration*, relatively good information is available on the extent of use of tools such as environmental impact assessments, environmental management systems and green procurement policies. However, little is known about their effectiveness in minimising environmental impacts.

- There is no agreed framework either globally or in Europe to develop indicators across the DPSIR framework which measure the positive and negative impacts of **tourism** on the environment and how these are being dealt with through policy responses, including the use of economic instruments. The main problem is measurement of tourism activity at the local level (NUTS V), where the bulk of tourism impacts occur. Some progress has been made to evalu ate the impacts of tourism on coastal areas through the LACOAST project, however, the absence of associated economic and pressures data at NUTS V level seriously constrains meaningful assessments. There are no agreed *eco-efficiency indicators* for tourism and data availability is likely to be a problem once such indicators have been defined. For *market integration*, there is no information available at the European level on the costs of the various externalities: water pollution, land and soil degradation, soil erosion, heritage loss, landscape loss. For *management integration*, there is no data available on EIAs for tourism projects or on green procurement strategies.

2.3. Spatial dimension

The geographic integration of environmental data is arguably as important as the integration of environmental considerations into sectoral activities, which has been also stressed in Chapter 2.3. There are increasing demands for spatial and territorial analyses to support policy development such as CAP reform, Strategic Environmental Assessment of Trans European Networks, the initiative to prepare a European Spatial Development Perspective, development of the Natura 2000 network, water management at the catchment area level and the enlargement process. Integrated policies can not exist without a territorial reference.

Within this report, a first attempt has been made to include information on the DPSIR and trends in the environment as seen from a spatial perspective (see Spatial Chapters 3.12 to 3.15). This analysis has highlighted the priority gaps and weaknesses in information needed to enable spatial environmental assessment:

- Much more needs to be done to improve the quality, geographic consistency and coverage of the information base. The scale of the input data required for spatial analysis will strongly depend on the type of application. Very often, applications at European level such as fragmentation of land, pressure on protected areas, are demanding detailed geo-referenced datasets. Examples of datasets which are still incomplete or missing are the boundaries of NATURA 2000 sites, physical structure of cities, contaminated sites and large combustion plants. For the European Polluting Emissions Register under the IPPC Directive geo-referenced datasets and a geographic information system will need to be developed.

- The CORINE Land Cover map is used as the reference layer of a territorial database, because of its cross-border thematic consistency and spatial resolution. However, this database has been created by the countries from satellite data acquired over a time span of more than 10 years (1985-1995), and therefore is becoming out of date. An update of this reference database for the year 2000, including all European countries, is urgently needed for better and more advanced assessment of ongoing territorial changes in Europe.

- Earth observation (EO), in spite of its potential, has so far played a limited role in environmental monitoring by national and international organisations. The use of EO should be accelerated as a unique tool for spatial analysis, filling in missing gaps, more timely information at European scale for change analysis and future outlooks. Recent developments in earth observation show optimistic prospects for monitoring of the terrestrial, atmospheric as well as marine environment. Although tremendous progress has been made by the Centre for Earth Observation on bridging between EO data providers and the user community, there is still a considerable gap between research and operational use for the environment. Collaboration with the Joint Research Centre on development of operational EO tools for support to environmental policies at European and regional level should focus on the information extraction from new high resolution data, change analysis, modelling and integration in GIS.

- Priority needs to be given to gathering data on socio-economic activities which lead to environmental pressures – such as population growth, sectoral activities, resource use – on a spatial level. Currently many of the statistics are only available at high levels of aggregation for administrative units such as country, regional or commune level within countries whereas data is required at a finer or different level of aggregation, for example at the water-catchment area level. Eurostat has a project underway to develop data in these areas, but there is some way to go in countries to obtain the data required.

- For the present reporting (spatial chapters), specific criteria were chosen for reporting on urban areas (> 100 inhabitants/km² NUTS5), rural areas (<100 inhabitants per km² NUTS5), coastal zones (10 km strip along the European coast) and mountain areas (over 1 000 m altitude, slope > 5°, excluding areas l<100km²). Better understanding and harmonisation of definitions applied for stratification or zoning of the European territory is needed.

- There is a strong need for further improvement of analytical tools such as geo-statistics, spatial modelling (Turner II *et al.,* 1997) and networking. The present information technology allows fast information exchange as well as powerful processing and analysis of voluminous and complex geo-referenced environmental and socio-economic data. In most countries and international organisations, Geographic Information Systems – indispensable for spatial analysis – are part of the operational infrastructure at local, national or European level, but interoperability, including improved co-ordination and access to data, needs to be improved.

2.4. Scenarios and outlooks

The *Baseline Scenario* used in this report aims to provide a consistent set of trends forecasts for the key economic and societal driving forces, for the environmental issues on which they have an impact and for human health. The exercise, based on a consistent chain of models, was the first of its kind in Europe and involved close co-operation between the EEA and the European Commission Services. It has exposed the strengths and weaknesses of current modelling and scenario expertise available in

Europe for environmental assessment. In general, coordination of modelling activities should be given priority attention in the future to ensure further the internal consistency and robustness of the model input data, the assumptions used and the output results. This should include the treatment of uncertainties and model sensitivities. As shown in sections 2.1 – 2.3 above, there is a need for more complete and consistent temporal and spatial data for past trends which form the basis for inputs to the scenarios and outlooks models. Better coordination is also needed at the international level to ensure consistent data on societal trends feeds the different models used in the *Baseline Scenario*. For societal trends, the assumptions underpinning the models used need to be refined further and alternative scenarios produced to provide ranges around the central estimates and to support sensitivity analysis. Currently, there are good models available for forecasting economic activity, transport demand, etc. Particular attention in the future needs to be paid to developing scenarios for urban population, number of households, the constituents of private final consumption, materials intensities, energy prices, tourism. For environmental issues, the most developed models and scenarios exist for air pollution aspects (climate change and transboundary air pollution) but these can still be improved. Next comes water where there are established models for forecasting water resources but less so for water quality aspects. Most attention needs to focus on improving models and scenarios for biodiversity and ecosystem impacts, waste generation, soil erosion and sealing, exposure to noise and exposure to chemicals. Many of these activities should take account where appropriate of human health impacts.

3. Using information to improve public awareness and participation

3.1. Setting the scene

The important role of the public in helping to achieve sustainable development was recognised in the EU's Fifth Environmental Action Programme (5EAP) (Box 4.2.1)

The importance of public information has further increased since the 5EAP in 1992 as environmental policies shift from directing the actions of the few, via regulations, to encouraging the behaviour of the many via incentives and information provision (see Chapter 4.1). Other developments have also increased the importance of public information, such as the move from 'supply side ' measures in transport, energy and water (the provision of roads, power stations and reservoirs) to the 'demand side' measures of public transport and efficiency improvements, which require the willing co-operation of many more people than was ever needed for construction activity. In addition, as the focus of policies moves from point source, environmental pollution from factory chimneys to the diffuse sources of pollution, from cars and consumer goods, so the importance of public information and participation for 'sustainable production and consumption' increases (Box 4.2.2).

The key elements on public information provision identified in the 5EAP, such as the level of public awareness, access to information, rights to participation, and the associated actions of consumers and citizens, are linked together (Figure 4.2.2). However, there is no simple, one-way relationship between awareness, information and action – each can influence the others in complex and subtle ways.

Box 4.2.1. Information and the public: the Fifth Environmental Action Programme (5EAP)

'The achievement of the desired balance between human activity and development and protection of the environment requires effective dialogue and concerted action among partners… . The success of this approach will rely heavily on the flow and quality of information both in relation to the environment and as between the various actors including the general public'

'The success of the drive towards sustainability will depend to a very considerable extent on the decisions, actions and influence of the general public. But while surveys show a high, and increasing, level of environmental awareness among the general public, the public is considerably lacking in essential information …'.

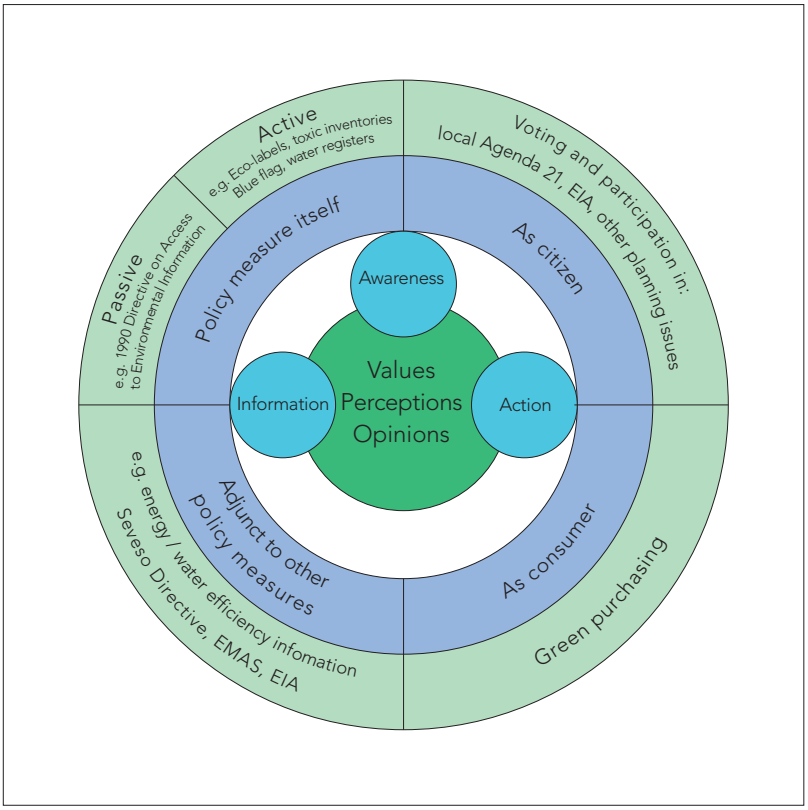
'In addition to having access to available environmental information under the respective directive, and right to involvement in the assessment of environmental effects of major projects, it is essential that the citizen be enabled to participate in the process of setting conditions for operating licenses and integrated pollution control, and be facilitated in judging the actual performance of public and private enterprises through access to inventories of emissions, discharges and wastes and to environmental audits'.

Box 4.2.2. Sustainable production and consumption and public participation

The critical task is to create the conditions which improve the capacity of individual consumers and public authorities to choose, use and dispose of the goods and services they require in a sustainable way, in other words to move the sustainable alternatives from the margins to the mainstream… .

Open public participation is both a prerequisite and a way of stimulating public support for more radical alternatives. Ultimately lasting changes in consumption behaviour are only likely if those concerned understand their impacts, know about the alternatives, are motivated to change and gave the capacity to act.

Figure 4.2.2 **Key elements of public information and participation**



Source: EEA

3.2. States of minds

'Before Action comes Perception' — Aristotle

The level of awareness, or state of the public mind, on the environment has an influence on how information is received and used both by both the public and politicians. A simple and popular way of judging the state of the public mind is to do an opinion poll that asks how concerned people are about the environment compared to other issues, such as the economy or unemployment. However, the results rise and fall rapidly in response to how people perceive the way in which the issues are being addressed. If they think that governments are managing a serious problem fairly well then it is not of 'front-of-mind concern,' compared to the issues that they feel are not being managed well.

Since 1989-92 when the environment was a central concern for the public and politicians this 'front of mind' concern has been partly replaced by worries about unemployment and the economy, and many have interpreted this to mean that the public does not put a high priority on the environment. However, when asked about how worried they are about the environment as such, without having to rank it against other issues, Europeans indicate that they are more concerned about the environment now than in 1992 (Figure 4.2.3). The high level of concern about the environment, (which, at 80-90%, is similar to that in North America and Japan), was also noted in the Eurobarometer survey in 1995, which found that 87% of the EU public were very/quite worried about a range of global environmental threats.

Public opinion about environmental issues partly depends on people's *values*, or what they consider important in their lives. Moreover, it is often differences over values, rather than over information and its significance, that explains conflicts between scientists and the public over complex and uncertain environmental issues (Box 4.2.3).

The EU Ulysses focus group project (1997-99) is exploring one way of eliciting the values of the public about uncertain and complex issues such as energy and climate change, but there are other methods that governments and others in the EU are increasingly using. These include consensus conferences, (pioneered in the EU by the Board of Technology of the Danish Parliament), citizens' juries and deliberative polls. The effectiveness of these activities has not been systematically evaluated but an indication of their usefulness can be gauged by the contrasting experiences of food irradiation in the UK and Denmark. The Danish Parliament had available a very negative report by a lay panel and decided that irradiation of food should not be approved for general use. In the UK the Advisory Committee on Novel Foods and Processes decided that the process should be introduced. There was a hostile response from the public, and industry was unable to use plant it had installed. 'The outcome might well have been avoided if there had been appropriate public debate before the decision was taken.' (RCEP,1998).

An issue in the radiated foods episode was that of justification, or need, where the public's values about the need for irradiated food were in contrast to the scientists views about the risks of the process. This is an increasingly prevalent issue in environmental debates over complex problems, such as chemicals, radiation and GMOs, (see Chapter 3.9), where increasingly 'hard' (i.e. strongly held) public or consumer values need to be reconciled with increasingly 'soft'

(i.e. uncertain) scientific facts. The Brent Spar episode (Box 4.2.4) seemed to be an example of this shift which involved the public in Germany, the Netherlands and other EU countries.

Controversy over large-scale transportation projects have been the focus of conflict between the public and authorities in the UK, the Netherlands and other countries, and efforts are underway to try and improve dialogue. In 1994 the Dutch Ministry of Transport and Communication established the 'Infralab' with a mission 'to overcome the gap between the authorities, experts and society' (van Zwaneberg *et al.*, 1998) by organising dialogue between the public and authorities at the early 'framing' stage of a project.

A failure to have timely public debate about controversial issues can widen the gap between the public and governments, which can then lead to mistrust. Trust in the sender of information is a key element in how it is received and used (Macnaughten, 1998). However, public authorities and industry are not considered by the European public to be very reliable sources of information, according to a Eurobarometer poll (Figure 4.2.4). Mistrust in public institutions, and in science, seems to vary widely between Member States, with low levels of trust being reported in some countries such as the UK and Italy, and high levels in Germany and the Netherlands (Jamison, 1998).

Trust, and the perceived reliability of the information provided, is partly related to how information fits in with local experiences: information that cannot be related to local circumstances is often ignored (Lancaster University, 1995). This is a particular challenge for European institutions who need to produce pan-European information that reflects regional and local diversity (Waterton, 1995).

3.3. Access to information

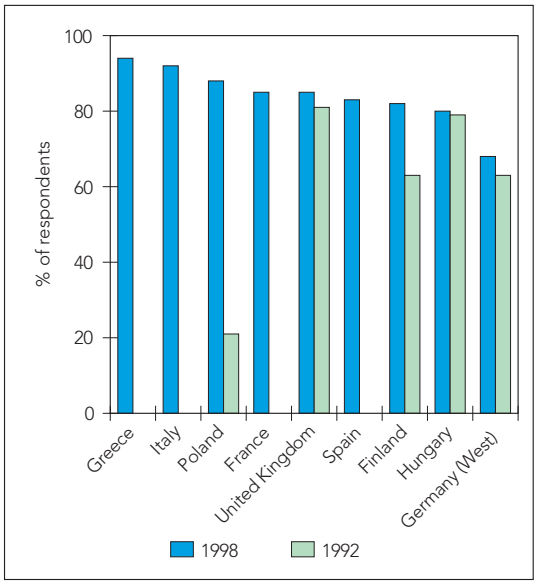
The EU has taken several initiatives to provide public access to information (Box 4.2.5).

The Directive on Freedom of Access to Environmental Information is being revised and updated. Several reviews have identified the benefits and limitations of the Directive (EEA, 1997; REC, 1998).

Having access to information is a 'passive' right: the active provision of information to the public has also been encouraged at EU and Member State level. In addition to the

Respondents personally worried a great deal/fair amount about environmental problems in 1992 and 1998

Figure 4.2.3



Source: International Environmental Monitor 1998; 1992 Gallup survey data

Box 4.2.3. The importance of values in environmental affairs

'A truly integrated assessment must take account of values, including those held by citizens…' (Ravetz, 1996)

'Conflicts of values in environmental policy turn up again and again… providing a continuing debate about moral choice… they oblige people to stike a balance between counting what can be quantified and caring for what cannot be quantified.' (Ashby,1977)

'The public's judgement about hazardous waste and global warming… is strikingly similar to the scientists' views. The few examples of divergence seem rooted more in value differences than in expertise.' (Doble, 1995)

'Results show that scientific uncertainty is not a hindrance to political action if it is communicated explicitly and discussed openly: talk with us, don't teach us, is the basic rule.' (Kasemir, 1999)

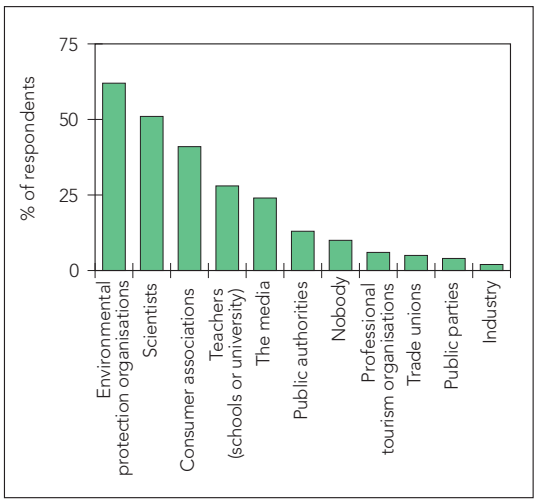
Box 4.2.4. Brent Spar: A case of 'soft' facts and 'hard' values?

Although the amount of hazardous materials involved in the proposed dumping of the Brent Spar oil platform in 1995 was not large, the disposal was of symbolic importance. Not only was the Spar the first of approximately 400 oil platforms in the North Sea due to be decommissioned in the coming decades, but the proposed method of disposal at sea was viewed as sending the wrong signals that the seas could be used as free dumping grounds for the waste products of industrial society. Although such a policy had been agreed by Shell as the Best Practical Environmental Option (BPEO), and subsequently endorsed by the UK government, Greenpeace were able to occupy the Brent Spar and use the moral argument about dumping to initiate a co-ordinated consumer boycott against Shell products, starting in Germany and spreading to other countries. The widespread media and public response to the boycott took even Greenpeace by surprise, and made a very substantial impact on Shell, resulting in a reversal of policy.

As the facts about the long-term impacts of deep-sea disposal were not certain, and the values of the public were strongly held, the conflict may be seen as part of a growing tendency towards such 'soft' facts and 'hard' values in environmental risk management.

Figure 4.2.4 **Which sources of information 'tell the truth' about the environment (several answers possible)**

Source: Eurobarometer,1995



general duty of the EEA to 'ensure that the public is properly informed about the state of the environment', and to 'ensure the broad dissemination of reliable environmental information', several other EU initiatives in Box 4.2.5 require the active provision of information, such as the eco-label.

3.4. Information provision and behaviour change

The links between information provision and associated changes in behaviour are complex and difficult to unravel (Williams, 1997). It is clear from the previous discussion on awareness and values that the receiver's state of mind and general situation is critical to the successful communication of information that intends to change behaviour. The process has to be viewed in two directions, and the *efficient* communication of information does not necessarily mean it will be used effectively. The range of behaviour choices open to the receiver is crucial, as are other aspects of the 'information use environment' (Menou, 1993). More subtle indicators of effectiveness of information provision are needed that can identify impacts other than behaviour change itself and which are generated more by the receiver's agenda than the sender's.

The use of eco-labels is an increasingly common way of trying to influence the market and consumer behaviour (see Chapter 4.1). A review (OECD, 1997) of several eco-label schemes, including those in the EU, concluded that, although data on environmental effectiveness was lacking, there was evidence of positive impacts on both consumers and producers (Box 4.2.6).

A recent Nordic Council review of product change management in Sweden and Finland focused on detergents, clothing and textiles, electrical and electronic appliances, home and office furniture, and paper products. It analysed information flows and eco-labels and found that although such information was not yet integrated into the actors' normal decision-making routines, there was potential for improving the environmental impacts of products across the product chain via better information and communication flows (Nordic Council, 1998).

A specific study of the EU energy label on refrigerators and freezers found evidence that such environmental information provision lead to some behaviour change (Box 4.2.7).

Evidence of other effects of information on behaviour is scarce but where there is an authoritive report by a scientific body on a specific issue, such as the leukemia risk from the benzene in some unleaded fuels, and there is extensive coverage by the mass media, and different choices are readily available, without much financial cost, then behaviour can change dramatically (Figure 4.2.5; Fouquet, 1997).

The liberalisation of energy and other utility markets can provide opportunities for greater consumer choice, and pressure, which could be used, for example, to increase the market shares of renewable energy supplies (Fouquet, 1998). In addition, the experience in the US with the Toxic Release Inventory is that public information

Box 4.2.5. Public access to environmental information: some EU initiatives

- Major hazards from Industry (the 'Seveso' Directive, 1988);
- Radiation emergencies (Euratom Directive, 1989);
- Labelling and advertising of food (food labelling Directive, 1979 and 1989; nutritional labelling, 1990; novel food Regulation, 1997; GMOs, 1997/98);
- General information on the environment (freedom of access to environmental information, 1990);
- Eco-labelling of consumer goods (Community eco-label award scheme Regulation, 1992);
- Environmental management of companies (eco-management and audit voluntary scheme, 1998);
- Chemical emissions (Integrated Prevention and Pollution Control Directive 1996 – due in 2002);
- Environmental data (EEA regulation, 1990).

Box 4.2.6. Effects of eco-labelling

The OECD studied eco-labelling schemes in several countries: the EU Eco-label Award Scheme, the Nordic Swan, the Swedish Environmental Choice Programme, the Canadian Environmental Choice Programme, the Blue Angel, the Green Seal, the Japanese Eco-Mark and the French NF Environment.

Transparency and consultation
Eco-labelling programmes all have mechanisms for transparency, ranging from publication of information to active dissemination to interested parties, to simply establishing inquiry points; and they have similar consultation processes. Decision-making on the final eco-label criteria is generally not open to outside participation.

Market impacts
Data concerning the market impact of eco-labelled products is very difficult to obtain. It is often confidential commercial information in the hands of industry. Some scattered anecdotal evidence shows that sales have increased when an eco-label has been obtained, but there is no statistical data in general to show the market power an eco-label may confer on a product. Producers however continue to apply for and pay for eco-labels, indicating they have some market value. It is difficult to separate out the market impact of the eco-label from other factors which influence a product's market share.

Eco-labelling programmes have been more successful in countries or regions which benefit from a higher level of consumer awareness of environmentally preferable products and therefore a consumer demand for eco-labelled products (e.g. Sweden). Environmental NGOs, consumer groups and the media have contributed to increasing consumer awareness of environmentally preferable products through consumer awareness-building campaigns of various kinds (e.g. the Swedish Society for Nature Conservation in Sweden, consumer organisations and the specialised press in Germany). In certain cases, eco-labels have had a significant impact on the market for specific product categories (e.g. detergents in Sweden).

Overall, eco-labelling has only been moderately successful with the individual consumer. However, eco-labels may have an important market impact when retailers specify they want to stock products with eco-labels (e.g. ICA retailers in Sweden) or when they become a tool in identifying environmentally preferable products for government procurement.

Trade concerns
Some eco-labelling programmes such as the EU Eco-label Award Scheme, the Nordic Swan, and NF Environment generally include production-related requirements in their eco-label criteria.

The eco-label for T-shirts and bed linen and the eco-labels for paper products developed by the EU have been the largest source of trade concerns because they include criteria related to the production stage of products which are largely imported into the EU.

Environmental effectiveness
Although data relating to the environmental benefit achieved through eco-labelling is lacking, a few estimates of the environmental effectiveness of eco-labelling programmes have been made in terms of pollution avoidance. Generally, however, due to the difficulty of isolating and measuring the environmental benefits of eco-labelled products, environmental effectiveness has instead been evaluated indirectly on the basis of consumer awareness and consumer demand for eco-labelled products, and changes in producer behaviour. Public awareness and attitudes to eco-labelled products vary significantly depending on the country. In some instances, the development of eco-labels has had an impact on the behaviour of manufacturers, strongly encouraging them to modify their products in order to qualify for an eco-label so as to maintain their products in retail chains, for example. Surveys have indicated that eco-labels are better known to women than men and to younger people than older people.

Source: OECD, 1997.

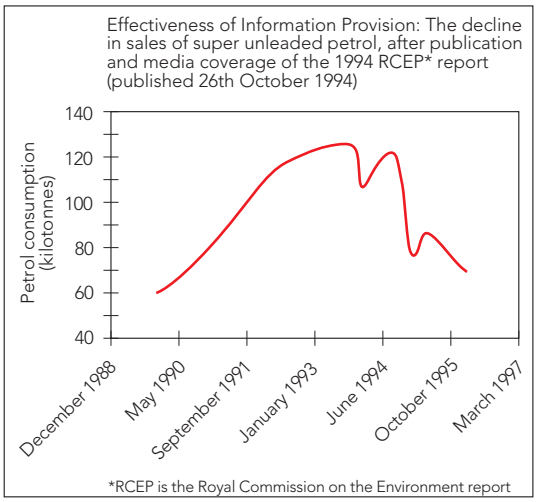
Box 4.2.7. Energy labelling

The impact of refrigerator and freezer energy labelling on purchase decisions has been studied in a cross-European survey of people buying cold appliances since the introduction of the energy label. They found that consumers use the Energy Label and they understand its message. The label is especially influential when the consumer is already concerned about energy use of appliances.
The study found large national differences in the importance attributed to energy use, and that this was not related to the relative price of electricity, but to environmental concern. Of those who said they recalled seeing the energy label, there was a similar degree of national variation over whether it had influenced purchase (61% in Denmark to 3% in Greece), with a strong relationship between the impact of the label and the expressed importance of energy use as a purchase criterion. The label was widely trusted as being accurate, but the variable rates of compliance with the labelling scheme between different countries also reflected the degree to which energy was considered an important factor, and the extent to which the labels influenced purchasing decisions. The label had little effect on purchasing patterns in the southern countries, even though the benefits of cold appliances would be greatest where the summer is hot. In northern countries, where there is a longer history of concern about energy use, the label has had a much greater influence. Across the EU, it is estimated that about a third of consumer purchases of cold appliances are now influenced by the Energy Label. The energy label can thus be considered to be successful where there is already a concern about energy use; it does not, of itself, appear to generate this concern.

Source: Winward et al., 1998

Figure 4.2.5 **An example of the role of information provision: the sales of super unleaded petrol in the UK, 1988 - 1997**

Source: Fouquet, 1997



can play a significant role in pollution reduction. 'Public disclosure of environmental information on emissions is a cornerstone of the regulatory process in the US. Experience has shown that the public disclosure of this data has had a major impact on compliance rates and has led to improved environmental management' (USEPA,1994). Several EU countries provide public access to chemical release data, and the IPPC directive will extend this practice across the EU.

There is little information available that could help determine the optimum investment in public information provision on pollution release and control. A review of economic analyses of information disclosure strategies for pollution control (Tietenberg, 1997) concluded that, whilst there is evidence that information strategies can be effective in motivating environmental improvement, there is no evidence about the cost effectiveness of such strategies compared to other methods of pollution control.

The public appears to be ready for further behaviour change on the environment, as indicated in Eurobarometer polls (Box 4.2.8), and from the rising demand for organic produce and green, or ethical, investments.

3.5. Public participation

The EU has taken a number of initiatives to encourage public participation (Box 4.2.9) and the success of such measures depends in part on the timing and quality of the information provided to the public. In particular, early involvement of the public at the scoping stage of a project, under Environmental Impact Assessment (EIA), or of a programme, plan or policy (Strategic Impact Assessment) seems to maximise the chances of dealing with value differences and of incorporating local knowledge (Sheate and Atkinson, 1995). The updated EIA directive, 1997, places greater emphasis on public consultation, requiring information to be provided that allows the public to express an opinion before development consent is granted, and which includes reasons for decisions and 'descriptions of the main measures needed to avoid, reduce and, if possible, offset any major adverse effects'. However, the treatment of such environmental mitigation steps in EIA can be problematic (DETR, 1997). The treatment of health impacts in EIA, which particularly affects the public, is also poor (BMA, 1998).

EU countries have national laws transposing the EIA Directives into their national practices, allowing for the public participation provisions described in the Directive. However, national differences in democratic and administrative traditions means that public participation in practice varies considerably (Garrett and Martins, 1996). Access to information, and to the Courts, are necessary for successful public participation, particularly where the objectives of economic development and environmental protection conflict (Box 4.2.10)

3.6. What's ahead

Both the review of the Directive on Freedom of Access to Environmental Information and ratification by the EU of the Aarhus Convention 1998 (Box 4.2.11) will provide further

Box 4.2.8. Some public actions on the environment

Most common actions

These actions were identified as being 'already done' and/or that people would 'be prepared to do more often/start doing to protect the environment'. The six highest scoring actions were:

- Avoid dropping paper or other waste on the ground (95%);
- Sort out certain types of household waste… for recycling (84%);
- Save tap water (82%);
- Save energy by using less hot water, by closing doors and windows to save heat (81%);
- Not make too much noise (79%);
- Buy an environmentally friendlier product, even if it is more expensive (67%).

Source: European Commission, 1995

opportunities for public information provision and participation. Meanwhile, the EEA's development of the European Reference Centre for European environmental data and information as a public information service could provide an information base for policy makers, non-governmental organisations and the public. As the focus of environmental activites widens to cover sustainability issues, so the need to inform and involve the public is likely to increase significantly.

Box 4.2.9. Rights to consultation or participation: some EU initiatives

- consumer participation in products standardisation (Council Recommendation, 1988);
- public consultation over release of GMOs (the GMOs Directive, 1990, suggests public may be consulted);
- participation in Environmental Impact Assessment (EIA Directives, 1985 and 1997);
- participation in the permitting procedure for new industrial installations (Integrated Pollution Prevention and Control Directive, 1996);
- public opinion on some major accidents or hazard installations (amended 'Seveso' Directive, 1996).

Box 4.2.10. The Acheloos river diversion project

Acheloos is the largest river flowing entirely in Greek soil. In Greek mythology, Acheloos was the God of all rivers.

The Acheloos river diversion project involves the major diversion of the river from its physical route to a totally different catchment basin, the Thessaly plain in Eastern Greece. The project involves the construction of three dams, three tunnels, extended irrigation works covering an area of 350 000 ha, drainage and anti-flooding networks and many kilometres of new roads. The aim was to increase the production of cotton which enjoyed the support by the Common Agricultural Policy (CAP).

The diversion is expected to cause severe alternations to the Messolongi wetland where the river flows. This wetland is one of the 11 RAMSAR sites in Greece. Due to critical point in which the wetland is now, it is believed that further reduction of the freshwater input to the wetland will be devastating for the system (Scoullos, 1996).

There is no detailed study for the available water resources in Thessaly and the real needs and alternative methods for meeting these needs.

The campaign against the project started in 1992 by four of the largest Greek NGOs. The objectives of the campaign are:

- to cancel the project and to protect important habitats and monuments;
- to provide information, raise awareness and promote dialogue and partnerships between stakeholders and the public.

The local authorities of the lower Acheloos area where the RAMSAR wetland is found asked the NGOs to support their opposition to the proposal and to confront jointly the Environmental Impact Aassessment prepared by the Ministry. However, the project is very popular in Thessaly, the largest cultivated plain of Greece which is intended to benefit from the diversion.

In 1994 the NGOs were successful in two legal cases against the Government for inadequacies in the IEA. It was the first time in Greece, and Europe, that a Higher Court had decided that an integrated EIA was required for large complex development schemes in order to assess whether the project is compatible with the notion of sustainability and the precautionary principle. The Greek Government refused to halt the construction works but ordered a new EIA. The NGOs and local authorities of the upper Acheloos district submitted an injunction to a Local Court asking for the immediate compliance of the Government with the Decisions of the Council of State. The case was lost.

A case was also taken in 1995 against the Government denial to allow the NGOs access to information related to the actual water flow of Acheloos, which is one of the most important questions of the case. The case was won and a decision of the Council of State was issued despite the fact that the relevant EU Directive was not at that moment integrated into the Greek law.

New environmental terms for the construction and operation of the diversion project, according to the conclusions of the new EIA have been inserted by the Government and the quantity of water to be diverted has been reduced to 6 000 million m^3/year, compared to 1.1 billion m^3/year.

The Campaign, and the construction, continue.

Source: Scoullos and Constantianos, 1999

References

Ashby, E., 1997. *On Reconociling Man with His Environment.* Oxford University Press, Oxford, pp. 85-86.

BMA, 1998. Health and Environmental Impact Assessment: an Integrated Approach. British Medical Association, London.

DETR, 1997. Mitigation Measures in Environmental Statements. Department of the Environment Transport and the Regions, London.

Doble, J., 1995. 'Public opinion about issues characterised by technological complexity and scientific uncertainty', in Public Understanding of Science, 4, 1995.

EEA, 1995. *Europe's Environment: The Dobris Assessment.* European Environment Agency, Copenhagen. Office for Official Publications of the European Communities, Luxembourg.

EEA, 1997. Public Access to Environmental Information. Prepared by R.E. Hallo, Stitchting Natuur en Milieu (the Netherlands Society for Nature and Environment), May 1997. Experts' Corner No 1997/1, European Environment Agency, Copenhagen.

EEA, 1998. *Europe's Environment: The Second Assessment.* European Environment Agency, Copenhagen. Office for Official Publications of the European Communities, Luxembourg.

Box 4.2.11. The Aarhus Convention,1998

The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters was adopted in the Danish city of Aarhus at the Fourth Ministerial Conference in the 'Environment for Europe' process, in June 1998, and signed by 35 countries and the European Union.

The Aarhus Convention aims to strengthen:

- Rights of access to environmental information via a wide definition of information, a presumption in favour of access, and a public interest test for exempted information;
- Rights to participate in environmental decision-making, including an obligation on the decision-making body to take due account of the outcome of public participation, and to inform the public of the decision, and the reasons for it;
- Rights of access to justice in environmental matters, including access to administrative or judicial procedures to challenge acts and omissions by private and public bodies which breach environmental laws, subject to the standing of members of the public in national law.

EEA/UNEP, 1998. Chemicals in the European Environment: Low Doses, High Stakes? EEA and UNEP Annual Message 2 on the State of Europe's Environment European Environment Agency, Copenhagen, Denmark, and United Nations Environment Programme, Châtelaine Switzerland. UNEP, UNEP/ROE/97/16.

EEA/WHO. *Water and Health in Europe* (in press).

European Commission, 1995. *Europeans and the Environment in 1995: Eurobarometer 43.1* (Brussels: European Commission).

Fouquet R., 1997. Environmental Information and the Demand for Super Unleaded Petrol, Surrey Energy Economics Discussion Paper, no.90, University of Surrey, Guildford.

Fouquet R., 1998. 'The UK Demand for renewable electricity in a liberalised market', Energy Policy, 26(4), 281-293.

Garrett, C. & Martins, I., 1996. EIA and Administrative Management Models: a marriage of ineffectiveness? IAIA '96 Proceedings, Estoril.

International Environmental Monitor, 1998. Environics International Ltd. Toronto

Jamison, A., 1998. 'Technology Policy meets the public', Pesto Papers 2, p.164, Aalborg University Press, Aalborg.

Kasemir, B., 1999. 5th Ulysses workshop on 'Integrated Assessment Focus Groups: A new Approach to stakeholder involvement in Environmnetal policy', March 1999.

Lancaster University, 1995. 'Public Perceptions and sustainability in Lancashire', by Macnaghten, P. Grove-White ,R.,Jacobs, M.,Wynne,B., Lancashire County Hall, Preston.

Macnaghten, P. and Urry, J., 1998. Contested Natures (London, Sage)

Menou, M.J., 1993. Measuring the impact of research information on practitioners, IDRC, Ottawa.

Nordic Council, 1998. Environmental Improvement in Product Chains, Temanord, Nordic Council of Ministers, Copenhagen.

Norwegian Ministry of the Environment, 1998. *Consumption in a Sustainable world,* Report of a Workshop, Kabelveg, Norway.

OECD, 1997. *Eco-labelling: Actual Effects of Selected Programmes.* Organisation for Economic Cooperation and Development.

Ravetz, J, 1996. Integrated environmental assessment: developing guidelines for good practice'. Research Methods Consultancy. London

RCEP, 1998. Setting Environmental Standards: 21st Report. The Stationery Office, London.

REC, 1998. Doors to democracy. Regional Environment Center for Central and Eastern Europe

Scoullos, M., 1996. Environmental impacts of the Acheloos river diversion. In 15th Congress of the International Association for Bridge and Structural Engineering (IABSE), Congress report. Copenhagen, 16-20 June 1996

Scoullos, M., Constantianos, E., 1999. Personal communication, Elliniki Etairia, The Hellenic Society for the Protection of the environment and the Cultural heritage. Athens

Sheate, W & N Atkinson, 1995. Public Participation in Environmental Decision-Making: The European Dimen- sion. Environmental Policy and Practice 5, 3, 119-129

Tietenberg, T. 1997. 'Disclosure strategies for pollution control'. Paper for conference on Environmental Implications of Market-Based Policy Instruments, Göteborg, November 1997.

Turner II, B.L. *et al.,* 1997. '"Socializing the Pixel" and "Pixelizing the Social" in Land-Use/Cover Change (LUCC) with reference to scalar themes'. IGBP-IHDP LUCC Newsletter No 1, February 1997.

UK/EA, 1998. Chairman's conclusions, Bridging the Gap Conference. UK Environment Agency, VROM (The Netherlands) and European Environment Agency. London, June 1998

USEPA, 1994. Changing Environmental behaviour in the USA through the use of Public Disclosure of Information. Environmental Protection Agency, Washington.

Van Zwanenberg, P., te Velde, R., Ostby, P., 1998. 'Roads to Sustainable Transport?', in 'Technology Policy Meets the Public', Pesto Papers 2, Aalborg University Press, Aalborg.

Waterton, C, Grove-White, R., Rodwell, J., and Wynne, B., 1995. CORINE: Databases and Nature Conservation – the new politics of information in the European Union. Centre for the Study of Environmental Change and Unit of Vegetation Science, Lancaster University.

Williams, W., Wilson, K. and McConnell, M., 1997. 'Is there any knowledge out there? The impact of research information on practitioners', British Library Research and Innovation report n°62. British Library.

Winward, J., Scheillerup, P., and Boardman, B., 1998. Cool Labels: the first three years of the European Energy Label (Energy and Environment Programme, Environmental Change Unit, Oxford).

Glossary

5EAP	Fifth Environmental Action Programme (EU)
AAE	average accumulated exceedance
AC	Accession Countries
AC10	ten central and eastern European Accession Countries
AFA	antibacterial feed additives
AOT	Accumulated Ozone exposure over a certain Threshold value (parameter used to express effects of ozone)
AQG	air quality guidelines
As	arsenic
BAT	best available technology
BOD	biochemical oxygen demand
BSE	bovine spongiform encephalopathy
BSS	basic safety standards
Bt	Bacillus thuringienis
CAP	Common Agricultural Policy (EU)
CBD	Convention on Biological Diversity (UN)
Cd	cadmium
CEC	Commission of the European Communities (or European Commission)
CEFIC	European chemical industry confederation
CET	Central European Time
CFC	chlorofluorocarbon
CFP	Common Fisheries Policy (EU)
CH_3Br	methyl bromide
CH_4	methane
CHP	combined heat and power
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CLRTAP	Convention on Long-Range Transboundary Air Pollution (UNECE)
CLRTAP-HM	Convention on Long-Range Transboundary Air Pollution by Heavy Metals
CLRTAP-POP	Convention on Long-Range Transboundary Air Pollution by Persistent Organic Pollutants
CO	carbon monoxide
Co	cobalt
CO_2	carbon dioxide
COD	chemical oxygen demand
COP3	Third Conference of the Parties to the UNFCCC, Kyoto, Dec. 1997
COP4	Fourth Conference of the Parties to the UNFCCC, Buenos Aires, Nov. 1998
COPs	cereals, oilseed and protein crops
Corinair	CooRdination of Information on the Environment AIR emissions (former EC programme), since 1995 a EEA/ETC-AE programme (CORe Inventory of AIR emissions)
Cu	copper
dB(A)	international sound pressure level unit meaning 'decibel with an A frequency weighting' which reflects the sensitivity of the human ear
DDD	1,1-dichloro-2,2-bis(4-chlorophenyl)ethane
DDT	1,1'-(2,2,2-Trichloroethylidene)bis(4-chlorobenzene)
DG XI	EC Directorate-General XI (Environment, Nuclear Safety and Civil Protection)
DPSIR	Driving forces, Pressures, State, Impact, Responses
dw	dry weight
EAP	Environmental Action Programme
EBRD	European Bank for Reconstruction and Development
EC	European Community
ECB	European Chemicals Bureau (Joint Research Centre, Ispra, Italy)
EDTA	EthylenDiaminTetraAcetic acid

EDS	Endocrine disrupting substances
EEA	European Environment Agency
EFTA	European Free Trade Association
EIA	environmental impact assessment
EINECS	European INventory of Existing Chemical Substances
EIONET	European Information and Observation Network
EMAS	Environment Management and Audit Scheme (EU)
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollution in Europe
EMSC	European Mediterranean Seismological Centre
Enterococci	Type of bacteria present in the intestines of animals and humans
EPE	Environmental Programme for Europe
EPOCH	European Programme on Climatology and natural Hazards
ERDF	European Regional Development Fund (EU)
ESDP	European Spatial Development Perspective
ETC/AE	European Topic Centre on Air Emissions (EEA)
ETC/AQ	European Topic Centre on Air Quality (EEA)
ETC/IW	European Topic Centre on Inland Waters (EEA)
ETC/LC	European Topic Centre on Land Cover (EEA)
ETC/MC	European Topic Centre on Marine and Coastal Environment (EEA)
ETC/NC	European Topic Centre on Nature Conservation (EEA)
ETC/S	European Topic Centre on Soil (EEA)
ETC/W	European Topic Centre on Waste (EEA)
EU	European Union
EU15	European Union (15 Member States)
EUNIS	European Nature Information System
EUR	euro
EURAM	European Union Risk RAnking Method
Eurostat	Statistical Office of the European Union (Luxembourg)
EUSES	European Uniform System for Evaluation of Substances
FAO	Food and Agriculture Organization (United Nations, Rome)
FCCC	Framework Convention on Climate Change (UN)
FYROM	Former Yugoslav Republic of Macedonia
GDP	gross domestic product
GEM-E3	General Equilibrium Model for Energy-Economy-Environment interactions
GEO	Global Environment Outlooks (UNEP report)
GHG	greenhouse gases
GJ	gigajoules
GM	genetically modified
GMO	genetically modified organism
Gt	gigatonnes
GVA	gross value added
GWP	global warming potential
HBFC	hydrobromofluorocarbon
HCB	hexachlorobenzene
HCFC	hydrochlorofluorocarbon
HCH	hexachlorocyclohexane (g-HCH = lindane)
HELCOM	Helsinki Commission
HFC	hydrofluorocarbon
Hg	mercury
HM	heavy metal
HPVC	high production volume chemicals
HSRN	high-speed rail netork
I-TEQ	International Toxicity EQuivalents with respect to 2,3,7,8-TCDD
IAEA	International Atomic Energy Agency (UN)
IC	internal combustion (engine)
ICAO	International Civil Aviation Organisation
ICES	International Council for Exploration of the Seas
ICP	International Co-operation Programme (UNECE)
ICRP	International Commission on Radiological Protection
ICZM	integrated coastal zone management

IEA	integrated environmental assessment
IIASA	International Institute for Applied Systems Analysis
INES	International Nuclear Event Scale
IPCC	Intergovernmental Panel on Climate Change (UN)
IPPC	Integrated Pollution Prevention and Control (EU Directive)
IRS	Incident Reporting System
ISSA	Information Society Services and Applications
IUCLID	International Uniform Chemical Information Database (Joint Research Centre, Ispra, Italy)
km	kilometers
ktonnes	thousand tonnes
LCA	life-cycle assessment
Ldn	Day-Night Level, a descriptor of noise level which is based on the energy-equivalent noise level (Leq) over the whole day with a 10 dB(A) penalty to noise levels experienced during night time (22.00 - 07.00 hrs)
Leq	equivalent sound pressure level
LFA	less favoured area
LIFE	financial instrument for the environment (EU)
LOIS	Land-Ocean Interaction Study (funded by UK Government and CEC)
LRTAP	Convention on Long-Range Transboundary Air Pollution (UNECE)
MAC	maximum admissible concentration
MAP	Mediterranean Action Plan (Barcelona Convention)
MARS	Major Accident Reporting System
MEDPOL	Mediterranean Pollution Monitoring and Research Programme
MIRABEL	Models for Integrated Review and Assessment of Biodiversity in European Landscapes (see Chapter 3.11)
MJ	million joules
MMM	Multi-Media Model
MS	Member State (of EU)
mSv	millisievert (radiation exposure unit)
Mt	million tonnes
N_2O	nitrous oxide
NGO	non-governmental organisation
NH_3	ammonia
Ni	nickel
NMVOC	non-methane volatile organic compound
NO	nitric oxide
NO_2	nitrogen dioxide
NO_3	nitrate
NO_x	nitrogen oxides
NRC	National Reference Centre (EEA)
NTA	nitrilotriacetic acid
NUTS	nomenclature of territorial units for statistics (Eurostat)
O_3	ozone
ODP	ozone depletion potential
ODS	ozone-depleting substance
OECD	Organisation for Economic Cooperation and Development
OSPARCOM	Oslo and Paris Commission
PAH	polycyclic aromatic hydrocarbons
Pb	lead
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
PCT	polychlorinated triphenyl
PEEP	prominent European environmental problem
PFCs	perfluorcarbons
PHARE	Poland, Hungary – EU Assistance for the Reforms of the Economies (currently extended to 13 central and eastern European countries)
PIC	prior informed consent (procedure)
PIPP	policies in place and in the pipeline (baseline scenario, August 1997)
PM	Particulate Matter

PM10	respirable Particulate Matter with aerodynamic diameter between 2.5 and 10 µm (see Ch. 3.3)
POP	persistent organic pollutant
ppb	parts per billion
ppm	parts per million
PPP	polluter pays principle
PPS	purchasing power standard
ppt	part per trillion
PSC	polar stratospheric cloud
pSCI	potential site of community interest (EU)
Pt	platinum
PVC	polyvinylchloride
RIVM	National Institute of Public Health and Environmental Protection, the Netherlands
SAC	special area of conservation
SAVE	specific actions for vigorous energy efficiency (EU)
SCI	site of community interest (EU)
SEA	strategic environmental assessment
SFA	substance flow assessment
SME	small and medium-size enterprises
SO_2	sulphur dioxide
SPA	special protection area
SPIRS	Seveso Plants Information Retrieval System (EU)
t	tonnes
TACIS	technical assistance to the Commonwealth of Independent States (EC)
TBT	tributyl tin
TCDD	tetrachlorodibenzodioxin
TEN	Trans-European Network
TERM	Transport-Environment reporting Mechanism (EU)
TEU	twenty-feet equivalent
toe	tonnes of oil equivalent
TRI	trichloroethen
UAA	usable agricultural area
UN	United Nations
UNCED	United Nations Convention on Environment and Development
UNCDD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe (Geneva, Switzerland)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USEPA	United States Environmental Protection Agency
UV	ultraviolet radiation
VC	vinylchloride
VOC	volatile organic compound
VRE	vancomycin resistant enterococci
VVER	pressurised water reactor
WHO	World Health Organisation
WTO	World Tourism Organisation
ww	wet weight
WWT	waste water treatment
Zn	zinc