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Dear Reader,


Photo: Bernd Vogel

As the logo of the Federal Environment Agency, the UBA, states “For man and the environment”. A team now comprising some 1,200 people has been working towards this objective for the past 33 years in Germany. The Agency’s activities take place at the point where science and politics intersect, providing impetus and facts, and suggesting ways in which the environment and health can be effectively protected against negative influences.

The UBA has a statutory obligation and a commitment to use its scientific expertise to advise politicians in their decision-making processes, and to offer them practicable suggestions. This also involves acting as an early warning system for pollution and other threats to human health and the environment. Identifying tomorrow’s problems today is the objective of the forward-looking research carried out by the UBA. There are many examples showing how it has succeeded and among those that occur to me are the discussions, initiated by the UBA, on the harmful effects of diesel soot and the environmental impact of medicines.

2006 was an important year for scientific achievements by the UBA. The Science Council was commissioned by the German government to also evaluate the Agency and it has confirmed the value of the work carried out by the UBA to protect vital natural resources. In particular these experts praised the Agency’s outstanding, interdisciplinary approach to its tasks, the wide scope of the topics it addresses, and the high degree of identification and motivation displayed by its staff. In some areas such as the hygiene of indoor air and drinking water the Science Council has attested that the UBA occupies a unique and distinctive position in Germany. The Science Council was very positive in its assessments but it also pointed out the need for constant checks and improvements in order to maintain and develop the quality of the scientific work. We are working on it.

This evaluation was significant for the UBA in two respects. Its staff have critically examined their own approach to research and discussed the assessment standards to be applied by scientists in the provision of policy advice. The objective is to effect further improvements to the scientific work of the Agency. The main emphasis is on the strategic planning of research work to ensure more accurate and effective deployment of a limited research budget and of a staff whose numbers are continually being reduced. The UBA will also be linking more closely with national and international scientific communities and will continue to encourage its staff to improve their scientific qualifications.

In addition to work of a “purely” scientific nature our daily work is also concerned with implementing environmental legislation, such as the laws on chemicals, pesticides, protection against infection, biocides and pharmaceutical products. One thing is certain: enforcement and attention to scientific research are two sides of the same coin. Enforcement depends on the scientific capabilities of the staff and it in turn continually provides a fresh impetus for new research topics. Moreover the enforcement of environmental laws nowadays is largely based on our past scientific work.

This work of enforcement is also becoming more international. The guidelines for assessing substances and materials now have European roots, reflecting current levels of scientific knowledge, and they are constantly being expanded and adapted. The staff of the UBA apply their experience and scientific skills in a highly effective way within the relevant committees. Many of today’s valid enforcement guidelines bear the imprint of the UBA and help to ensure that the high level of protection available in Germany also applies to Europe. This is particularly relevant in the environmental assessment of medicines, the technical basis of which has been established by the UBA, and in the technical guidelines

required for the new European chemicals regime REACH (Registration, Evaluation and Authorization of Chemicals).

REACH came into force on 1 June 2007, providing a new basis for European chemicals policy. Manufacturers and importers must now supply data for all their products and it is also their responsibility to provide the relevant assessments. Approval is required before particularly hazardous chemicals may be used, and the users of these substances now have to meet a new set of obligations. This gives rise to numerous technical questions, and compromises have to be reached to ensure that these regulations are both manageable and reasonable for the companies concerned. It is only in this way that REACH can fulfill the expectations that many people have placed in it: protecting the environment and consumers from the harmful effects of chemicals.

Not only does REACH require the UBA to make its own technical and scientific contribution, it also provides an impetus for the acquisition of more far-reaching scientific knowledge. The wealth of publicly available data about the behaviour and effects of many substances in the environment will encourage new findings about the relationships between structure and effect and about underlying mechanisms. The methods for predicting concentrations of substances in the environment and for combining substances into groups provide some other examples of how REACH is stimulating scientific enquiry.

REACH also confronts the UBA with new challenges. The emphasis is no longer on in-depth, comprehensive assessments of individual chemicals in the environment but on the question of how the state, after having largely entrusted companies with the responsibility for ensuring the safety of chemicals, can organize effective ways of monitoring results. The UBA makes its experience and expertise available and advises companies to enable them to meet their responsibilities more effectively. This service is also a part of its enforcement work.

The “environment” comprises everything that surrounds people throughout their lives, in their homes, at work and during their leisure. Protecting the population from the health hazards presented by airborne pollutants, chemicals, noise and other harmful influences is a component of environmental and health policy that has been attracting increased attention for some years now. Consequently “Environment and Health” is one of the three main themes dealt with in this annual report.

The natural resource of biodiversity, the many different animals, plants micro-organisms and eco-systems is at risk due to the needs of a growing world population. We are substantially reducing this biological plurality and depriving it of its dynamic before it has been sufficiently understood. Around the world thousands of species of animals and plants are under threat of irrevocable extinction. Among the factors contributing to this are climate change, deforestation, the escalating demand by human beings for more space, and the pollution of terrestrial and aquatic ecosystems. Germany is one of the signatories to the UN Convention on Biological Diversity. Not only should be biological diversity receive protection because of its benefits to us now and in the immediate future but above all because we do not know what beneficial effects it may bring us and our descendants in the more distant future.

Sustainable development has been the guiding principle of environmental and development policy for the 21st century since the World Summit in Rio de Janeiro in 1992. Among its implications are the need for everyone to be granted as much access to natural resources as is necessary in order to satisfy their basic requirements. The economical and more efficient use and sustainable management of natural resources therefore present the main challenges, now and in the future. In accordance with the German government’s sustainability strategy, raw material productivity in the country is set to double by 2020, compared with 1994. Under the title “Using resources – protecting resources”, in this annual report we describe a number of strategies. These include the export of innovative techniques to improve efficiency, especially to rapidly expanding economies such as that of China, and the strengthening of regional economic cycles and efficiency centres, supplying companies and consumers alike with advice on how to make better use of energy and raw materials. A more far-sighted approach to vital natural resources should be an integral part of our everyday thoughts and actions, thereby ensuring that our descendants do not face a future that is worse than ours, and one that will, we hope, be substantially better in many parts of the world.

I hope you enjoy reading this report.

Prof. Dr. Andreas Troge
President of the Federal Environment Agency

Photo: Clemens Höfler

HEALTHY LIVING IN AN ENVIRONMENT WORTH LIVING IN

The "environment" comprises everything that surrounds people throughout their lives, in their homes, on their way to do their shopping, at work and during their leisure. People's health and well-being depend largely on the quality of this environment. One important aspect of environmental and health policy concerns the need to protect the public from health hazards presented by airborne pollutants, chemicals, noise and other harmful influences, and this is also a major factor in safeguarding the quality of life. Environmental protection is sustainable health care.

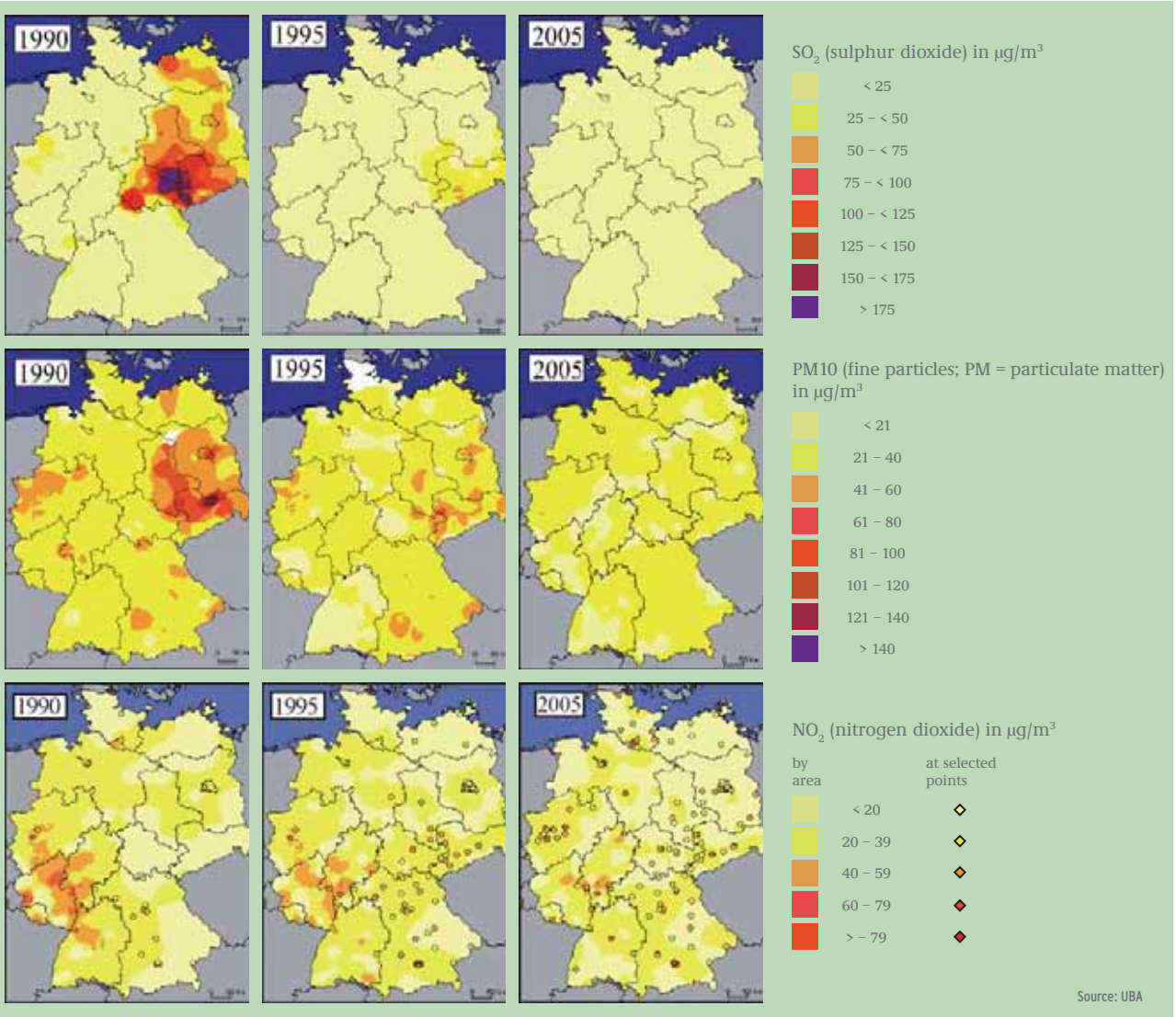
For many years the Federal Environment Agency (UBA) has made the environment and health its main concerns and has been working together with other German authorities and international organizations such as the European Union and the World Health Organization (WHO). The "Aktionsprogramm Umwelt und Gesundheit, APUG" (Environment and Health Action Programme: the German version of the National Environment and Health Action Plan), with its secretariat at the UBA, is an important platform for networking in this field. These combined efforts in various policy areas are aimed at avoiding or reducing diseases caused or exacerbated by environmental stresses, and to reduce the incidence of such diseases, thereby supporting sustainable development [1].

Air pollution control – a success story or an unfinished one?

It is now almost forty years since winter smog became one of the first environmental topics of concern to the general public. High airborne concentrations of sulphur dioxide and dust during inversions, led to an increased incidence of cardiorespiratory diseases. Traffic bans and production restrictions were measures applied to combat winter smog. Since those days there has been a significant improvement in air quality (Fig. 1, p. 5). For example, sulphur dioxide concentrations decreased from between 50 and 75 micrograms per cubic metre ($\mu g/m^3$) in 1985 to less than 25 $\mu g/m^3$ in 2005. Since then nitrogen dioxide levels have declined by more than half due to statutory regulations, which have forced large power stations producing electricity and heat, industrial plants and waste incineration plants to install state-of-the-art emission control. Measures have also been introduced to reduce the emissions from road traffic.

During the 1980s public attention focused on the health hazards resulting from summer smog. The increase in road traffic in particular, due to its emissions of oxides of nitrogen and volatile hydrocarbons as precursors led to a rise in ozone levels. Ozone is the principal substance in the summer smog mixture, leading to problems with the respira-

Figure 1: **Changes in air quality between 1990 and 2005 in Germany**



tory tract and eye irritation. Air quality has improved significantly since the introduction of the three-way catalytic converter. Whereas in the early 1990s readings of ozone concentrations frequently exceeded the alert threshold of 240 µg/m³ as 1-hour average, from all the readings taken by measurement stations during the extremely hot summer of 2006 this level was only exceeded on five occasions.

In recent decades our air has become much cleaner and the risks to health have declined noticeably as a result. However, it should be pointed out that this positive development has remained static since 2000 in the case of many pollutants. Moreover, the limit values for fine particles and nitrogen dioxide which are based on recent studies on health effects are being exceeded quite substantially, especially in built up areas and along busy roads. Air quality in Germany still does not comply with the EC target as values for ozone.

Consequently, despite acknowledged successes in improving air quality, there are no grounds for widespread satisfaction, especially since the limit

Table 1: **EC air quality values and WHO recommendations**

	PM 10 – limit value to be met 2005 (24-hour-mean)	NO_2 limit value to be met by 2010 (annual average)	Ozone target value for 2010 (8-hour-mean)
EC air quality value	50 µg/m³ not to be exceeded on more than 35 days	40 µg/m³	120 µg/m³ not to be exceeded on more than 25 days
WHO recommendation	50 µg/m³ not to be exceeded on more than 3 days	40 µg/m³	100 µg/m³ without exception

values currently in force certainly do not exclude every risk. Achieving further improvements presents a massive challenge: In some areas the technical possibilities for continued reduction in emissions have been largely exhausted, and further improvements are only possible through numerous "small steps". In imposing limit values the legislators weigh the costs of the measures to reduce emissions against their benefits. The values recommended by the WHO (Table 1, p. 5) are long term objectives whose attainment will also require non-technical measures, including the work of educating consumers and businesses about the rational use of energy and ecologically acceptable mobility concepts.

Minor causes – major effects

The limit values for fine particles are to be met since the beginning of 2005 but are not universally complied with. This presents a problem because fine particles are responsible for a large proportion of air pollution health effects. Increased concentrations of fine particles affect the respiratory tract. Asthmatics require more medication, there are a rise in hospital admissions, increases in cardio-vascular problems and greater mortality as a result of diseases of the respiratory tract. The WHO estimates that life expectancy in Germany is reduced by an average of ten months as a result of the pollution caused by fine particles in ambient air [2].

Epidemiological studies have revealed an almost linear relationship between concentrations of fine particles and the adverse effects on the cardio-vascular and bronchial system [3]. This means that not only peak concentrations but also relatively low concentrations contribute to these effects and, because they occur more frequently, can even be the main contributors to the overall effect. That is why peak pollution levels, and above all, average levels must be reduced. For health effects, the annual average is therefore more important than the daily means.

Where particles are deposited they irritate tissue, which can lead to inflammatory changes in the respiratory tract, and because of the close links between the functions of breathing and blood circulation, both systems tend to be adversely affected. The smaller the particles the further they can penetrate the respiratory tract. If they are larger than 10 micrometres (µm = one millionth of a metre) they can barely pass through the larynx, but smaller particles can penetrate into the smaller bronchial passages and the alveoli. Ultrafine particles (less than 0.1 µm) can even enter the bloodstream through the alveoli and be distributed throughout the body. However, there is still insufficient data to enable concrete, quantitative statements to be made about the adverse effects of ultrafine particles on health. Even less is known about the effects of the equally small nanoparticles, which are specifically manufactured to possess certain technical properties and are used in the automobile and chemical industry, biotechnology and environmental technology. With increasing use these nanoparticles can also find their way into the environment. It is still largely unclear whether this presents any health risks. The composition of indoor airborne dust, in terms of its size, material properties and sources, can differ substantially from that found in ambient air, which is why the relationship between ambient particle concentrations and health effects is not directly applicable to indoor air.

A bad atmosphere in the home

In our latitudes we spend some 20 hours of every day in enclosed rooms, mainly at home or at a place of work. A sense of well-being also depends on having pure air, but this can by no means be taken for granted, because of the various harmful substances which can be found in homes and offices, or can make their way into the air in rooms, for example, from building products, furnishings (see also p. 80), cosmetics and cleaning products.

Building products offer one example: one source of "a bad atmosphere" indoors is provided by those building products which release volatile and semi-volatile organic compounds (VOC and SVOC). Such compounds not only impact adversely on the quality of indoor air but can also have a negative effect on health and well-being. It is therefore important during the manufacturing process to limit the amount of substances which may present a health hazard. The Committee for Health-related Evaluation of Building Products (AgBB), which has its secretariat at the UBA, has developed an evaluation scheme for limiting emissions and this has now been included in the approval process operated by the German Institute for Building Technology (Deutsches Institut für Bautechnik – DiBt) for various building products. The DiBt is operated jointly by the German federal states and is responsible within Germany for approving building products. In order to obtain the technical approval, new floor coverings now have to comply with AgBB criteria, and this will be extended to other product groups. With the support of the UBA, the German federal government is endeavouring to establish the German programme of testing in Europe, too.

Fungal mould is another example. Not only chemical but also microbiological contaminants can occur indoors. The number of complaints about mould in homes and offices has been increasing over the years, probably due largely to the reduced exchange of air in heat-insulated and airtight homes and an increased awareness by the public of the hazards associated with mould in the home.

In sensitive persons fungal mould can provoke allergies and asthma. The German Environmental Survey of Children (GerES IV) carried out by the UBA in close cooperation with the Robert-Koch Institute's German Health Interview and Examination Survey for Children and Adolescents (KiGGS) from 2003 to 2006, found, e.g., that well over six per cent of all children aged 3 to 14 years who were surveyed (case number n=1,538) had developed a sensitization to at least one of the four investigated types of fungal mould occurring in indoor environments (Fig. 2 and 3). In the case of alternaria, a fungal mould that typically occurs in outdoor air, this applied to just under five per cent. The sensitivity increases with the age of the children [4]. In addition to the state of the building and the activities of its users, the UBA is currently investigating the importance of airtightness of buildings as a contributory factor in the occurrance of fungal mould.

Energy saving versus indoor air quality

The introduction of the Energy Saving Ordinance in 2002 and its amendment in 2007 have intensified the requirements for thermal protection and heating systems in new and existing buildings. The aim is to reduce the energy requirements of a building by around one third, thereby not only reducing the consumption of finite natural resources such as mineral oil and natural gas, but also the emission of gases harmful to the climate (such as carbon dioxide) produced by the heating of buildings. This will be good for man and the environment.

The other side of the coin is that an airtight building shell, which is the only way in which the required energy savings can be achieved, leads to the build-up in indoor areas of the released substances. Unpleasant odours are produced too and, if the water vapour is not adequately removed by active ventilation, fungal mould can develop on cold surfaces or on those where suitable nutrients can be found. Relief can be provided during the construction or renovation of a building if products are used which release few if any harmful emissions into the air within the building. It is also vital to educate occupants about the adequate way of ventilating airtight buildings. In its statement entitled "Energiesparen in Gebäuden und Gesundheitsschutz sind kein Widerspruch" (There is no contradiction between energy saving in buildings and health protection) the UBA drew attention to this subject and issued recommendations on how to live and work in modern, airtight buildings without jeopardizing one's health [5–7].

When babies smoke

Smoking presents a health risk, and there is a growing public awareness that this also applies to passive smoking. However, too little attention is paid to the fact that unborn children and babies suffer from the harmful ingredients in tobacco smoke, as a result either of mothers smoking during pregnancy and when breastfeeding, or from passive smoking after birth. The children of mothers who are active smokers during pregnancy weigh less and are smaller at birth, and there is also an increased risk of stillbirths or of being born prematurely. Publications also report a higher rate of infant mortality.

Figure 2: **Proportion of children with sensitization, according to mould species**

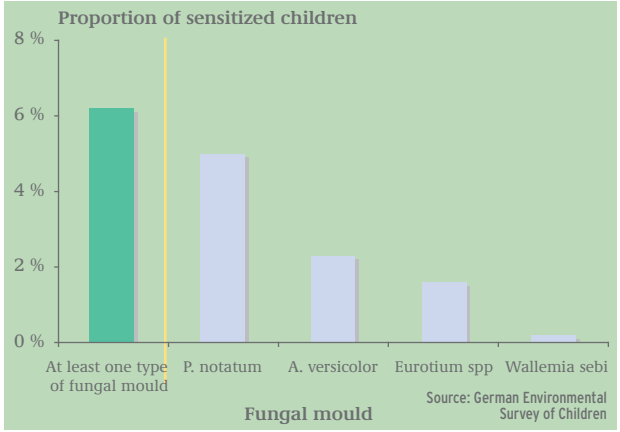
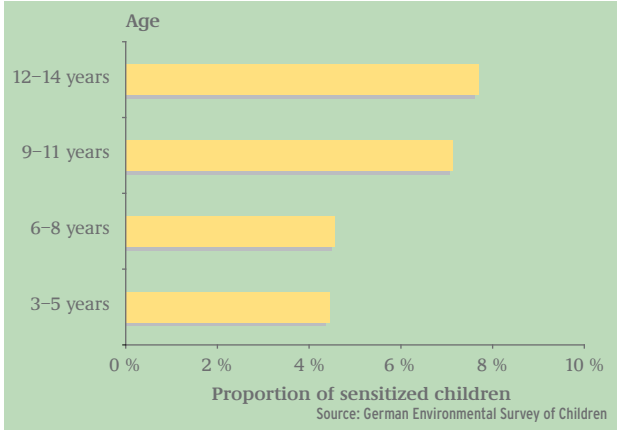


Figure 3: **Proportion of sensitized children, according to age**



Infants who are exposed to tobacco smoke face a risk of sudden infant death syndrome, bronchial hyperreactivity, bronchitis and pneumonia. It may exacerbate existing asthma in older children, while rates of middle ear inflammation and the need to remove tonsils and adenoids are on the increase. There also appear to be links with the onset of impaired mental development. Furthermore passive smoking increases the risk of cancer in later life.

Investigations carried out in the framework of the German Environmental Survey of Children have revealed that around 50 per cent of children still live in a household with at least one smoker. Mothers who smoke expose their children to higher levels of secondhand smoke than fathers. In just under half of all households with children and where smoking takes place every day the benzene content of the indoor air is so high that it would exceed the future EC limit value for benzene in ambient air. The more that children are exposed to tobacco smoke, the higher the amount of polycyclic aromatic hydrocarbons (PAH) that can be detected in their urine. Among these compounds one of the most important is the carcinogen benzopyrene. Despite all the knowledge about the dangers of active and passive smoking, adults still expose children to tobacco smoke and the many carcinogens that it contains. Protecting children against tobacco smoke therefore remains an important task of environmental and health policy in Germany.

Photo: BMU / Rupert Oberhäuser

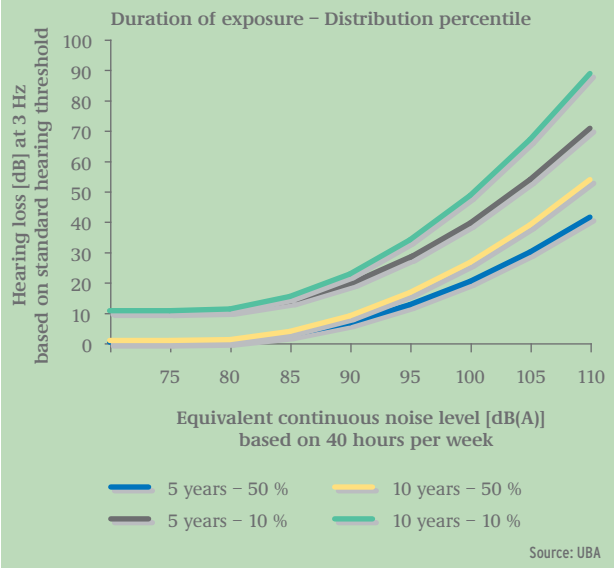
Pop makes you deaf

Excessive noise can cause hearing damage and even deafness. Other effects can include temporary or permanent tinnitus. This can be a consequence of regular exposure to high noise levels over extended periods as well as to brief, very loud peak exposure. Such high sound pressure levels not only occur at work but also during leisure, for example when listening to loud music via headphones, in concerts and at discotheques, when lighting fireworks or using loud power tools, other items of equipment or even some toys. Audiometry demonstrates that noise-related hearing loss is mainly in the 4000 to 6000 hertz frequency range. According to epidemiological studies the proportion of young people with noise-induced hearing loss has been increasing over recent years, or has already stabilized at a high level [8, 9]. Since in this age group noise at work cannot be the cause, it is likely to be the result of exposure to noise during leisure activities. As part of the nationwide German Environmental Survey of Children various hearing tests were carried out on children between the ages of eight and 14, revealing that 13 per cent of them suffered from hearing loss in excess of 20 dB(A) in one of the tested frequencies.

Hearing damage is irreversible, and the loss of hearing worsens if the person is exposed to additional noise. No satisfactory regulations have yet been introduced in Germany to deal with noise in leisure situations. Over an extended period one visit per week to a disco can cause lasting hearing damage. The ministers of health of the German states have recognized a need for action. An interdepartmental working group with the involvement of the UBA has recommended that the noise level of the music at all points accessible to those attending discotheques and concerts should be reduced to less than 100 dB(A). Compared with the current situation this would substantially reduce the potential hazards. Although this would not represent a “safe” noise level for frequent listeners, for all others it would be an acceptable compromise between protecting health and enabling people to enjoy their leisure activities.

The draft of the revised industrial standard DIN 15905 Part 5 “Measures to prevent the risk of hearing loss of the audience by high sound exposure of electroacoustic sound systems” supports these efforts, which are being backed up by events intended to educate disk jockeys (“DJ licence”), sponsored by the Federal Ministry of the Environment, the federal states and the health insurance for technicians (Techniker Krankenkasse), and organized by the association representing discos and dance halls, the *Bundesverband deutscher Diskotheken und Tanzbetriebe*.

Figure 4: **Estimate of expected hearing loss by young people in accordance with ISO 1999**

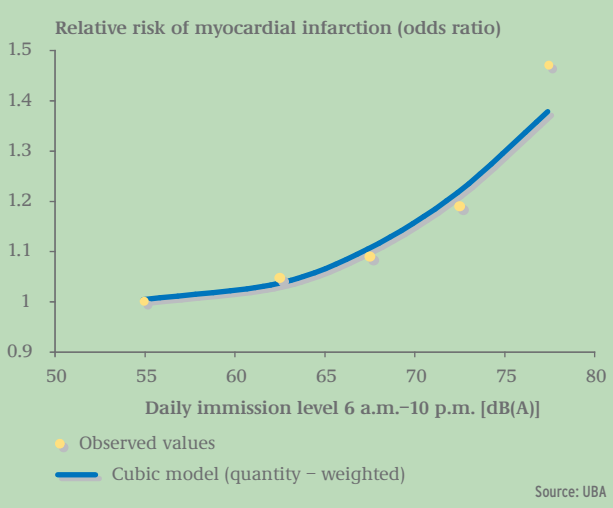


So loud that your heart stops beating

Noise affects the entire organism, with a distinction being made between the effects of noise on the hearing (aural effects) and those impacting outside the hearing (extra-aural effects). The most important extra-aural effects are annoyance, sleep disorders, interference with learning and concentration (which have mainly been investigated in children), and stress-induced metabolic and functional impairments. As a psychosocial stress factor noise activates the hormonal and autonomous nerve systems. Experiments using animals and human short-term exposures have revealed that noise is responsible for an increase in the release of stress hormones, as well as affecting blood flow, blood pressure, heart rate and the pumping properties of the heart. Blood pressure, blood fats, the blood sugar level and blood viscosity are all adversely affected in those who are repeatedly exposed to noise at work or at home. A permanent alteration in these biological risk factors as a result of disturbances to the regulatory system increases the risk of cardio-vascular diseases such as high blood pressure (hypertonia) and ischaemic (produced by a lack of oxygen) heart disease, including myocardial infarction. The autonomous nervous system provides circulatory and metabolic regulation, which is largely an unconscious action. This explains why autonomous reactions also occur during sleep and are experienced by people who claim to have accustomed themselves to noise [10].

Road traffic is the main source of noise, with 60 per cent of the German population claiming to suffer from it. Disturbed sleep can be expected when noise levels outside homes exceed 45 dB(A). Investigations have revealed that daytime noise levels of more than 65 dB(A) and 55 dB(A) at night, measured in front of windows, lead to an increased risk of high blood pressure and myocardial infarction. Around 15 per cent of the German population live on such noisy streets [11]. The UBA has compiled an analysis of current findings on the subject of traffic noise and the associated cardio-vascular risks, producing a dose-effect curve which can be used in preparing a quantitative risk assessment [12]. The findings of this report have been used in various activities by the WHO on the subjects of “Night time aircraft noise” and “Environment-related disease”.

Figure 5: **Dose-effect curve showing relationship between levels of road traffic noise and the risk of myocardial infarction**

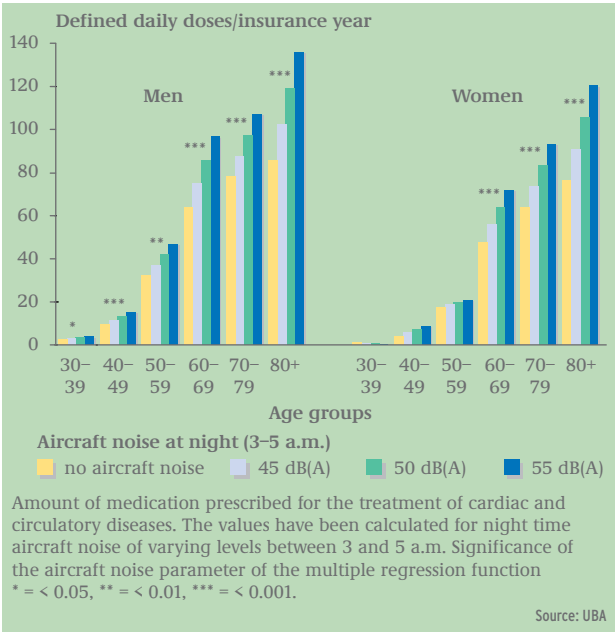


For those affected by it, aircraft noise is particularly stressful because, unlike the noise of road or rail traffic, it can be heard from all sides of a building. The UBA, together with other European research organisations, is currently investigating the influence that the noise produced by aircraft and road traffic has on the blood pressure of those living in the vicinity of six airports [13]. This project, which is supported by the European Union, will be completed in 2007 when its findings will be published.

Those affected by night time aircraft noise visit their doctors more frequently and are also prescribed more medications, according to the findings of an epidemiological study commissioned by the UBA, in which researchers evaluated the health insurers’ prescription data [14]. It was revealed that patients who had been exposed to night time aircraft noise were prescribed significantly higher rates and levels of medication than those living in quiet neighbourhoods. The medications in question were for reducing blood pressure, for the treatment of cardio-vas-

cular diseases, tranquillisers and anti-depressants. The most serious effects of aircraft noise were observed during the second half of the night, and were more pronounced in women than in men. Although the study did not attempt to analyse the causes, it did back up the findings of other investigations, which also showed that aircraft noise can provoke psychological disturbance and cardio-vascular diseases. The health data that are available to the statutory health insurance organisations are of a high quality and, subject to data protection safeguards, provide a significant epidemiological research resource.

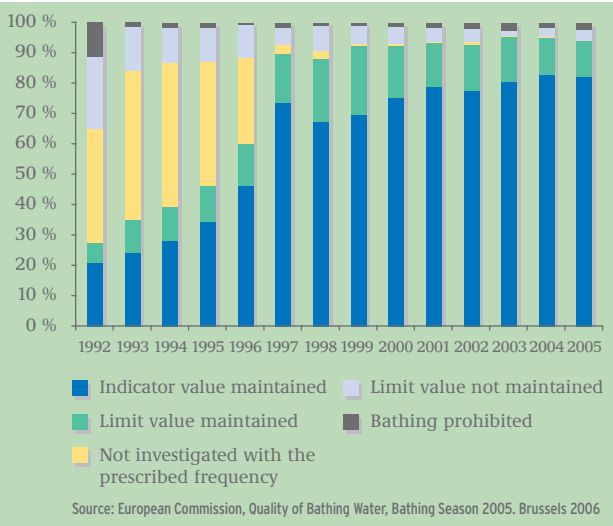
Figure 6: Night time aircraft noise leads to an increase in the amount of prescribed medication



Amount of medication prescribed for the treatment of cardiac and circulatory diseases. The values have been calculated for night time aircraft noise of varying levels between 3 and 5 a.m. Significance of the aircraft noise parameter of the multiple regression function * = < 0.05, ** = < 0.01, *** = < 0.001.

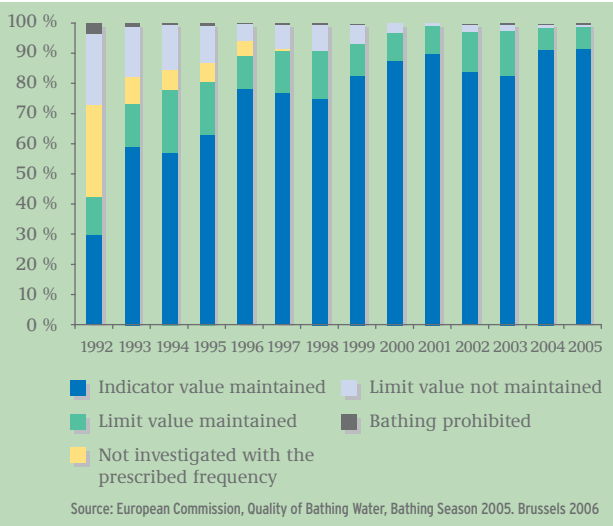
Source: UBA

Figure 7: Quality of freshwater bathing waters in Germany 1992 to 2005



Source: European Commission, Quality of Bathing Water, Bathing Season 2005. Brussels 2006

Figure 8: Quality of coastal bathing waters in Germany 1992 to 2005



Source: European Commission, Quality of Bathing Water, Bathing Season 2005. Brussels 2006

Clean bathing

The European Union issued its Bathing Water Directive for monitoring bathing waters as long ago as 1976 to protect bathers' health. The Directive imposes certain requirements regarding the chemical, physical and microbiological quality of the water. Since then the quality of bathing waters in Germany has steadily improved (Fig. 7 and Fig. 8). In the 2005 bathing season 95 per cent of the bathing waters complied with the quality requirements demanded by the Directive.

The European Commission has taken new scientific findings into account in its revision of the Bathing Water Directive, which entered into force on 24 March 2006 and must now be implemented in German law within two years. The UBA was actively engaged in the revision of the Directive, which includes a research project to investigate the health risks to bathers. The new Directive contains many positive features such as a reduction in the monitoring parameters to include only hygienically relevant indicators, standardisation of the microbiological detection methods, an obligation to identify potential sources of contamination, active steps to control the quality of bathing waters, and lower imperative values for coastal waters. The Directive also requires that the public be comprehensively informed about the quality of bathing water and about the measures being taken to improve water quality.

The revised Directive calls for a change in attitude from passive monitoring to active management of the bathing waters, the aim being to provide better health protection for bathers. The responsible re-

gional authorities are required to produce a so-called bathing water profile for each bathing water with information on physical, geographical and hydrological properties as well as possible causes of contamination. For bathing waters these are: sewage and rainwater discharges and avulsion from agricultural land following rainfall, which can cause faecal contamination and thus present a health hazard to bathers. The bathing water profiles also include an assessment of the risks of a mass proliferation of cyanobacteria or algae. The UBA and the German Länder have prepared recommendations to protect bathers from cyanotoxins (toxins of blue green algae). These recommendations have proven to be an easily manageable instrument for the responsible regional authorities to monitor bathing waters. The newly established CyanoCenter at the UBA provides advice and support for the analysis and health risk assessment of potentially toxic cyanobacteria and for the development and improvement of monitoring programmes and strategies adapted to meet the needs of specific situations [15].

Drinking water: free-flowing, clear and healthy

Drinking water of excellent quality is available from the tap almost everywhere and at any time in Germany, and in seemingly limitless quantities. Over 99 per cent of the population is connected to the public drinking water supply and each year more than 5200 water companies supply 4800 million m^3 of drinking water to households and small businesses. On average everyone in Germany obtains 129 litres daily from the public supply.

Irrespective of whether it is used for drinking, cooking or washing, the quality of drinking water has to be perfect. In Germany quality requirements are regulated by the Drinking Water Ordinance (TrinkwV 2001), which stipulates that drinking water must be clean and palatable, and must be free of pathogens and substances in concentrations that present a concern to health. In its current version the TrinkwV uses 49 parameters to define the quality of water, for which limit values and other requirements (i.e. concerning apperance, odour and taste) are specified. The TrinkwV is supplemented by technical rules laid down by the German Technical and Scientific Association for Gas and Water (Deutsche Vereinigung des Gas- und Wasserfaches – DVGW), the German Institute for Standardization (Deutsches Institut für Normung – DIN) and the Association of German Engineers (Verein Deutscher Ingenieure – VDI), which describe the generally recognized state-of-the-art codes which must be observed along with the limit values.

Because disruptions to the drinking water supply cannot be entirely ruled out, the Drinking Water Ordinance insists on regular surveillance. The monitoring data collected in recent years reveal that the quality of drinking water in Germany is good to very good. Over 99 per cent of the drinking water samples met all the statutory requirements. Our demands for high quality drinking water means that the multiple barriers set up to protect this water from contamination must be continually maintained. Consistent protection of source waters, the removal of any possible contaminants during treatment and the safe distribution of water in domestic plumbing systems too are essential for the supply of pure drinking water.

Domestic installations have a significant influence on the quality of drinking water. All too often incorrectly installed or operated drinking water installations pose health hazards such as legionnaires' disease or an excessive metal content in the water from domestic taps (see also p. 66). The German Environmental Survey of Children confirmed that stagnant samples can contain increased levels of lead, cadmium, copper and nickel if drinking water has been left standing for long periods in the pipes. The UBA therefore recommends that water should not

Drinking water in Germany: clean, in sufficient quantities, at a reasonable cost and constantly available.

be used for human consumption or food preparation if it has been in the pipes for several hours, for example over night. Baby food in particular should only be prepared using water that has been freshly taken from the running tap.

Is that fair?

How are environmental burdens distributed among the various groups of the population in Germany? Might people in low income groups be exposed to more environmental contaminants than the more affluent in their homes and the surrounding areas? These questions are being dealt with in international discussions under the heading of "Environmental Justice". In Germany too there are indications that the burdens resulting from environmental problems are unevenly distributed among the population. For example, poorer people tend to live in cheaper and less attractive districts, often on main arteries with a high traffic density where the residents' health is adversely affected by the noise and exhaust fumes. The UBA is turning its attention increasingly to the socially uneven distribution of environmental benefits and burdens, along with their health implications.

The data revealing whether and to what extent environmental exposures and susceptibility to environmentally induced diseases depend on social factors (such as education, income and professional status), have still not been adequately investigated in Germany [16]. Empirical data are available in particular with regard to traffic-related air pollution, noise and indoor exposure, and on human corporal exposure to contaminants. Research findings have clearly identified links between social factors and environmentally induced contamination [17]. A number of studies into exposure to airborne pollutants, taking readings using a subjective assessment of the pollution or details about the traffic situation in the residential neighbourhood, revealed the consistently higher exposures of people with a low social status [18].

First representative findings from the German Environmental Survey of Children also identified varying levels of exposure to pollutants according to social status.[1] The children with low social status who were examined had a higher concentration of lead in their blood than children of mid-range or high social status (Fig. 9). In contrast children of a higher social status have a significantly greater contamination with polychlorinated biphenyls (PCBs) than those of mid-range or low social status (Fig. 10).

Figure 9: Lead in the blood (3 to 14 year olds) according to social status

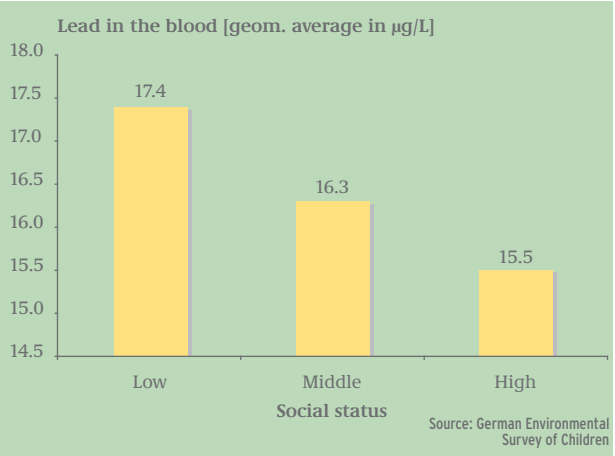
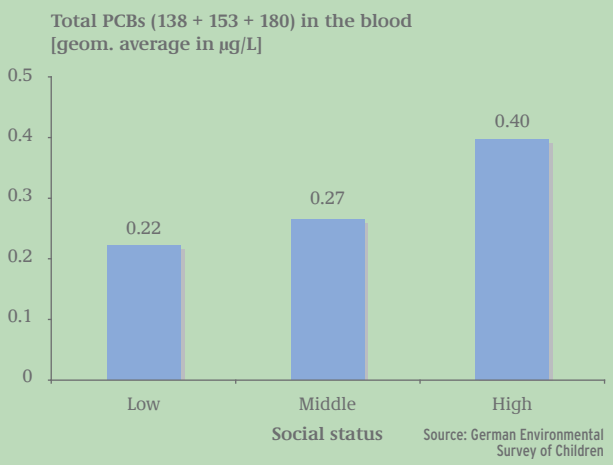


Figure 10: Total PCBs (138 + 153 + 180) in the blood (7 to 14 year olds) according to social status



Studies of environmentally induced diseases also indicate social differences. According to the findings of the German Environmental Survey of Children and Adolescents (2003–2006), for example, girls and boys with a high social status (18.9 per cent) suffer more frequently from allergies than children in the middle social groups (17.8 per cent) or those with a low social status (13.6 per cent) [19].

Although the causes are not known, it is evident that environmental influences cannot be assessed without considering social questions. The principle of environmental justice is that every individual has the right to live in a healthy environment. Conse-

[1] Social status is determined using the 3-stage Winkler Index (upper, middle and lower class), which is made up of the indicators of "education", "income" and "professional standing of the main wage-earner in the family".

quently environmental justice is essential for implementing health-related environmental protection for all groups of the population. The UBA will be devoting greater attention to this subject in future.

Health-related environmental monitoring

The wide range of environmental influences that present a health hazard demands regular and systematic monitoring and assessments of the extent to which the population is affected. The method to give preference to is health-related environmental monitoring, assessing the degree to which the population is subjected to exposure to pollutants and establishing relationships between environmental factors and impacts on health (see also p. 58) The UBA uses two instruments for this purpose:

1. From 2003 to 2006, in the German Environmental Survey of Children the agency examined the environmental exposures to which 1,790 children throughout Germany were subjected. This survey provided the first representative data on children as a potential at-risk group, which can be used as a basis for developing and justifying environmental standards. Because it is not possible to obtain full and precise information about all the forms of pollution to which the public are exposed, estimates produced with the aid of mathematical models are often necessary. Frequently a realistic picture of the pollution situation can only be obtained through a combination of observations (measurements) and estimates. The German Environmental Surveys conducted by the UBA provide an important data base for these estimates.

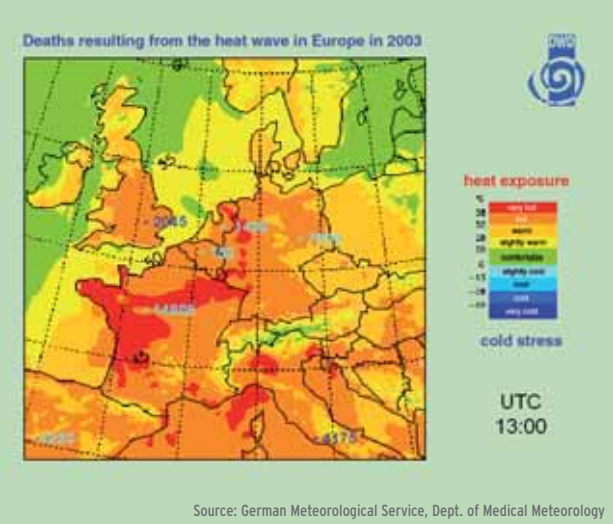
2. The Human Specimen Bank, part of the national Environmental Specimen Bank, holds an archive of samples taken from human beings, which have previously been examined to determine what contaminants they contain. This archive can provide a review of environmental influences extending back many years and may form the basis for demonstrating the development of pollutants whose origins are in the past.

Given the current levels of knowledge and the objectives of environmental policy, the continued development of health-related environmental observations is a necessity.

Warmer, wetter, more extreme – climate change and its consequences

For some time now Europe, and Germany too, have been experiencing storms, flooding and landslips resulting from heavy and continuous rainfall and periods of extreme temperatures. These have a destructive effect on settlements, buildings and protective structures, and on nature itself. The consequences for human health are either felt immediately in the form of injury and death, or less directly in the form of certain diseases resulting from the increased spread of pathogens or from high temperatures. A study in this field from Baden-Württemberg reveals that some 2000 additional deaths (around 7000 throughout the nation) can be attributed to the very hot summer of 2003 [20].

Figure 11: The number of deaths that occurred in Europe in August 2003 was above the expected mortality rate

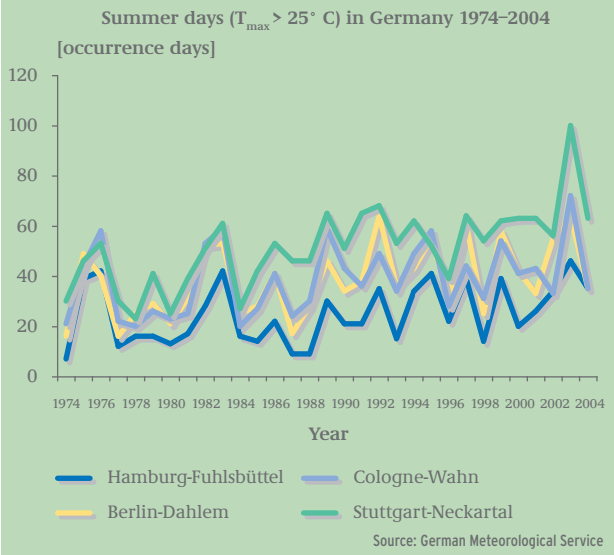


Climate change can also have an adverse impact on environmental conditions and thus, indirectly, on human health. This includes, for example, the combination of local atmospheric pollution and warm weather, which can constitute a significantly higher risk factor for the incidence of (allergic) complaints associated increasingly with air pollutants. These consist mainly of chronic airways diseases accompanied by cough and breathing difficulties. Environmental conditions may also worsen because more frequent forest fires release greater quantities of particles, increased solar radiation leads to the formation of more tropospheric ozone, and the extended pollen season means that the air contains more allergy-causing pollen during a longer period.

Rising temperatures, as we have seen, for example, during the summer in Germany (Fig. 12), provide

more favourable conditions for the spread and transmission of disease vectors such as insects, ticks and rodents. Although there are indications of a widening of the potential distribution zone for malaria in Germany too, the UBA assesses the risk of the spread of this particular disease in this country to be very small because of the hygienic conditions and the high standards of health care.

Figure 12: Summer days in Germany 1974–2004



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INTEGRATED ENVIRONMENTAL PROTECTION – THE BASIS FOR MAINTAINING BIODIVERSITY

Biodiversity refers to the diversity of habitats, the species that inhabit them, and the genetic information which these species carry. Humans are part of this biodiversity and dependent upon it. Among the things that it supplies them with are food, medicines and raw materials. Each year global ecosystems provide important services for mankind with a value of 26 trillion euros [21], which far exceeds the value of all global human production (global national product). However, we not only protect biodiversity because we realise its concrete value to us but above all because we do not know precisely what advantages it can offer mankind. The protection and sustainable use of biodiversity helps to reinforce the stability of eco-systems and keeps the options open for future uses.

The increasing needs of an expanding world population are a threat to efforts to deal carefully with the natural resource of biodiversity. Integrated environmental protection should act to counteract this risk and create suitable conditions to ensure that species can continue to develop in all their diversity and with a high degree of genetic variety. In drawing up environmental policy objectives and sets of rules attention must be given to biodiversity as a vital asset that requires protection, and this applies for example to maintaining the quality of water, the soil and air, and to land use.

The Convention on Biological Diversity (CBD), which was approved during the Conference on Sustainable Development held in Rio de Janeiro in 1992, calls for the protection of biodiversity, as well as regulating the sustainable pattern of its use and fair distribution of the benefits that it provides [22]. By signing this agreement the 188 countries, including Germany and the European Union (EU), as a community of states, have undertaken to bear their share of global responsibility for maintaining biodiversity. One of the main objectives that the EU has set itself is to halt the loss of biodiversity by 2010 [23].

The extent of the losses and the consequences

There has been a dramatic decline in biodiversity around the world. In connection with the 7th Conference of the Parties to the CBD (COP7) in 2004 the European Commission published the following figures [21]:

- Species are dying out between 1,000 and 10,000 times faster than the natural rate of extinction.
- 80 per cent of the forests that covered the earth 8,000 years ago have been felled, damaged or fragmented.

- Up to a third of the world's coral reefs are already damaged and a further third are under threat.
- Over 25 per cent of the land area and more than 900 million people around the world are threatened by continuing desertification and its consequences [24].

Communities of living creatures form a complex network of mutual dependences although, at present, we only have a limited comprehension of how their individual functions interrelate. The ways in which the loss of species impacts on the functions of individual ecosystems and the services they perform for humans have not yet been adequately researched. A long period often elapses between harmful effects and identifiable damage. For example the soil readings taken as part of the work of monitoring forests in Europe are already indicating changes resulting from the deposition of atmospheric pollutants, but one would have to be an expert to recognise the preliminary symptoms such as the emergence of atypical plants, and the loss of leaves or conifer needles.

Causes of the decline in biodiversity

By creating its own basis for life mankind is changing the natural conditions upon which plants and animals depend. Habitat changes cause concomitant changes to the communities of living things. No serious problems arise if the intervention is only slight, or if there are sufficient alternatives and time for these communities to adapt. With the onset of industrialization at the latest mankind, with his many activities, has been effecting such massive changes to the global biochemical cycles (for example those of carbon and nitrogen) that the natural balance of things has been serious disturbed, both globally and in the affected regions. Ecosystems initially act as a buffer against such damage and can also recover, but if the disturbance continues or increases, and although the effects may not be detectable by humans, they can lead to changes (for example, in the form of acidification, climate change) along with restrictions on living conditions and on the species typical of a particular habitat. The main causes for the worldwide loss of biodiversity are:

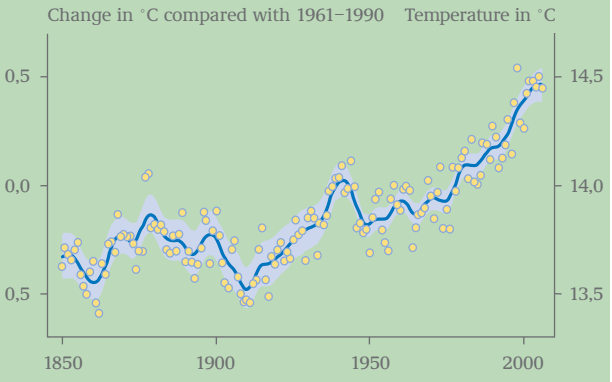
- Climate changes resulting from the release of greenhouse gases produced by the burning of fossil fuels, industrial manufacturing and agriculture, and wide scale changes in land use (deforestation, conversion of marshland and pasture into arable land);
- changes in land usage, the sealing of land areas and fragmentation of the landscape, as well as changes in the structure of natural surface waters (river-straightening, construction of weirs);
- contamination of terrestrial and aquatic ecosystems by nutrients and pollutants from agriculture, industry and transport.

These stress factors form the main themes with which the UBA is participating in the "National Biodiversity Strategy" under the leadership of the Federal Ministry for the Environment and the Federal Agency for Nature Conservation [25]. This strategy formulates quality objectives and targets for action in the national effort to implement the agreement on biodiversity, and it addresses all the different options for action and those involved in such action. It includes environmental protection objectives, which incorporate biodiversity as a resource worthy of protection. The stress factors are closely interlinked with one another and produce a feedback effect. For example, large deposits of nitrogen can further exacerbate the water shortage in forests produced by climate change. Measures must therefore transcend individual media and sectors in order to be effective.

Climate change – palm trees in Germany?

Together with local factors such as the type of soil, water regime, exposure, ancillary chemical conditions and the extent of human interference, the climate has a substantial influence on all aspects of biodiversity (at various levels such as genes, organisms, species, populations and ecosystems). Fig. 13 clearly shows the change in temperatures

Figure 13: Change in global temperatures since 1840



Observed change in average global surface temperature. Changes in temperature (left axis, line and T-area) refer to the average temperature for the period 1961-1990. The smoothed curve indicates the ten-year mean, the yellow dots (right axis) show the yearly mean.

Source: IPCC

since 1840. It reveals that global warming of several tenths of a degree has occurred in recent decades, amounting to approximately 0.74 °C between 1900 and 2000. The predicted rise of 0.4°C over the next two decades will not allow sufficient time for some flora and fauna to adapt and is likely to lead to severe damage and losses for many ecosystems [26].

Benefiting from climate change, many species from other regions are establishing themselves, in some cases drastically affecting the range of species in various habitats. In combination with drier conditions, the mass reproduction of warmth-loving species will further damage the ecosystem of the forests. Although some of us might consider a Mediterranean type climate in Germany and palm trees on the Baltic as an advantage in tourist terms, this could also result in the loss of certain species of animals and plants which currently form part of a stable nutritional network. The stability of ecosystems which fulfil an important service for the human race, providing cultivated species and medicinal plants, is under threat. Climate change is accompanied by a reduction in precipitation (with dry summers in particular), which poses a particular threat to those rural ecosystems (including agro-ecosystems) which are dependent on the level of the groundwater table, such as floodplain woodlands and water meadows.

The types of trees commonly found in our woodlands such as larch and beech are less resistant to the stresses produced by dry periods as a consequence of climate change. Adapting the way the land is managed, for example in forestry and arable cultivation, can help to alleviate the situation. There is, however, no alternative to a reduction in energy consumption and the use of renewable forms of energy for reducing the emission of those gases which harm the climate. During Germany's presidency of the Council of the EU agreement was successfully reached to achieve further reductions in the EU after 2012, and Germany now has until 2020 to cut its greenhouse gas emissions by 30 per cent compared with the 1990 level (see also p. 51).

Planting trees is an important way of absorbing carbon dioxide, which is why the Kyoto Protocol also gives consideration to the planting of trees as a means of increasing the net carbon assimilation by the biosphere [27]. However, it should be remembered that greenhouse gases also have a direct and adverse impact on animal and plant organisms. For example, carbon dioxide is already helping to create acidification of the seas, which damages calcium-forming species such as corals.

In addition to a reduction in emissions of greenhouse gases, the UBA is also committed to finding strategies for adapting to climate change where its effects are no longer avoidable. A study has recently been compiled in Germany about known adjustment measures for promoting biodiversity, and these include water regime concepts for threatened wetland areas and environmentally suitable concepts for use in agriculture and forestry, as a means of providing space for the various processes taking place with ecosystems [28]. Another project provides a systematic investigation of the impact of climate change on water management at a European level [29]. The findings of this project have immediately been included in the preparations for the symposium "Time to Adapt! Climate Change and the European Water Dimension", which was held by the Federal Ministry of the Environment, together with the General Directorate Environment of the European Commission, during Germany's presidency of the Council of the EU, and focused on adjustments in various sectors (water management, agriculture, inland shipping, the electricity industry, tourism) to the effects of climate change on the water regime. As a result of the UBA workshop on "Climate change – challenges facing soil protection" in 2006 the UBA launched a research project summarising the changes to the climate and their impact on the quality and functions of the soil, for which suitable adaptation strategies were proposed [30].

Measures to adapt to climate change in order to maintain biodiversity also form part of the "German strategy for adjusting to climate change", due to be completed by 2008, and on which the federal government is working under the leadership of the Federal Ministry for the Environment. The UBA has set up a Competence Centre on Global Warming and Adaptation (KomPass), which is systematically processing all the relevant information, which will then be made available to decision-makers [31].

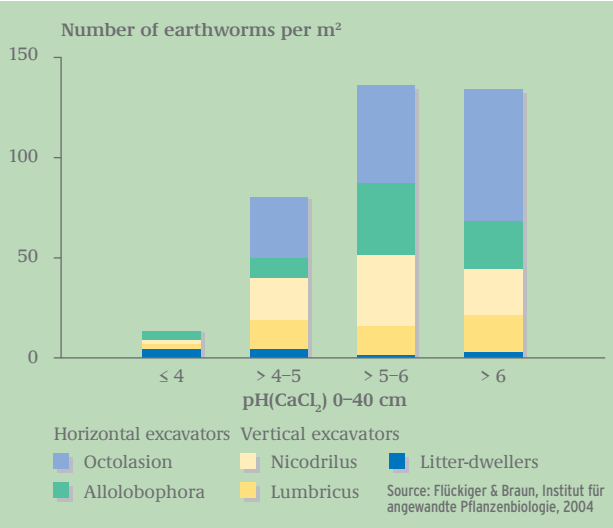
Protecting ecosystems by means of trans-border clean air measures

Back in the 1970s the death of fish in Scandinavian lakes and dying trees elsewhere in Europe revealed the effects on the biodiversity of aquatic and terrestrial ecosystems as a result of atmospheric pollutants carried over long distances. These were the result of the acidification and eutrophy produced by compounds containing sulphur and nitrogen from industry, transport and agriculture.

Deposits of nitrogen and sulphur cause acidification of the soil, the discharge of basic reactant nu-

trients (magnesium, calcium, potassium) and restricted conditions in the soil chemistry, leading eventually to adverse changes in soil diversity. Most soil organisms are dependent on specific areas of acidity (pH areas) where they can satisfy their requirements for nutrients. Deep-burrowing earthworms cannot survive if the pH value drops below 4 because this causes the soil to release toxic aluminium. No "ecological replacement" exists for earthworms, and without their activities, turning over the soil and helping with decomposition, many oxygenating and humus-forming processes would cease. Fig. 14 shows the number of earthworms, which are vital for various processes in the soil, as a function of the degree of acidity. The acidity limit for deep-burrowing earthworms corresponds roughly to the threshold value for toxic effects on tree roots. These are based on the so-called critical loads for acid.

Figure 14: Number of earthworms as a function of soil acidity



Critical loads are the permanently tolerable rates of material deposition and are determined by the typical local properties (climate, soil parameters, vegetation) of the ecosystem under consideration. According to current knowledge, if they are not exceeded over an extended period, no damaging effects occur to the structure and function of the observed ecosystems. However, if they are exceeded over a longer period this is an indicator of harmful effects on the ecosystem. However, it may take several decades until ecosystems react in an identifiable way to overruns of critical loads. Even if a lower deviation occurs later to permanently tolerable deposition rates it may take hundreds of years before the status values of the affected ecosystem return to the original level. European air purity and biodiversity policy utilizes critical loads as environmental quality targets.

The increased presence of nitrogen as a by-product of agriculture, cattle farming, transport and industry is one of the most powerful underlying causes of a loss of biodiversity. Under natural conditions the presence of nitrogen inhibits plant growth. Long-term increases in the deposition of nitrogen from the air alters the balance between nitrogen and other nutrients (such as magnesium, phosphorus and potassium) in the soil, and this affects their balanced absorption by plants. This imbalance in the nutritional state of the ecosystem results in reduced tolerance to short-term disturbances or stress (frost, drought, pests). In communities of plants, such as forests, individual species capable of more rapidly converting nitrogen into growth may displace others which have become adapted to conditions of low nitrogen.

Changes in the range of species at a particular location interfere with the functioning of the ecosystem. Thus the massive proliferation of grasses and shrubs that results from excessive nitrogen in forests can mean that there is insufficient water to meet the needs of stands of trees. In areas that already experience low precipitation (for example, north-eastern Germany) this can exacerbate the consequences of climate change on the supply of water to trees and the formation of groundwater.

International efforts to reduce emissions have been introduced in response to long distance, transboundary transport of the relevant atmospheric pollutants. Mention should be made in particular of the Geneva Convention on Long-range Transboundary Air Pollution [32]. This convention adopts an effects-based clean air policy, using critical loads as environmental quality objectives with reference to ecosystems and materials, in order to determine maximum national emission levels. The UBA chairs the international working group which determines the methodology for the critical loads and their application, compiles data and prepares it for inclusion in clean air policy [33]. The EU bodies with responsibility for implementing the agreement on biodiversity have proposed that exceeding critical loads should be adopted as a specific indicator of the loss of biodiversity [34].

Measures that have been undertaken as part of national and international clean air policy in recent decades have enabled significant reductions in the deposition of sulphur to be achieved. However, this

Stand of pines in north-eastern Germany, without any evident signs of nitrogen pollution.

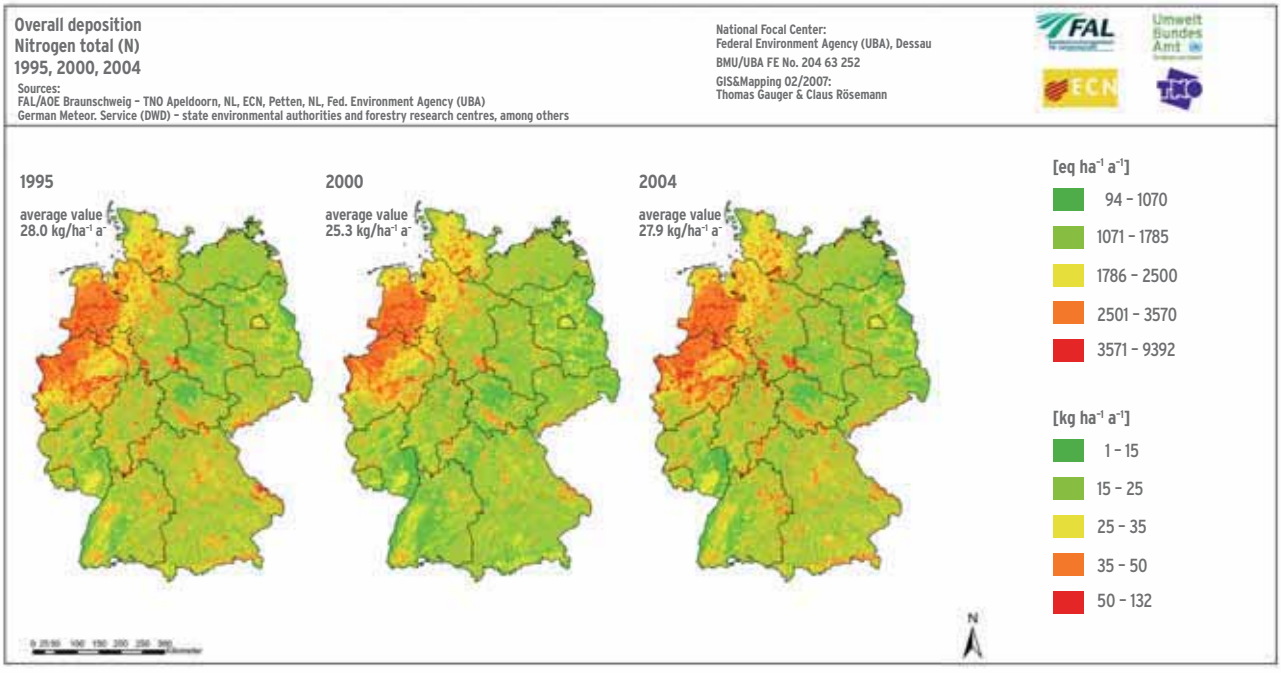
Thick undergrowth of elder and other plants as a result of increased deposits of nitrogen.

success has not been duplicated in the case of nitrogen, especially where livestock farming is concerned, and there has been only an insignificant decline in this type of pollution in recent years [15]. The critical rates of deposition of nitrogen compounds continue to be exceeded across a wide area, largely due to the amount of ammonia produced by domestic livestock. Various steps need to be taken, including limiting the numbers of cattle, along with technical measures such as reducing the emissions of ammonia from livestock sheds, storage and the amounts spread on the land.

Intelligent land management: a way out of concrete and asphalt

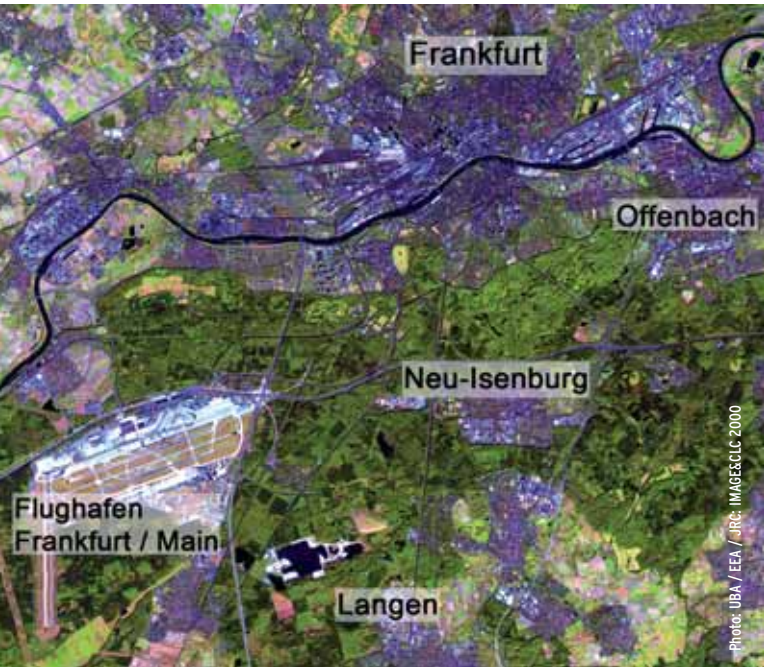
Germany makes extensive use of its land resources, and not only as a location for buildings. Under each square metre of land surface which is being used for settlements or transport purposes lies one cubic metre of soil with all its organisms and natural fertility. Any use of land for settlements, industry or transport destroys natural habitats and the routes used by the creatures that live there, endangers or destroys important natural functions of the soil and

Figure 15: Overall deposition of nitrogen in 1995, 2000 and 2004



its diversity. For many years the trend has been to develop construction sites on the outskirts of towns, and this increases the pressures on the environment as a result of traffic, for example in the form of noise and pollution.

Significant impairments to biodiversity are produced as a result of the fragmentation of natural areas by transport routes (see Fig. 16). Increasing fragmentation, leading to the creation of small "islands" of land, means the loss of the space needed to accommodate populations and communities of wildlife, species and genetic diversity, and of the accompanying opportunities for genetic exchange within these species. Those animals for which a large territory is essential, such as birds of prey, martens, wild cats, otters and red deer, need unfragmented areas with little traffic.

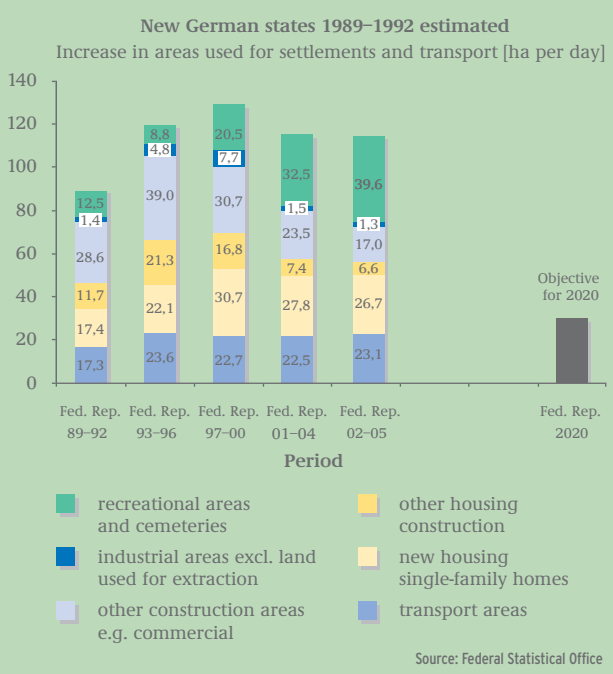


Satellite photo of land fragmentation around Frankfurt am Main.

In November 2006 the Federal Statistical Office [36] published figures on the development of areas occupied by settlements and transport: between 2002 and 2005 the average increase was 114 hectares (ha) per day, the equivalent of some 160 football pitches, and this mostly occurred at the expense of agricultural areas. Compared with the four-year averages of 115 ha/day from 2001 to 2004, and 129 ha/day for the period 1997 to 2000, there has only been a slight slowdown in the rate at which new land is being used. One of the objectives of the German government's sustainability strategy is to reduce the amount of new land being used to 30 ha per day by 2020, but Germany is still a long way off this target.

In order to achieve a fundamental change the various regional planning, legal and economic instruments must be developed further and appropriate measures must be adopted.

Figure 16: Daily increase in areas used for settlements and transport – the causes and those responsible



The UBA is developing suitable strategies, measures and instruments to conserve land areas, protect the soil and limit the amount of sealing and fragmentation of land (see box). In order to safeguard biodiversity in more densely populated areas and on the outskirts of towns the UBA recommends retaining not only large, unfragmented areas in excess of 100 km² but also a number of smaller unfragmented areas (exceeding 64 km²) and, taking an overall view of Germany, to impose limits on mid-sized fragmentation.

Initiatives undertaken by the UBA in 2006 for intelligent management of land areas or which it supported with technical articles:

- Publication and dissemination of data and facts on the development of settlement areas: http://www.env-it.de/umweltdaten/public/theme.do;jsessionid=3B426894C2504B1A778EA9BB5AE0DEFD?nodeIdent=2479
- Further development and the application of indicators for landscape fragmentation [37], in

particular that of "effective grid size" [38] as a measurement of average land fragmentation at national and state level, as an improved quantitative means of registering development trends;

- Proposals for municipalities and regions on inner city urban development
  Andreas Troge: Die Schätze der Städte sichten und bewerten *(Viewing and evaluating the treasures of the cities)*; in: "Diskurs kommunal 2006: Der Stadt Bestes finden – Wer rettet unsere Städte jetzt?". Konrad-Adenauer-Stiftung – Politik und Beratung, page 83:
  http://www.kas.de/db_files/dokumente/7_dokument_dok_pdf_8571_1.pdf
  Thomas Holzmann: „Demographischer Wandel und Umweltwirkungen". Paper given on 8 November 2006 at the conference "Älter, weniger, weiter weg – Demographischer Wandel als Gestaltungsaufgabe für den Umweltschutz" in Berlin:
  http://www.nachhaltigkeits-check.de/cms/upload/061108-VortragHolzmann(UBA).pdf
- Abololition of the home-owners' subsidy, reduction in the commuting allowance: "Wie viel Erde braucht der Mensch – wie viel Ressourcen darf der Mensch in Anspruch nehmen?" *(How much land do people need – how many resources should they be allowed to use?)*
  Speech by the president of the Federal Environment Agency on 11 July 2006 in Dresden:
  http://www.umweltbundesamt.de/uba-info-presse/reden/ressourcen.htm
- Articles on the attention given to soil protection objectives in planning and approval procedures. Position paper produced jointly with the German Farmers' Association DBV:
  http://www.umweltdaten.de/publikationen/fpdf-l/3066.pdf

Integrated soil protection: not only gaining land but also restoring fertility to the soil

"A single gram of soil contains billions of micro-organisms such as bacteria, fungi, algae and single-celled creatures. Beneath one square metre of soil live hundreds of thousands and even millions of creatures such as threadworms, earthworms, mites, woodlice, springtails and insect larvae (see Fig. 17, p. 23). Extrapolated to give a figure for one hectare we arrive at a live weight of some 15 tonnes, or the equivalent of some 20 cows. It is therefore evident that far more organisms live in the soil than on it!" [39]. All soils have their own characteristics, which provide a habitat for a multitude of plant communities, animals and soil-dwelling micro-organisms. Soil diversity is therefore a significant factor in biodiversity.

The various pressures on the soil, such as deposits, erosion and soil compaction, deprive it of organic substances. "One gram of soil in good condition may contain up to 600 million bacteria from between 15,000 and 20,000 different species. In desert areas these figures decline to one million bacteria and between 5,000 and 8,000 species" [40].

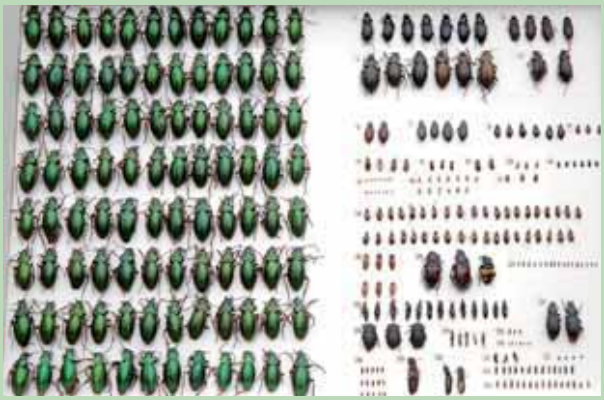
The climate also has a significant influence on the typical composition at a particular location, as well as on the quantities of organic matter in the soil. Soil flora and fauna that is typical of a particular locality helps to ensure the stability of soil functions and structures. Through their metabolic products soil organisms produce soil aggregates, which ensure the viability of the soil. In addition to living organisms other components in the organic substance of the soil are provided by organic material such as the remains of roots, leaves, excrement and humus. Humus is produced by the decomposition of organic matter in the soil, as a result of the metabolic action of soil organisms. Either directly or indirectly these contribute to maintaining soil quality and ensuring continued plant production. As provided by the Federal Soil Protection Law (BBodSchG) [41], one of the objectives of good agricultural practice is to maintain levels of humus consistent with the locality and the type of farming being practised there.

Intensive agriculture presents a risk to biodiversity

Covering 53 per cent (18,932,000 hectares) of the total surface area of Germany, agriculture has a widespread influence on the balance of nature [42]. Whereas traditional farming methods used to fulfil an important function in creating and maintaining the diversity of species, today's intensive agriculture poses risks to biodiversity for a number of reasons:

- Increased deposits of materials as a result of the use of fertilizers and pesticides, compost and sewage sludge;
- damage to the soil through erosion and compaction;
- restrictions on crop rotation, leading to fewer types of plants being cultivated, or more extensive monoculture;
- the use of areas that had been left fallow for long periods, or fringe biotopes, open land or wasteland for the cultivation of renewable raw materials.

Figure 17: Fauna with a body measurement in excess of 2 mm which crosses an area of 1 m² in 1 day



a) Activity density of fauna in the surface soil on winter wheat fields – clay soil
1 July 1950/51. Location: vicinity of Kiel

b) Activity density of fauna in the surface soil on winter wheat fields – clay soil
1 July 1985–1995. Location: vicinity of Kiel

Material, compilation and photo: Prof. Dr. B. Heydemann, 19258 Nieklietz

The production of renewable raw materials and their range of uses are constantly expanding. In the early 1990s less than 300,000 hectares were under cultivation for this purpose, compared with around 1.56 million hectares in 2006, which is 13 per cent of the total arable area in Germany. So far the main crops have been oilseed rape and maize. However, the cultivation of maize presents an increased risk of soil erosion because planting takes place early in the year and the soil does not receive any protection from the leaves until quite late in the year. Unless precautions are taken, such as mulching or undersowing (grasses) between the rows, the protection against erosion is often inadequate.

A potential area in Germany of an estimated two million hectares exists (in the medium term), rising to four million hectares in the longer term. Because of the encouragement being given to renewable energy production as a means of helping to protect the climate, there is a danger that more farming enterprises will switch from the production of food and livestock feeds to growing plants for energy purposes over the next few years, and that such cultivation will be extended to previously fallow or uncultivated areas. This trend could have negative implications for local flora and fauna.

However, the use of renewables to provide energy and materials offers genuine opportunities for reducing greenhouse emissions and for protecting finite fossil resources. As a substantial component in the renewable energy mix, renewable raw materials could make a significant contribution to combating climate change and the loss of biodiversity that this implies. However, integrated environmental protection solutions are needed to avoid a conflict of objectives. For this reason the UBA is preparing a strategy for the sustainable production and use of biomass. Using research and its work as a member of various associations it is supporting the development of international sustainability criteria which also incorporate the effects on soil biodiversity of cultivating renewable raw materials.

The EU also acknowledges the value of biodiversity in its Common Agricultural Policy. Since the most recent reforms were approved, the receipt of direct payments has been made dependent on, among other things, good professional practice (cross compliance). Member states can also pursue more far-reaching, specialized objectives, and in particular the safeguarding of biodiversity, with the aid of agri-environmental schemes. These are financed by the Agricultural Fund for the Implementation of the EU Rural Development Regulation (ELER), and also supported by the German federal and state authorities within the framework of the joint initiative known as GAK (Improvement of the Structure of Agriculture and Coastal Protection).

In 2001 the European Commission approved a plan of action for maintaining biodiversity in agriculture, in order to identify, avoid or eliminate the causes of a substantial decline or loss of biodiversity [43]. This plan of action has been set up in association with other international efforts, especially the agreement on biodiversity. It attaches great importance to providing support for farming practices that help to protect the environment, in order to preserve the environment and rural habitats, as well as Europe's rural heritage.

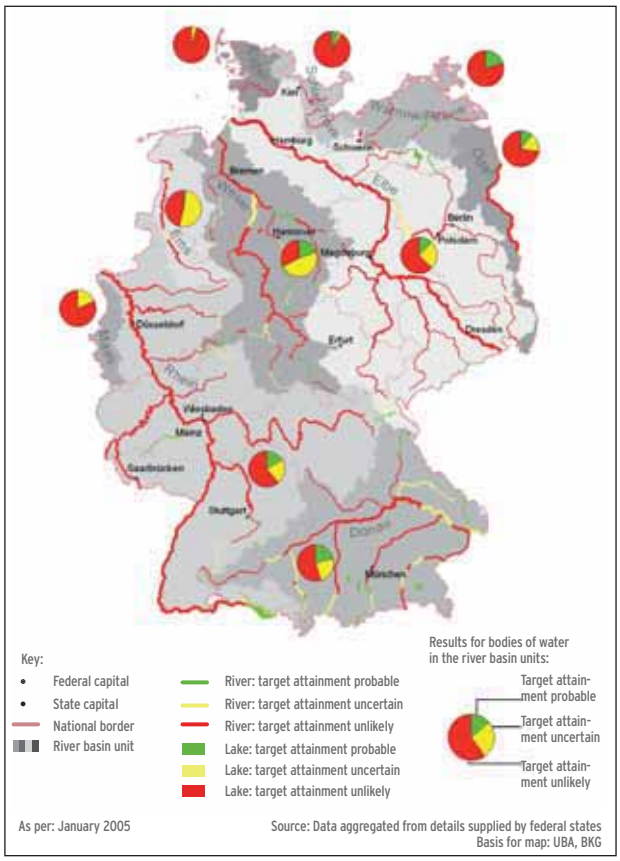
The good ecological state of surface waters: a guarantee of biodiversity

There are over 60,000 weirs in Germany, and on average one intersects a river or stream every two kilometres, preventing many fish from migrating and spawning. Moreover fish no longer encounter the natural diversity of gravel, sand and mud and typical aquatic plants, insects and shellfish, because waterways have been straightened and dredged to enable the banks to be settled and managed, and to provide sufficient depth for boats. And there is another factor affecting lakes and rivers: an excess of nutrients, especially from agriculture, which leads to a proliferation of algae, causing lakes to rapidly dry up and coastal waters to atrophy. The EU Water Framework Directive (WFD) of 2000 calls for all these issues to be addressed and to achieve good water conditions by 2015. With the WFD biological assessment standards for aquatic ecosystems have been introduced for the first time.

Taking stock of the WFD initially at the end of 2004 revealed how much progress has been made in maintaining the chemical purity of surface waters but it also showed some ecological deficiencies and their causes (see Illlustration.18). Without the implementation of additional measures it would be impossible to achieve good conditions in 62 per cent of Germany's rivers, and there would be uncertainty about a further 26 per cent. This can be attributed above all to hydromorphological pressures. The findings look somewhat better in the case of lakes, where additional measures are essential for 38 per cent, and may also be necessary for a further 24 per cent. The condition of transitional and coastal waters is far worse, with 91 per cent requiring additional action. In these waters nutrients are the main pollutant [44, 45].

For rivers and lakes the FWD introduces new assessment yardsticks based on their biodiversity and natural state: their ecological condition. The classification is explained in an EU guideline which has been prepared by the Group for the Common Strategy on the Implementation of the FWD under the leadership of Germany (UBA) and the United Kingdom [46]. It states that the potentially natural state should serve as the yardstick for assessment in Germany. Although this takes in irreversible changes from the past, such as the creation of clay soils in water meadows, it does not include changes due to the erection of buildings, for example. Slight deviations from what are considered good conditions are permissible (see Fig. 19, p. 25). A total of 51 types of aquatic habitat have been defined in Germany. In 2006 the Essen-based environmental organization

Figure 18: Findings of the categorization assessments according to the ecological condition of rivers and lakes in Germany



Umweltbüro was commissioned by the federal states and the UBA to develop profiles for the 25 different types of flowing water, with their specific abiotic (e.g. substrate) and biological (e.g. invertebrate fauna) characteristics [47]. Assessment methods are now available for almost all of the biological components required by the FWD (see Fig. 20, p. 25). Development work on the method for assessing invertebrates in moving waters that was commissioned from Essen University by the UBA was completed in 2006 [48].

Biological criteria are not yet an integral part of the measures to protect groundwater. So far these have concentrated on chemical and quantitative parameters (for example the concentrations of nitrates and pesticides) and a statement of water resources. Additional research will be required in order to develop criteria for assessing and protecting groundwater ecosystems. This was also formulated in the New Groundwater Directive (2006/118/EC), which was approved at the end of 2006. In 2006 the UBA organized expert discussions about the biological assessment of groundwater ecosystems and initiated a research project in order to ascertain the reference conditions [49].

Figure 19: Calculation of the ecological condition of waters in accordance with the FWD

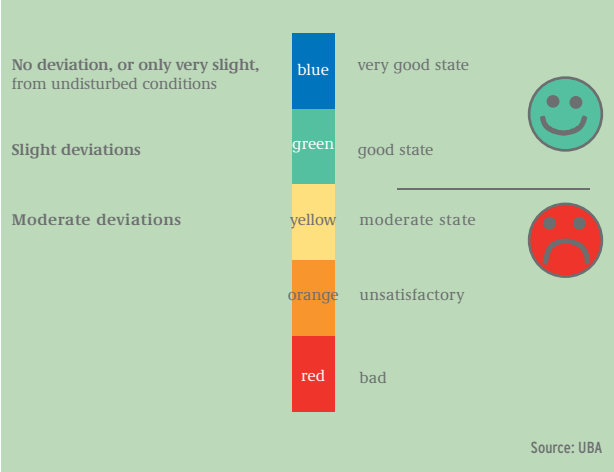
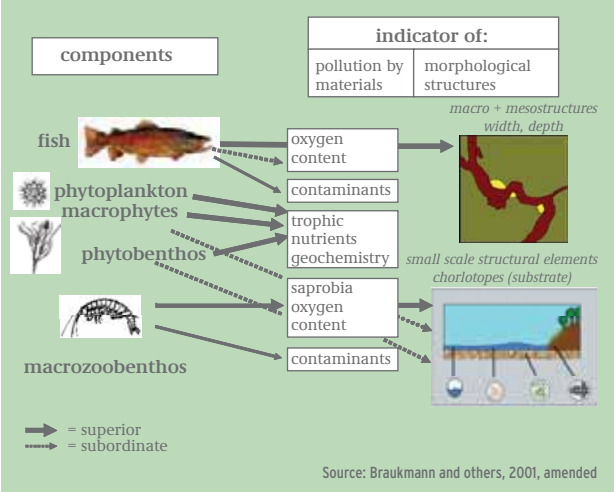


Figure 20: Biological components of the ecological condition and the stresses that they indicate



Eutrophication in rivers and lakes has until now been assessed in particular by examining the nutrient content, and in the sea by also recording the impact on ecosystems (algae populations, oxygen content and higher organisms). The UBA has contributed to the establishment of EU guidelines which now unify the approaches to be adopted with the EC Directive on nitrates and municipal sewage and the conventions for the protection of the oceans, OSPAR and HELCOM, which take as their basis the FWD [50].

The relevant authorities must now select effective and economical measures in order to achieve the objectives laid down by the FWD. The UBA issued a handbook for this purpose in 2004 [51]. It has since been supplemented by more recent work carried out by the agency:

- The EU guidelines describe the political and technical possibilities for improving the hydromorphology in harmony with hydro-power, shipping and flood protection [52]. Germany (UBA), in association with the United Kingdom and the EU Commission, is heading this work.
- The brochure "Landbewirtschaftung und Gewässerschutz" *(Land Management and Protection of Surface Waters)* indicates some effective, economical and to some extent profitable possibilities [53]. The UBA has commissioned the Wuppertal Institute for Climate, the Environment and Energy, together with the Board of Trustees for Technology and Building in Agriculture, and the Research Society for Agricultural Policy and Agrarsociology to investigate the effectiveness of political and technical measures in agriculture [54].
- A consortium headed by the University of Karlsruhe has been appointed by the UBA to produce management tools for calculating nutrient deposits in surface waters by the end of 2007 and has developed appropriate scenarios for action [55].
- The UBA itself has prepared concepts and measures for reducing deposits of pollutants in surface water, and especially for materials to which the FWD has given priority [56].

With its own strategy the European Commission is striving to improve the protection of the oceans. The ecosystem approach forms the main component of the strategy, whereby all relevant qualitative biological elements of the marine food network are to be observed and assessed with the aid of ecological quality targets. What is new about the ocean strategy is that it incorporates protection with the utilization of the ecosystem that is the sea. This necessitates placing areas which were previously studied in isolation, such as shipping, fisheries, offshore energy, protection of the seas and the development of coastal regions, in a context that incorporates utilization and protection (see also p. 61).

Biodiversity in materials policy

There are some 100,000 chemicals on the market, but so far only a quarter of them have been investigated to determine their toxicity to animals and plants. A small number, for example pesticides, are used specifically and openly in the environment. However, the release of the vast majority of them into the environment is an undesired side effect of their production, use or disposal. Because of these differences it is necessary to have specialized statutory regulations for individual groups of materials in order to reduce the environmental risks posed by

the deposition of chemicals to an acceptable level. However, environmental observations of the effects of polychlorated biphenyls (PCBs) or organo-tin compounds on aquatic animals reveal that this is not always adequately achieved and that further efforts are needed. Using pesticides as an example, the following section explains how the UBA, as the relevant assessment authority, acts to protect biodiversity, and what additional questions arise in making risk assessments.

Pesticides require a comprehensive assessment of their environmental risks due to the fact that their harmful effects are not confined solely to specific types of target, and because of their wide scale, intensive use in agriculture. The UBA withholds its approval or insists on certain conditions on the use of a particular chemical if unacceptable effects on the balance of nature cannot be excluded with a sufficient degree of reliability. This also implicitly includes biodiversity, which is should be seen as an integral part of the environmental protection objectives specified by the Plant Protection Law. The UBA is committed to ensuring that biodiversity, as an asset deserving of protection, is firmly anchored in the Plant Protection Law. This would facilitate the work of informing the public about this interdisciplinary subject.

The eco-toxicological assessment in accordance with the Plant Protection Law adheres to the so-called proxy principle, which means that the effects of substances are assessed using only a few standard types which are kept in laboratories, or with the aid of model communities of organisms. “Uncertainty factors” are therefore needed in order to adequately take into account any remaining doubts about the representative nature of the types tested and the degree to which the findings can be adopted to meet conditions in the field. The results of tests carried out at the UBA’s facility known as the FSA, which is used for simulating conditions in still and flowing water, confirm that uncertainty factors are indispensable when preparing a risk assessment for substances [57].

In principle the established assessment system also acts to ensure the protection of biodiversity by protecting all populations of non-target species. However, despite ongoing development of the assessment procedure by the UBA the system still has certain shortcomings. For example, indirect or cumulative effects of pesticides on biodiversity are not adequately covered by current assessment concepts. Indirect effects derive, for example, from the removal of excessive amounts of weeds growing on arable land using so-called broadband herbicides. This is because it deprives many animals in the food chain (such as yellowhammers and partridges) of a source of food and thus threatens the basis for their existence. It is known that the intensive use of insecticides also produces harmful, indirect effects via the food chain. It is therefore necessary to take an integrated view of the impact on biodiversity.

Each year 35,000 tonnes of active pesticide ingredients are applied to arable land and to fruit and vegetable cultivation in Germany.

Where animals and plants in the wild are exposed to excessive amounts the UBA only favours granting approval for the use of pesticides subject to the imposition of certain restrictions on their use. Restrictions requiring a certain distance to be maintained from lakes and rivers or bordering biotopes are the customary means of protecting neighbouring areas against drift or run-off. The restrictions on the distance to be maintained may be relaxed if farmers use drift-reduced spraying equipment. Users often consider these restrictions to be too extensive and complicated and moreover it is difficult to monitor whether they have been adhered to. Previous observations have now been supported by a project that has recently been completed by the UBA, revealing that, in practice, farmers often do not comply adequately with these restrictions. Monitoring data obtained from the nationwide pesticide monitoring programme carried out by the federal states also shows frequent failures to maintain the required distances from waterways and lakes [57a].

The agency is currently working together with other authorities to create a new assessment approach that would enable particularly endangered areas to be identified by using analyses of the land. Local

measures such as the creation of protective structures (hedges, for example) or strips of land bordering surface waters, can be used to reduce the risks at sensitive sites with an accompanying relaxation of nationwide restrictions on pesticide use. At the present time, in a number of studies, the UBA is assessing the viability of such approaches to the approval of pesticides.

In other areas of chemical legislation, as they apply to biocides and medicine, for example, the UBA, as the responsible assessment authority, bears the main responsibility for protecting the effectiveness and correct functioning of ecosystems and biodiversity against unacceptable deposits of chemicals. With the implementation of the new "REACH" regulations a standard test for determining the environmental properties of numerous industrial chemicals in common use as now been linked with this process for the first time. The serious lack of information about the environmental properties of these substances has now been remedied, improving the possibilities for early identification and thus for regulating those substances which present a particular environmental hazard. Prominent examples such as the notification of ecological risks presented by certain anti-fouling coatings or by hormonally active chemicals reveal the necessity for an integrated, care-based assessment of substances for chemicals in all areas, thereby avoiding any damage to biodiversity.

Strategies and programmes

The examples show that the protection of biodiversity can only be successful if the instruments of traditional nature conservation, i.e. the protection of species, and the identification and interlinking of protected areas, are augmented by those provided by integrated environmental protection. For example, atmospheric pollutants also impact on nature conservation areas. Moreover most biological resources are to be found outside these areas and consequently many of the traditional instruments of traditional nature conservation cannot be applied.

The examples described in this chapter indicate that further efforts are needed in order to

- ensure that biodiversity, as an asset in need of protection, is established even more firmly in those areas of environmental legislation where it has not previously received sufficient consideration,
- create greater public awareness that all natural resources, including biodiversity, are finite and must therefore be protected.

For this legislative period and during its presidency of the Council of the EU in the first half of 2007 the German government made the protection and preservation of biodiversity one of its main priorities and implemented the objects of the agreement through its "National Strategy on Biodiversity". This strategy addresses objectives, in terms of environmental quality and action, which are intended to protect biodiversity and which have already been established in environmental legislation or are the subject of proposals. The UBA certainly welcomes the fact that the strategy gives particular importance not only to climate change and the demand for land, but also to the loss of biodiversity produced by nutrients and pollutants. For example it is updating the sustainability target for the total nitrogen surplus for German agriculture and proposes an annual figure of 50 kg per hectare as a nitrogen surplus target on arable land by 2020. The UBA is working together with the Federal Agency for Nature Conservation to prepare a biodiversity strategy. It is essential to include other political areas and other players, such as planning authorities and companies, in order to attain these objectives.

Germany is hosting the 9th Conference of the Parties to the Convention on Biological Diversity, to be held in Bonn from 14 to 30 May 2008. One of the particular challenges will be to show how, with their current high consumption of natural resources, the industrialized nations can take steps to ensure the sustainable use of the natural basis for life in order to attain the objectives laid down by the convention, which are to halt the loss of biodiversity by 2010. One of the main themes of the convention involves the worldwide protection of forest ecosystems and an equitable way of balancing the advantages deriving from its use. For the less developed nations this implies a responsibility for halting the deforestation of the tropics, since it is forests that provide the habitat for over half of all existing species. At the same time the wealthy industrialized nations account for around 60 per cent of all global emissions of greenhouse gases. With the themes referred to above the UBA is also involved in the public discussions about protecting biodiversity and will be taking part in the 9th Conference of the Parties to the Convention on Biological Diversity next year in Bonn.

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USING RESOURCES – PROTECTING RESOURCES

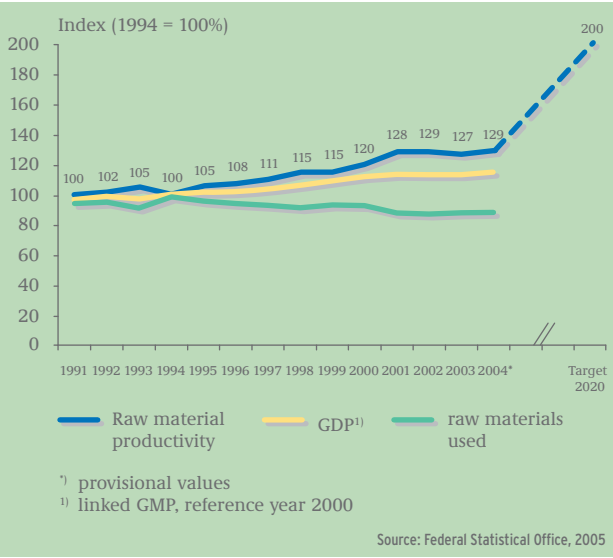
Human life and economic activity would be impossible without the resources obtained from nature. The extraction and use of raw materials always impose demands on land, materials and energy, as well as causing soil degradation and the emission of pollutants. Since the World Summit in Rio de Janeiro in 1992 one thing has been certain: throughout the world sustainable development is the guiding principle for the 21st century. Among other things this means that everyone in the world should have at least as much access to natural resources (see box) as is necessary in order to meet their basic needs, that renewable resources should not be used in excess of their regenerative capabilities, and non-renewable resources should be protected as much as possible.

Natural resources include both renewable and non-renewable raw materials, physical space (land), environmental media and flowing resources – such as wind energy, geothermal energy, tidal energy and solar energy.

In its decision on the sixth environmental action programme the EU Commission stated: "There is a limited capacity of the planet to meet the increasing demand for resources and to absorb the emissions and waste resulting from their use and there is evidence that the existing demand exceeds the carrying capacity of the environment in several cases."

The German government regards the frugal and efficient use and sustainable management of natural resources as one of the main tasks for the future. One of the objectives of the German government's sustainability strategy from 2002 is to double raw material productivity by 2020 compared with the reference year of 1994 (see Fig. 21). Expressed in financial terms this means that the average value of the economic benefit obtained from one tonne of raw materials must be increased from the 1994 level of 1,221 euros to 2,443 euros by 2020.

Figure 21: Raw material productivity



Despite widespread agreement about the objectives by the community of nations at the global summit in Rio de Janeiro, over the past 15 years there has been hardly any progress with the necessary overhaul of production and consumption in industrialized nations or with efforts to combat poverty in many of the less developed countries. Moreover the pressure on natural resources has been exacerbated due to the increase in per capita incomes in the less developed countries, combined with continued population growth, and the United Nations estimates that the world's population will increase from its present level of 6.6 billion to around 8 billion by 2025.

As a consequence of increased raw material productivity and improved energy efficiency, there has been a tendency in a number of areas in more advanced economies for the increase in demands on natural resources to be isolated from economic growth. Most of the less developed countries are still in a phase of early industrialization, or have yet to reach this stage, and the establishment of infrastructures and of basic or heavy industries creates a growing demand for resources. Meanwhile countries such as India and China are experiencing rapid economic growth, and they will be followed by others, which will all demand their share of material prosperity. We can expect consumption in these countries to follow the pattern set by industrialized nations. If applied on a worldwide scale western lifestyles are not compatible with the earth's ability to withstand such stresses, especially since the demands on the environment already exceed what is sustainable.

Globalization of the world economy continues, without offering any protection for natural resources or providing the same degree of access to rich and poor alike. In recent years the competition for raw materials has intensified and brings with it a threat of new international conflicts which could escalate and become more violent [58]. Experts fear that growing demand and unequal access to natural resources such as oil, timber, diamonds and metals will lead to armed conflicts. In the case of a number of raw materials (for example titanium, niobium, tin, beryllium, germanium and platinum) the main producing countries have already attained a market share which enables them to exert a strategic influence on prices and thus on world market supplies, or to use raw materials to apply political pressure [59]. There is also an increasing risk of violent conflict in various countries if access to soil, water or forests is restricted as a result of over-exploitation, environmental degradation or climate change. In some countries restricted access to land and a lack of documentary proof of ownership are already leading to violent disputes (see also p. 40).

Coltan is an ore containing tantalum, an element used in capacitors (for example in mobile phones, computers, hearing aids, heart pacemakers and electronic components in cars). The Democratic Republic of the Congo is one of the countries where it is produced, and between 1998 and 2004 the opposing parties in that country's civil war used the proceeds from coltan extraction and the award of mining rights to finance the violent conflict, thereby prolonging and intensifying the fighting. Some 3.9 million people are estimated to have become victims of this war [60]. At the "Strategic Metals" workshop organized by the Federal Environment Agency (UBA) in November 2006 experts discussed the various options and instruments for preventing and minimising conflict, using coltan as an example. The Federal Agency for Geosciences and Raw Materials is currently drawing up a certificate of origin for coltan. It is hoped that this will help to ensure that coltan ores originating from crisis areas are not used in the production of electronic equipment.

Initiative: Living well on less

If we consider the entire flow of materials and energy currently being generated by our consumption, in a year each and every one of us requires an average of some 80 tonnes of solid materials (such as steel, blocks and bricks, sand and gravel) and around 600 tonnes of water. In view of such volumes there is a need for an energy and resources policy in Germany too, in an effort to achieve more efficient use of raw materials and energy carriers throughout the entire value-added chain, and in this way to achieve a greater separation between the level of natural resources consumed and the standards of prosperity.

For many years the Federal Ministry for the Environment (BMU) and the UBA have been successfully promoting the sustainable use of natural resources, for example in the waste industry and the steel sector. The potential for reducing the consumption of natural resources exists in all areas of life in industrialized countries. The BMU and the UBA are currently preparing an initiative to encourage the effi-

The extraction of raw materials is always associated with destruction of the land, demands on energy and the emission of pollutants.

cient use of energy and resources. This is concerned with identifying and using various possibilities for action that will enable consumption to be reduced in absolute terms, and a significant amelioration of the environmental impact resulting from the use of natural resources. This initiative has identified specific fields of action: “Steel”, “Phosphorus”“, “Construction, Housing, Infrastructures”, “Biomass Production and Use”, “Information and Communication”, “Selected Metallic Raw Materials” and “Energy Efficiency”. One major strategic element of this initiative is to utilize the opportunities presented by the common interests of environmental protection, companies and the public in making more efficient use of energy and using more natural raw materials. With this initiative the BMU and UBA are endeavouring to create a greater appreciation of raw materials by society.

The EU Commission is also concerned with the sustainable use of natural materials. A thematic strategy published at the end of 2005 is intended to point the way for member states over the next 25 years, showing how the negative environmental consequences of using natural resources can be minimized [61]. The UBA and a further fourteen European environment protection agencies regard the attempt by the EU Commission as a necessary but insufficient step in efforts to preserve the natural basis for life [62]. They recommend defining targets for the EU as a whole and for specific countries and the introduction of information and monitoring measures. The member states will also be expected to provide continuous reports on whether or not they have attained the targets set for minimizing the consumption of natural resources.

Dual effect: using innovation to protect resources

Until now companies have concentrated in particular on increasing work productivity, while the improvement in resource productivity was significantly lower. In the production process itself the costs of utilizing resources are often considerable. For example, in manufacturing industry material costs account on average for more than 40 per cent of the total cost, which is around twice as high as the proportion accounted for by labour costs [63]. This clearly reveals the potential for achieving savings on material costs.

Recent years have seen a sharp rise in raw material prices on world markets, which have, in many cases, more than doubled, and this applies in particular to metals. In the future companies will have to focus more attention on reducing the input of materials. This will enable costs to be reduced, and only in this way will it be possible to offer competitive products on world markets. An estimate, based on an analysis of the potential, assumes that improved material efficiency in the manufacturing industries could result in annual savings of 27 billion euros by 2015. Backed up by appropriate political measures, these potential savings could even be increased by the same amount again [64]. Improved material efficiency would have a two-fold effect: in addition to easing the pressure on the environment and cutting the amount of waste as a result of reduced consumption of natural resources, the costs incurred by companies would be much lower too. The subject of resource efficiency

is therefore not confined to the field of environmental technology, and in fact every branch of industry would benefit.

New technical methods and new concepts are needed in order to boost resource efficiency. Production methods should be optimized or re-organized (for example, innovative moulding and joining processes to achieve savings of materials), new products should be created and designed (for example, in the processing sector, by the use of materials made from renewable raw materials rather than plastics made from oil). Innovative systems could also provide a fresh impetus. This also requires the development of new patterns of production and consumption, in which ownership rights and responsibilities offer greater incentives for the efficient use of resources (for example, car-sharing or chemical leasing). One thing is certain: making the use of natural resources more efficient involves much more than just achieving savings. Innovations are needed at various levels.

With their innovative, efficient products and methods German companies are well placed, and should continue to develop them. Failure to do so could mean that they become less competitive on the world market (see also p. 44). More efficient utilization would enable the deployment of the production factor "Natural Resources" to be reduced and replaced to some extent by another factor, that of labour. Companies frequently benefit from innovations aimed at improving resource efficiency, which also help to provide more employment and increase our prosperity. Until now they have often held back because of a lack of incentives and of information. According to one estimate a 20 per cent reduction in the costs of materials and energy could create up to 760,000 jobs over ten years [65]. The UBA has conducted a number of research projects in order to analyse the current situation and the opportunities available for environmental protection and economic development as a result of the improved efficiency obtained from innovations [66].

Industrial change: chemicals that protect resources and meet future demands

The chemical industry is among the most important and innovative in Europe and the world. It is the starting place for major material flows in the circular economy. Turnover by the German chemical industry alone in 2005 amounted to 152.8 billion euros. The chemical industry is the fourth largest industrial branch in Germany and accounts for more than ten per cent of the total manufacturing turnover [67]. A particular need therefore exists for Germany to develop sustainable chemicals production and to implement it at all locations, especially in view of the global responsibility that companies bear.

Alerted by the serious consequences of various accidents in the 1970s and 1980s, the chemical industry has made strenuous efforts to promote cross-media environmental protection. Statutory specifications, such as the implementation of the directive for avoiding and reducing environmental pollution from industrial plants (IPPC Directive) and accompanying research policy measures assist the development of new production methods that make more efficient use of materials and energy. Between 1995 and 2002 specific consumption of fossil raw materials did decline by some 13 per cent, but this was accompanied by a rise in the production index for primary chemical materials of 25 per cent, and overall use of fossil raw materials increased by a further three million tonnes of oil units.

The UBA agrees with the chemical industry that innovative technology will create opportunities for environmental protection and employment in Germany. Whereas competitiveness is the main concern for companies, the UBA is seeking to reduce environmental pollution resulting from chemical production and chemical products as a way of counteracting the stresses that they impose on the environment. As part of its efforts to influence the development of technical methods in order to reduce demand for natural resources and minimize health risks the UBA assesses these methods in terms of their environmental and health risks as well as their potential for relieving environmental stresses.

One innovation with a promising future that has been developed in recent years is micro-reactor/microsystems technology. The yields and diversity of suitable chemical production processes can be improved using micrometer-scale process engineering components and systems. Improved raw material productivity results in a reduction in the consumption of raw materials, in waste flows and in the amount of energy used. Furthermore the safety of processes is improved and, due to reduced operating costs and the ability to react more quickly to market developments, there are economic advantages too. Processes for the direct production of propylene oxide and vinyl acetate (the raw materials used to make plastics) in micro-reactors are currently under development.

Another way of helping to preserve natural resources is through the substitution of fossil raw materials.

For example, bio-plastics such as polylactides and polyhydroxy alkanoates, based on raw materials derived from plants, have the potential for replacing at least some of the plastics based on mineral oil (polyethylene, polypropylene). At present bio-plastics remain so-called niche products but some companies which are among the market leaders believe they could account for between 10 and 20 per cent of world plastics production by 2020 [68]. The development of prices is the decisive factor, and at present bio-plastics are still much more expensive than oil-based products.

Sustainable chemistry is concerned with the entire life, i.e. not only the manufacture but also with the processing, use and disposal of chemicals and chemical products. This is an area where new business models such as chemical leasing offer an opportunity for combining economic and environmental objectives. Under chemical leasing companies do not sell the chemicals themselves but only their use. In the ideal scenario, after they have been used, all the chemicals revert to the manufacturer, who processes them for renewed use. This concept is intended to benefit the economic interests of all concerned, as a means of reducing the amount of chemicals used and in order to improve the technical and environmental criteria.

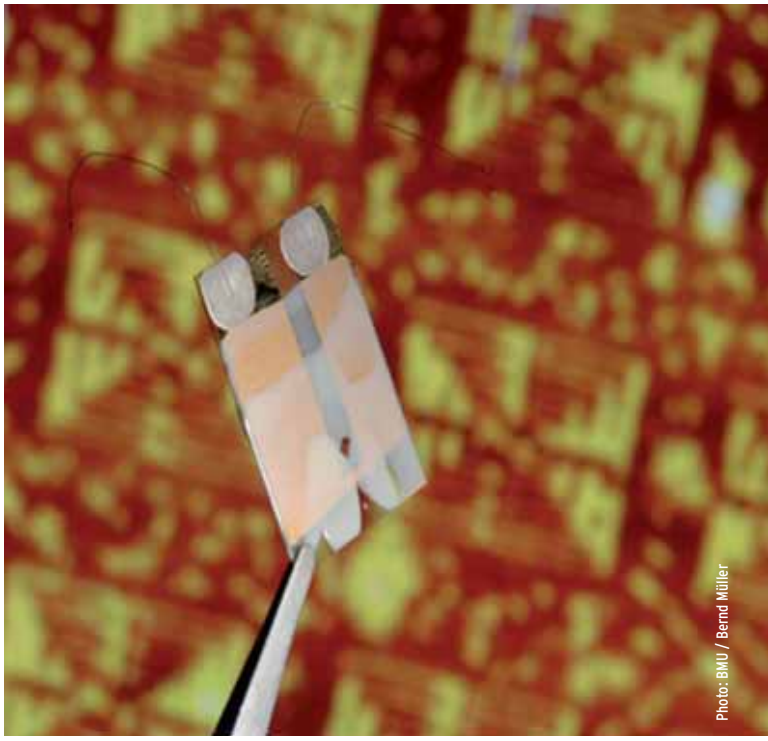
Biotechnology in overdrive: Minute enzymes with a massive capacity for savings

Industrial biotechnology, also referred to as "white biotechnology", refers to the use of biological processes for technical procedures in industrial production. Unlike chemical processes, biotechnical processes take place under comparatively mild conditions in aqueous surroundings, at low temperatures, normal pressures and with a neutral pH value. Because of the amount of energy and raw materials that they consume, and the pollutants that they emit, industrial chemical processes can impose considerable pressures on the environment. Integrated production using biotechnical processes, on the other hand, relieves the pressures on the environment because they

- utilize alternative raw materials or replace fossil raw materials with renewable materials,
- permit production processes that conserve resources and are low in energy use,
- avoid the use of substances which harm health and the environment,
- result in by-products which are biologically re-usable and biodegradable and help to cut emissions, and
- create useful materials from residual matter.

However, biotechnology is not always less harmful to the environment than normal processes, and the environmental compatibility of processes should be assessed in each individual case.

Biotechnical processes are already well established in many commercial fields. Nowadays biotechnology is employed almost exclusively in the production of vitamins (vitamin B2, vitamin C), carbonic acids (L-lactic acid, citric acid) and amino acids. However, a great deal remains to be done. Industrial biotechnology is restricted by the limited availability of efficient enzymes. From all the almost inexhaustible diversity of nature only some 75 enzymes are used in industrial production processes, because many micro-organisms have not been researched or cannot be cultivated. The German government's high-tech strategy recognizes that more research needs to be carried out in order to make use of this diversity.



Technology conquers the nano-world: a chip with nano-structures.

Nanotechnology: opportunities for the environment and industry

Nanotechnology is another so-called key technology. Based on the definition by the German Bundestag's (lower house of parliament) Office for Assessing Technological Consequences (TAB), the UBA regards nanotechnology as the manufacture, examination and use of structures (such as particles, layers of tubes) with dimensions of less in than 100

nanometre (nm), i.e. over 1,000 times smaller than the diameter of a human hair (approx. 100 micrometres). Artificially produced nanoparticles and nano-scale systems components can reveal new kinds of properties, such as increased reactivity, altered light absorption accompanied by colour changes, which are important in the development of new products and applications. The new materials and properties are derived from special surface properties and in some cases from the geometric form of the material.

Nanotechnology and its products permit the more efficient use of raw materials and energy during the life of a product, thereby cutting the emission of pollutants and reducing energy consumption. A number of applications are already commercially available, such as catalytic converters and coatings to provide scratch-resistant, anti-reflective and anti-adhesive surfaces. The use of light-emitting diodes (LED) based on nanotechnology enables energy efficiency to be improved by between three and five times compared with the lighting obtained with conventional energy-saving lamps. Given an average electricity consumption for lighting in Germany of around six gigawatts (total energy annual consumption: 53,000 gigawatt hours), on its own the use of light-emitting diodes utilizing nanotechnology offers an energy saving potential equivalent to the output of several power stations.

Nanotechnology is also being used in efforts to achieve more effective use of regenerative energy, for example in so-called organic solar cells and coloured solar cells. Organic solar cells (photo-active layers of organic material) absorb light more effectively than anorganic solar cell materials, enabling them to operate at a much reduced light intensity. Coloured solar cells can capture light more efficiently as a result of the nanometre-fine distribution of a light-absorbing pigment.

The rapid pace of development in process engineering, which also includes products made using nanotechnology, offers not only enormous economic opportunities but also promises to relieve environmental pressures. However, the risks to human health and the environment have not yet been adequately clarified. In assessing the additional risks posed by nanoparticles it is vital to determine the form in which such materials come into contact with humans and with the environment. A number of important questions need to be answered in this context and, together with the current state of knowledge, they have been compiled by the UBA in a paper containing background information [69].

Rarities: obtaining knowledge and completing cycles

The environmental impact of many of the rare metallic raw materials has still not been adequately investigated. Many of them have an important part to play in the electrical and electronic sectors, especially in information and communication technology, while others are used in medicine and in nanotechnology. Demand in these various fields is increasing, possible substitutes rarely supply all the specific properties, and recycling is comparatively difficult and intricate.

Although as a rule these metals are only extracted and used in very small quantities, and do not match the quantities of other metallic raw materials, it is now known that the extraction of some of them is accompanied by very severe environmental stresses, while experts suspect that this is also the case with others too [70]. The available data about many of these substances is simply too limited to enable their environmental impact to be assessed. The UBA is in the process of investigating previous unknown environmental effects of rare metallic raw materials. Improved data and an analysis of environmental effects enable details to be obtained about the required action and forecasts to be made about future trends and possible applications in new kinds of technology.

The main “ecological backpacks”, i.e. the consumption of primary materials in the extraction of the raw material, and the associated environmental stresses, are already known in the case of certain rare metallic raw materials [71]. This applies in particular to the platinum group metals (PGM). For example, the production of one gram of platinum makes the same contribution to the greenhouse effect (in CO_2 equivalents) as five kilograms of copper, or 5,000 times as much. In the case of water pollution (expressed in terms of total nitrogen) the factor is 1,000.

The amounts of PGM being recycled from consumer goods and their applications are currently unsatisfactory. In particular when consumer goods (such as cars fitted with catalytic converters) are exported, the PGM is lost when these items come to the end of their life unless the destination countries have set up the necessary conditions for recycling. As an initial step in increasing the amount of PGM recycling the UBA has analysed the flows of exports of used cars and end-of-life electrical and electronic equipment from the port of Hamburg to countries outside Europe [72]. Whereas the available data on the exports of electrical equipment shows that there is considerable room for improvement, an

analysis of the automotive sector indicates the first signs of success, for example in persuading exporting companies to devote more efforts to international recycling.

Over three million cars are taken off the roads annually in Germany, but only one in six is recycled.

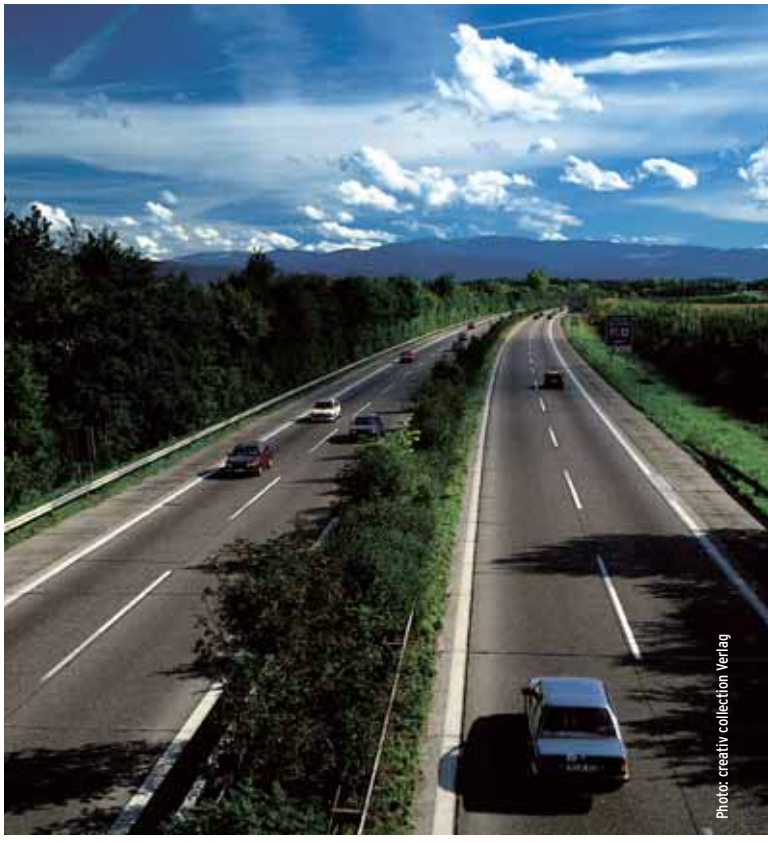
Change of style: creating open spaces instead of fragmentation and sealing of land areas

The construction, fitting out, modernization and maintenance of buildings and infrastructure not only consume a great deal of energy and materials but at the present time they also require a constant supply of new land for settlements and transport. As a consequence open land, which is not only needed for recreational purposes but also provides a valuable habitat for plants and animals, is being fragmented, settled and in some cases sealed. This also reduces the available options for using this land for cultivating food, livestock feeds or renewable raw materials or to absorb CO_2. The term carbon sink (also known as a carbon dioxide sink or CO_2 sink) is used in the geosciences to refer to a reservoir which absorbs and stores carbon, either temporarily or continuously. Forests and oceans are important CO_2 sinks.

Urban sprawl creates additional areas occupied by buildings which have to be heated in the winter and, possibly as a result of climate change, may also have to be cooled in summer in future. They are also responsible for increased traffic, causing the consumption of more fuel and the associated environmental pressures, as well as a greater consumption of materials in response to the expansion and maintenance of the infrastructure. This imposes a growing burden on the environment and the economy, which will be passed on to future generations. In addition to ensuring that less new land is used, in future there must be substantial reductions in the amounts of materials and energy used, and in the pressures on the environment arising in connection with the construction, operation and subsequent demolition of settlements and infrastructures. In the process of developing settlements and infrastructures the UBA has drawn up objectives, measures and research questions based on current knowledge, with the aim of protecting resources (see also p. 21). Future research projects will identify potentials for reducing the land areas and the amounts of materials and energy used in construction, housing and infrastructure, as well as finding ways, measures and instruments for making the best use of the available potential.

Keeping one's feet on the ground: Recycling land areas instead of using them up

Soils are an important natural resource. As part of the balance of nature they fulfill some significant functions, providing a habitat and basis for life for plants, animals and soil organisms, as a vital component of the cycles of nutrition and water, and as a



No signs of a change in the trend: too much land is still being taken for settlements and transport.

filter and a buffer for contaminants. Clean soil is necessary in order to ensure supplies of clean drinking water, and it would virtually impossible to maintain agricultural production in the long term without it. Protection of the soil has always been one of the main concerns of environmental policy. It is obvious that, in order to conserve resources, measures are needed to provide quantitative protection of land areas in the face of growing demands from settlements and transport, quite apart from the need to protect soil quality from the deposition of contaminants.

Figures released in November 2006 by the Federal Statistical Office (see also p. 21) provide emphatic proof of the need for action by politicians, business, science and consumers. Between 2002 and 2005 the area occupied by settlements and transport grew by an average of 114 hectares (ha) per day, the equivalent of some 160 football pitches. At the same time some 139,000 ha (or around 195,000 football pitches) of derelict land, most of it formerly used for industry, could be available principally for re-use for settlements and transport.

Setting the pace: the waste industry looks to the future

The German government passed its Recycling and Waste Law in 1994, specifying its objectives with regard to the management of waste, to largely avoid or prevent the production of problem refuse, to utilize the useful substances contained in waste and to dispose of non-reusable materials in an environmentally responsible way. Since then far-reaching improvements have taken place in utilizing both the materials and the energy from various product groups, and to some extent with the waste from settlements. In 2004 the rate of return for waste paper reached 73 per cent, and the figure for waste oil was 100 per cent. In 2005 the increasing amounts being recycled, and above all the implementation of the Waste Storage Regulation of 2001 with its prohibition on the storage of untreated waste, together with the increased efficiency of domestic waste incinerators, led to savings of around 46 million tones of CO_2 equivalents compared with 1990 [73].

Individual measures are unlikely to lead to further, large scale increases, and the "traditional waste management industry", in the sense of a community of waste disposal enterprises, is finding itself increasingly at the limits of its capabilities. Following the comprehensive exploitation of the potential of the waste industry for protecting resources, additional possibilities can only be utilized through a large number of lesser measures. With its 6th Environmental Action Programme, in 2002 the European Union underlined its position regarding the sustainable use and management of natural resources and waste. Among the objectives of this action plan are

- a reduction in the total amount of waste produced;
- increased efficiency in the use of resources and
- the need to sever the link between economic expansion and increased waste production.

This provides the basis for a thematic waste avoidance and recycling strategy which establishes objec-

photo: creativ collection Verlag

Since June 2005 only pre-treated settlement waste may be put into landfill.

tives and measures for reducing the environmental stresses resulting from the production and management of waste [74]. Measures are to be undertaken, for example, to encourage recycling, re-use and the avoidance of waste, throughout the entire life of a product or a natural resource.

Subjecting individual flows of residual materials to close scrutiny and taking into consideration the preceding processes (production, consumption), the results of a number of projects have confirmed that further scope exists for optimizing the recovery of useful materials and thus for the substitution of primary raw materials [75]. Because of the reduction in the relevant emissions, optimization of the channels for the use and exploitation of residual and waste products of biogenic origin not only enhances climate protection but protects stocks of raw materials too (see also p. 88). The use of innovative and sophisticated processes for recycling phosphorus leads to the availability and efficient use of this resource. This has enabled Germany to meet a large proportion of its phosphate requirements as well as making an active contribution to protecting natural deposits of phosphates in countries such as Morocco, Algeria and South Africa.

Resource policy: a global task

As mentioned in previous sections, there are many reasons why natural resources should be protected. Here is a summary of them:

- The limited availability of fossil reserves and concerns about the threat of conflicts over resources;
- the desire by some countries and the European Union to become less dependent on imports;
- the increased efforts by European countries to make more productive use of raw materials in order to safeguard their economic growth targets, without consuming additional natural resources;
- the escalating costs of energy and raw materials.

There are many ways in which natural resources can be conserved, for example:

- In its strategy on resources the EU proposes taking the environmental effects of resource use into consideration in all areas of public policy-making;
- Germany and other EU member states want to contribute to conserving resources by exporting innovative, efficiency-promoting techniques, especially to rapidly expanding economies, in order to boost those countries' own resource efficiency;
- many German local authorities are already making efforts to strengthen regional economic cycles, using and exploiting their own flows of resources for this purpose;
- efficiency centres advise companies and consumers on ways of conserving energy and stocks of raw materials;
- with its action plan of May 2004 entitled "Preventing Civil Crises, Resolving Conflicts and Consolidating Peace" the German government created a national framework of measures to promote a responsible and sustainable use of resources which are potential sources of conflict [76].

However, such measures are still not enough to preserve the natural basis for life for subsequent generations around the world. Sustainable development, the guiding principle of the 21st century, requires an even greater commitment, especially on an international scale. This makes it imperative that the EU strategy for sustainable development is given a more international dimension [77]. The focus of the development cooperation by the EU should be on combating poverty and on encouraging the sustainable use of natural resources. Moreover it is important that the EU enshrines the aim of reducing absolute consumption of resources in the Lisbon Strategy too.

Sustainable development is a global task. Over the coming years the EU must drastically reduce the amount of resources that it consumes in order to be able to make a proportionate contribution to the sustainable development of mankind. This objective can only be attained if, in addition to improving technical and organizational efficiency, we reconsider our lifestyles and incorporate the idea of conserving the natural basis of our lives in our everything thoughts and deeds.

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Photo: creativ collection Verlag

DIVISION I "ENVIRONMENTAL PLANNING AND SUSTAINABILITY STRATEGIES"

Sustainable development cannot take place without changes occurring in those areas which are of particular importance for the protection of the environment and of humans, such as energy and climate protection, transport and noise abatement, international environmental issues and regional planning. Helping to structure sustainable development in Germany, in Europe and globally forms the link between the Division I and its four departments. It draws up proposed concepts and instruments in order to adhere to politically desirable objectives or those which the Federal Environment Agency (UBA) considers necessary for maintaining the quality of the environment. The effectiveness of these instruments is examined, using a number of different scenarios, for example, and further developments are made to them. Sustainable development is only achievable through cooperation with the international community of states, which is why the work of coordinating the UBA's international collaboration is also dealt with by Division I.

The Division can only provide its wide range of services within the scope of trans- and interdisciplinary working methods involving the various faculties – social sciences, jurisprudence, natural sciences and engineering – and through intensive in-house collaboration and the inclusion of outside partners both on a national and an international level. That is why Division I is also responsible for product planning and, deriving from this, for research planning for the entire agency.

The implementation of a national sustainability strategy depends to a very great extent on the degree to which society accepts the objectives and the measures that are applied. The statutory obligation of "informing the public about environmental issues" is therefore another main focus of the Division's work. Its target groups consist of specialists and the public alike.

Additional details about the work of the Division can be obtained at:
http://www.umweltbundesamt.de/uba-info-e/e-fach1.htm

DEPARTMENT I 1 "SUSTAINABILITY STRATEGIES AND INFORMATION"

Building blocks and instruments for a sustainable use of resources

Many measures are required in planning and implementing strategies and programmes for the sustainable conservation of resources. These contribute towards

- filling in the gaps in knowledge,
- investigating possible future developments,

- providing information about problems and approaches to tackling them,
- changing attitudes to promote production that makes more efficient use of resources and encourages consumption that helps to conserve resources, and
- initiating and supporting combined action by the relevant participants.

The Federal Environment Agency (UBA) makes some important contributions in this respect.

Using scenarios to examine interconnections

The use of scenarios can help to illustrate complex interconnections and make them easier to comprehend. They are based on a number of assumptions and describe possible developments, as a way of clarifying the scope for action by those who create environmental policy, and the decisive influencing factors. Scenarios provide answers to questions such as: "What must we do now in order to achieve a desired condition y in x year's time?" In this way the necessity of various measures can be examined and their possibilities for success can be assessed. This makes them an important component when advising politicians and disseminating environmental information.

Calculations for the scenarios are carried out using models depicting certain areas, such as mobility, energy and climate protection, landscape and regional planning. To improve comparability and the links between the scenarios produced by the UBA, the agency is currently engaged in a research project to determine which approaches are best suited for developing a systematic method and improving clarity. Using comprehensive sustainability strategies the aim is to provide an even better level of scientific support for the German government's efforts to encourage sustainable development.

Using indicators to make progress measurable

Indicators are an additional means of guiding environmental policy measures and examining their success. Indicators provide a record, a description and an assessment of complex facts such as the climatic changes resulting from greenhouse gas emissions, or how the increasing demand for land impacts on biodiversity. Indicators are a clear and important instrument for providing information, for interested members of the public and for decision-makers too.

Discussions currently centre on a number of different indicators for describing specific aspects of the use of and the demands made on resources. The UBA has therefore commissioned reports which will contribute to a clarification of the term "natural resources" and enable assessments to be made of the expressiveness of individual indicators (for example those pertaining to raw material productivity). An extensive glossary of resource-related themes is intended to provide greater clarity in the discussions about conserving resources, which are increasingly taking place in the public sphere too.

The indicator for "raw material productivity"

The indicator for "raw material productivity" expresses the relationship between gross domestic product and the volume of extracted and imported abiotic raw materials (such as metals) and goods used in Germany. This indicator summarizes the volume used irrespective of the type of raw material. As a consequence the raw materials which dominate in terms of volume (such as sand and gravel) tend to determine the import trend while other raw materials which are also relevant in terms of their contribution to environmental stresses (such as copper and platinum) play virtually no part all. The UBA has initiated a research project in order to develop the existing indictor for "raw material productivity" even further. The following are among the main questions dealt with by this project:

- Should the indicator only consider the extraction of raw materials or should other stages in the processing and use be included too?
- What environmental stresses are associated with the extraction and provision of the raw materials?
- Are the indicator or set of indicators applicable to renewable raw materials as well?

The improved indicator should take into consideration the various environmental impacts associated with the provision of raw materials, thereby improving the quality of national and international reporting on the environment and sustainability.

Environmental data for Germany 2007

One single indicator cannot depict the many and varied aspects of the way that natural resources are used. With the publication of "Environmental Data for Germany 2007" the UBA has produced a compendium, subtitled "Practicing sustainability – protecting natural resources and the environment",

which provides a broad overview of the extraction and import of economically important resources and their use in production and consumption in Germany [78].

The brochure describes the direct impact on the environment of the use of various resources: raw materials, energy, water and land area. It also outlines the efforts being made by society to relieve the stresses on the environment, such as environmental legislation, along with economic and technical measures to enable resources to be used in a way that helps to conserve them. The indicators and trends show the point at which gains in efficiency become apparent in the patterns of provision, production and consumption. They also point out where increases in resource efficiency are needed. The parameters and indicators are quantified pointers which can be used to provide guidance in the deployment by Germany of measures and instruments, thereby assisting in the ongoing process of decoupling the use of natural resources from economic development.

KIS – a new website with environmental information

The main tasks of the UBA include informing the general public in a generally understandable way about the state of the environment, the causes of environmental stresses and practical possibilities for solving environmental problems. The UBA has developed its Environmental Core Indicator System (KIS) for this purpose, to provide a compact picture of the developments taking place in environmental protection [79]. It lists over 50 indicators, from “Greenhouse Gases” to “Renewable Energy” and “Lead in Blood”. The UBA uses the internet to present these indicators, clearly illustrating how each parameter has developed over past years, and how environmental trends can be assessed. Information about many different aspects is available to users: the methodology used to draw up the indicators, the subject-related basis for making assessments and the legal foundations, as well as the measures and instruments used to attain environmental policy objectives.

The environment, caught between conflict and cooperation

Photo: UBA / Volkhard Möcker

There is a growing awareness that environmental degradation and the increasing shortage of natural resources are possible causes of international crises and conflicts. Access to natural resources is vital for the very survival of many people in the less developed world. The uneven distribution and use of natural resources such as oil, timber, gold, diamonds and minerals can serve to exacerbate the tensions between different population groups or between the government and the population. In some conflict zones valuable natural resources are the very means whereby wars are financed. However, sustainable use of natural resources and combined efforts to protect environmental assets can help to prevent conflict and safeguard peace. A travelling exhibition that was staged at the UBA in Dessau from 18 October to 17 November 2006 showed why the over-exploitation of nature presents a threat to human security, and how conflicts over natural resources can be avoided and dealt with [80].

New utilization strategies for consumption that also help to conserve resources

The public also has an important part to play in an economy that is striving to conserve resources. For example, when making purchasing decisions they could choose more environmentally friendly products or make more efficient use of resources by adopting new strategies for use. New strategies for use simply means prolonging the life of products, for example through continued or repeated use, and more intensive, i.e. communal use.

The UBA coordinates and assesses research projects by the Federal Ministry for Education and Research in pursuit of these objectives, which has tried out various approaches for re-using and reprocessing products, as well as setting up networks in support of such strategies [81]. The findings reveal that new strategies for use have positive effects on environmental protection as well as helping to create jobs. As an example: one project led to the establishment of a company for refurbishing old items of furniture, providing employment for several people. The implementation of new strategies for use is very encouraging, especially in cooperative groups in which complementary interests can be combined for the mutual benefit of all concerned. One example is in housing, where shared use serves both social and ecological interests.

There are also certain obstacles to these new forms of use, especially when extensive changes to existing attitudes and behaviour are required, for example, with the communal use of products. Economic conditions too, such as low prices in certain sectors of the market (e.g. computers) or political conditions (like the discouraging fiscal attitude to car-share schemes) can inhibit new strategies for use. More research is therefore needed in order to find solutions that will overcome these obstacles and lead to the widespread establishment of sustainable forms of use.

International cooperation to protect resources

On an international level too the UBA is committed to more effective protection of natural resources. At a meeting of the European Network of Environmental Protection Agencies in Dessau in September 2006, for example, a group comprising members of the network published a position paper containing proposals for restructuring the European strategy on resources [82]. The paper had been compiled by the EPA working group “Sustainable use of natural resources”, under the chairmanship of the UBA. Among its proposals were for improvements to the transfer of knowledge and technology in developing countries and in the new member states of the EU, for example, in order to assist the spread of advanced environmental technology and to improve the resource efficiency of their economies.

One practical approach in this respect is the advisory assistance programme provided by the Federal Ministry for the Environment. The UBA has been commissioned by the ministry to provide technical support and to oversee the administration of the projects included in this programme. The programme contributes to a better use of the potential for exercising more care when dealing with natural resources in the countries of Central and Eastern Europe. For example, with technical assistance from the UBA, transport experts from Bremen and Riga revised the transport concept for the Latvian capital, one of the main aims being to make public transport more attractive. The project resulted in a number of concepts and special recommendations, such as the re-organization of bus routes and the creation of park-and-ride facilities, which the transport companies can implement immediately. This counteracts the existing trend, one characterized by a rejection of public transport and the greater use of individual forms of transport, with all the negative environmental consequences that this implies.

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DEPARTMENT I 2 "ENVIRONMENTAL PROTECTION INSTRUMENTS"

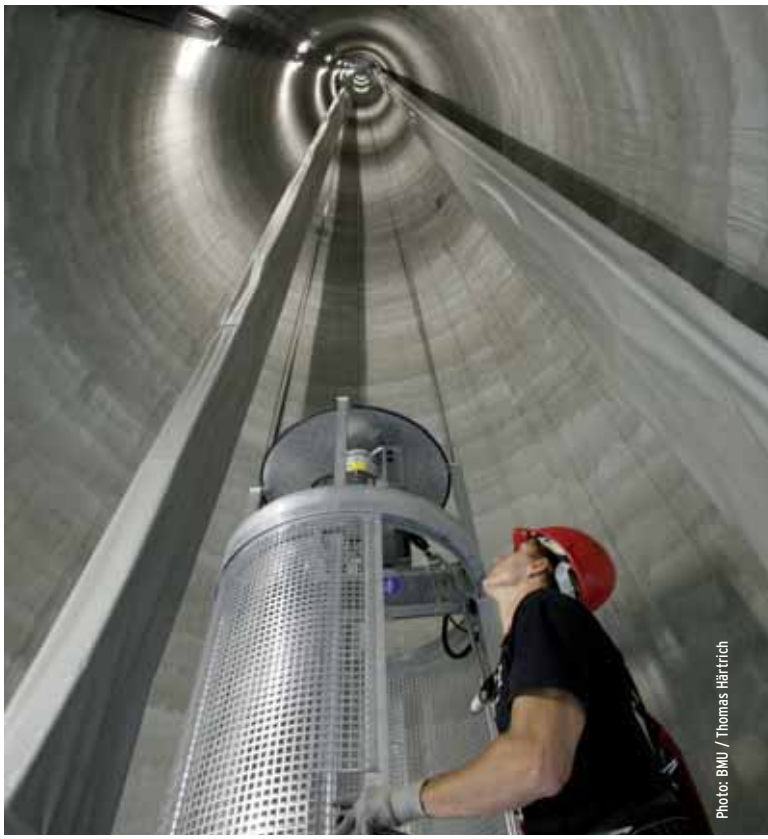
Environment – Innovation – Employment

Environmental policy faces more global challenges now than ever before. Climate change is a reality and is occurring at a faster rate. Increasing worldwide demand for raw materials such as oil, steel and ores is the cause of environmental stresses, while companies have to cope with the rising cost of raw materials. Around the world more than two billion people still do not have access to clean water. In particular in view of rapidly expanding economies such as those of China and India, we cannot tolerate an attitude of "carry on regardless".

The need for action is all too obvious. We can only face these global challenges if we make our business methods more efficient and change our consumer habits to make them more sustainable. Discussions have now entered a new dimension. Whereas only a few years ago it was only a matter of justifying environmental policy measures, nowadays we have gone one step further. There is now a widespread general awareness of the need for a consistent environmental policy, and of the opportunities that it presents. According to the latest representative survey of environmental awareness in Germany, 70 per cent of the population insists that the government should do more to protect the environment in future. 69 per cent believe that a consistent environmental policy also benefits the economy, while 67 per cent would like to see Germany leading the way in environmental protection policy.

There is also a greater awareness of environmental policy by the management of German and international companies. Environmentally friendly products and services are a worthwhile area for investment. Companies are investing in environmentally efficient production methods, i.e. that conserve energy and resources. There is a growing awareness of the need for a revolution in efficiency as a means of safeguarding prosperity and the natural basis for life.

The challenges of environmental protection call for strategies that transcend national borders. A more emphatic environmental and economic policy on a European-wide scale, offering systematic incentives for innovations that help to protect the environment, can provide a valuable impetus for greater added value in Europe, because the market for technology that protects the environment and for improved energy systems is among the most vigorously expanding markets in the world.



Environmental technology is an expanding market: technicians in a wind generator tower.

Economic opportunities on "green markets"

The growing worldwide demand for technology that helps to protect the environment leads to the creation of new markets as well as opening up considerable economic opportunities. The Federal Environment Agency (UBA) has analyzed the prospects for

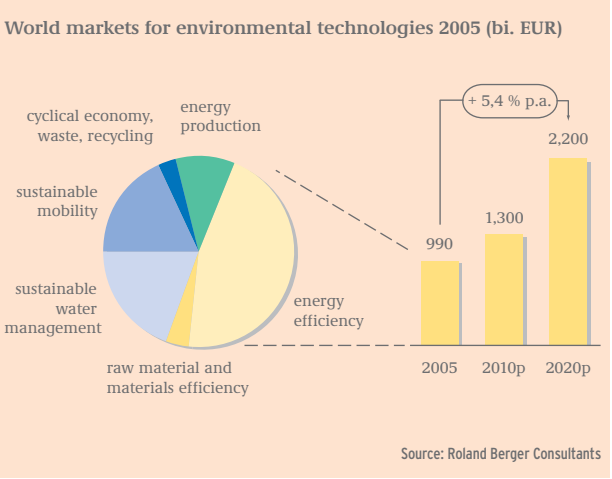
Environment – Innovation – Employment: a subject for Europe

Environment, Innovation, Employment was the slogan of Germany's presidency of the Council of the EU during the first half of 2007, as well as the subject of the informal meeting of ministers of the environment in Essen from 1 to 3 June 2007. This provided an opportunity for the environment ministers of the EU member states and the candidate countries, EFTA nations and representatives of the EU Commission to discuss a number of concrete political approaches to these issues. These include:

- the introduction of a European top runner approach along Japanese lines;
- increased use of economic instruments such as those of emissions trading;
- environmentally friendly procurement by the public sector;
- increased research into technology intended to protect resources and assist the environment;
- selective support for lead markets;
- systematic examination of the background conditions of modern technology in all areas of policy-making;
- support for eco-innovations in accordance with the Lisbon Strategy.

The ministers emphasized that ambitious environmental legislation is a major component in efforts to modernise the economy as well as encouraging innovative developments in environmental technology. Only the continuous pursuit of environmentally efficient innovations in all sectors of industry will safeguard Europe's leading position on a competitive global market, as well as providing a suitable response to global environmental problems. It is now up to the European Commission to prepare a comprehensive, integrated strategy for promoting eco-innovations [83].

Figure 22: World markets for environmental technology

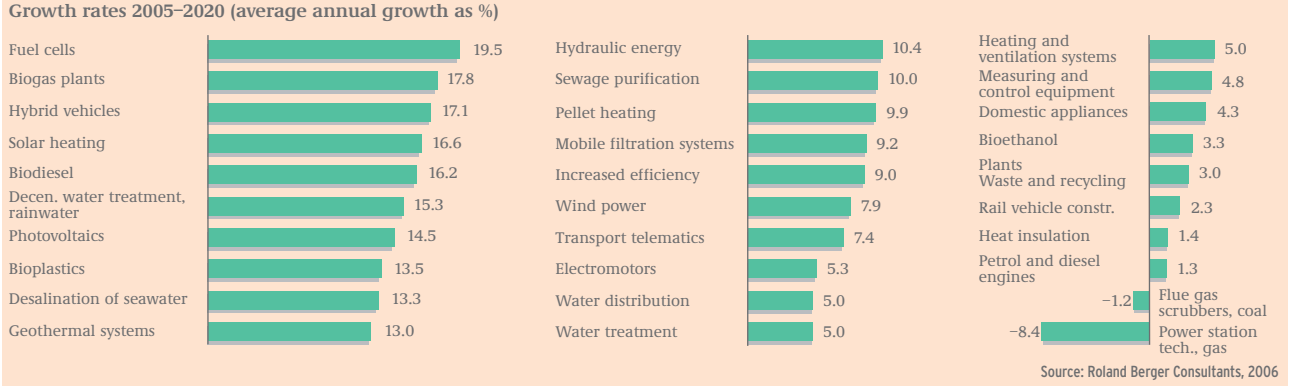


the main markets of the future which have a particular environmental relevance ("green markets") [2]. It revealed that the world market for environmental technologies had a volume of just under 1,000 billion euros in 2005. In the future companies in this sector are anticipating above-average growth and consequently, by 2020, the world market volume is likely to rise to more than 2,200 billion euros.

Expansion on world markets is driven by the sectors of renewable energy, efficient energy production and sustainable water management. Companies are expecting energy and propulsion systems to provide the highest growth rates.

With world market shares of between 15 und 25 per cent, German companies are major international suppliers, but they are still neglecting certain technological developments, for example, in the area of hybrid vehicles. It is only more recently, under the pressure of increasing demand and competition from Asian suppliers, that German companies have shown a greater commitment to the development of this technology.

Figure 23: Growth rates in environmentally relevant product groups worldwide



Environmental innovations: a potential for business and employment

The latest reports commissioned by the UBA confirm that innovations and investments in environmental technology continue to bring economic benefits [85, 86]. Germany leads the world in the international trade in goods with the potential to protect the environment (see box). With over 18 per cent of the world market in 2004 German companies were slightly ahead of the USA. Germany has been able to increase its share steadily since 2000. While five per cent of Germany's exports now consist of goods with the potential for use in environmental protection, the average for OECD countries is 3.8 per cent. In the field of environmental protection Germany's highly competitive export sector enjoys additional specialized advantages. In addition to the above-average importance of goods for environmental protection in the export field, the advantages of specialization are also apparent in the fact that Germany's position in world trade is far better for environmental protection products than it is on average for research-intensive items. A positive contribution is also being made to the balance of trade, the ratio of exports to imports being much higher in the case of potential goods for environmental protection than it is for the manufacturing industry as a whole.

Potential environmental protection goods – for example pumps, pipes, measurement, control and regulating equipment, can all be used for environmental protection purposes as well as fulfilling other functions. The concept of potential environmental protection goods can be traced back to a convention which was developed by various research institutes in association with the Federal Statistical Office in the 1990s and which has been used since then in studies into technological viability.

Patent applications provide an important indicator of the innovative strength of a country. Among the patents in the environmental field that are filed every year with the European Patents Office, the highest share, 23 per cent, is accounted for by Germany, although this share is declining. The German environmental protection industry has played a leading technological role for many years, and German companies are more active than their competitors in securing copyrights for new products and production methods, thereby preparing the way for new markets. This is an important factor in their future competitiveness.

This pioneering role in environmental protection also has a positive effect on the labour market. Even during periods of economic recession employment figures in the field of environmental protection remain stable at over 1.5 million. The market for renewable energy is undergoing particularly dynamic expansion. It currently employs more than 210,000 people, compared with just 57,000 in 1998 [87].

Environmental policy must continue to offer incentives for innovation

Environmental policy gives a valuable impetus to innovation. This has also been confirmed by a survey of companies that was commissioned by the UBA [86], which revealed that companies regarded the Renewable Energy Law as by far the most important piece of legislation for promoting innovation. The successes have been due to a combination of stable long term conditions for encouraging innovation and the creation of high levels of demand.

Without a progressive environmental policy providing systematic incentives it would not be possible to maintain and even improve the strong competitive position enjoyed by Germany and the EU in the

Table 2: **OECD countries' share of world trade in potential environmental protection goods**

	share as %											
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Germany	17.8	17.5	17.9	17.5	16.6	17.5	17.5	16.4	17.2	18.3	18.8	18.3
USA	19.2	18.7	17.9	18.6	20.9	20.7	21	23.3	22.3	20.2	18.4	18
Japan	12.8	13.4	13.7	12.7	12.1	10.0	10.6	12.4	10.2	9.8	10.1	12.1
Italy	10.2	9.4	9.3	9.7	8.8	9.1	8.7	7.6	8	8.1	8.4	7.7
UK	6.6	7.1	7.0	7.2	7.7	7.5	6.9	6.5	6.8	6.6	6.6	6.8
France	6.8	7.1	6.9	6.7	6.5	6.8	6.5	5.7	6	6.2	6.4	5.9
others	26.6	26.8	27.3	27.6	27.4	28.4	28.8	28.1	29.5	30.8	31.3	31.2

Country's exports as a proportion of total exports by OECD countries

Source: Legler and others (2006), Niedersächsisches Institut für Wirtschaftsforschung

long term. The importance of environmental policy conditions for the success of domestic companies has been increasingly recognized by other countries too, which have been applying their own innovative strategies.

Technology-forcing: the law to limit emissions from cars in California

Since 1 January 2007 California has imposed a limit of 70 mg of nitrous oxide per mile – approx. 43 mg per kilometre – on newly registered private cars, without making any distinction between diesel-, petrol- or gas-powered vehicles [89]. This limit is far stricter than the Euro 4 standard which currently applies to diesel-engined cars in Europe. Even the Euro 6 standard, due to be introduced in 2014, only specifies a limit of 80 mg per kilometre. The response by the automobile industry has been the plan to offer vehicles for sale under the name Bluetec in the autumn of 2007. BMW, Audi and a number of other manufacturers are working on "clean" engines of this kind. As this example shows, technology-forcing does work.

The top-runner approach in Japan

The leader imposes the yardstick. This is the principle behind the Japanese top-runner approach. Based on proposals from a working group comprising representatives of industry, science and administration, lawmakers continually impose new standards for products which consume high levels of energy. Depending on the innovation cycle of a particular product group these revisions are made over a period of between 3 and 12 years. The model with the lowest consumption figure serves as the yardstick for a minimum standard, which all the other products must attain within a specified period. In so doing companies also take the opportunity to label their products to show the extent to which they have attained the objective and stating annual energy consumption or the energy efficiency of the product.

The advantages of both examples are obvious: consumers benefit in the form of reduced energy costs, the atmosphere is subjected to lower carbon dioxide emissions, and companies obtain a continuous flow of innovations.

As part of a UBA research project, the European Economic Research Centre and the Centre for Environmental Policy Research at the Freie Universität Berlin have investigated international policies on the promotion of environmental innovation [88]. They point to two examples which are of particular interest: the Japanese top-runner model and the Californian initiative for limiting the emissions from private cars (see box).

An analysis of international policies is useful in two respects. Firstly it provides companies with information about regions and countries where a demand for increased innovative technology is likely to exist in future, and secondly it provides starting points for drawing up future framework conditions for innovations in Germany and in Europe. In addition to established competitors such as the USA and Japan, the so-called newly industrialized countries are also forcing their way onto the market. Additional efforts in research and development and to encourage further diffusion of the market for innovative environmental and climate protection technologies are needed in order to remain competitive. The UBA is assisting the Federal Ministry for the Environment in its focus on "Environment, Innovation, Employment" with a number of research projects.

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DEPARTMENT I 3 "TRANSPORT, NOISE"

Energy efficiency and the reduction of traffic noise

The coming years will see a continued sharp rise in traffic volumes, accompanied by increase energy consumption and the emission of climate-threatening carbon dioxide (CO_2), a state of affairs that that has also been predicted by the European Union. Approximately one third of all the energy consumed in Europe is accounted for by the transport sector, which is accountable for a large proportion of greenhouse gas emissions in the EU [90]. According to estimates by the Federal Environment Agency (UBA), between 2005 and 2020 transport output in Germany will rise by 553 billion to 751 billion tonnes/kilometre (approx. 26 per cent) for freight traffic, and for passenger traffic the equivalent rise will be from 1,222 billion to 1,437 billion person/kilometres (around 15 per cent). More traffic also means a further increase in noise pollution. According to surveys conducted by the UBA, two thirds of the population in Germany suffer from the effects of noise, especially from traffic [91].

Traffic will continue to increase during the coming years.

The adverse effects of motorized traffic on public health and on the natural basis for life calls for technical innovations and new concepts when planning traffic routes. The main elements of an environmentally sound transport policy consist of an efficient public transport system, the construction and expansion of a network of attractive pedestrian and bicycle paths, assistance for regional economic cycles and the transfer of goods traffic onto the railways. In addition to measures for the avoidance and transfer of individual transport services, a significant contribution to achieving energy savings in the transport sector and thus to protecting the climate can be made by improving the technical efficiency of the means of transport. It was against this background that the Department "Transport, Noise" of the UBA revised the report on the state of "Reducing CO_2 levels in Traffic" from 2003 [92].

The potential efficiency of motor vehicles has by no means been exhausted

According to estimates by the UBA the long term potential (up to 2050) for achieving energy savings with private cars is approximately 70 per cent, and around 40 per cent for commercial vehicles. This estimate is based on the use of highly efficient propulsion systems and effective lightweight construction. With conventional propulsion systems reductions in fuel consumption of up to 30 per cent can already be achieved in a cost-efficient way, i.e. with only slight additional costs for the manufacturer and using currently available technology. Examples include turbo-charged combustion engines with a reduced cubic capacity (downsizing), fully variable regulation of all engine parameters (for example, valve regulation), efficient, automatic gearboxes and hybrid propulsion system (a combination of combustion engine and electric motor).

The strategy employed so far by the EU for reducing fuel consumption and consequently the CO_2 emissions of private cars has failed. This was based fundamentally on a voluntary commitment by the automobile industry to restrict the CO_2 emissions of new vehicles to a fleet average of 140 g/km, corresponding to around 6 l/100 km for petrol-engined cars, by 2008/2009.

The motor industry's slogan has always been "bigger, more powerful, faster". Although engines have

become more efficient over the past ten years, most improvements in efficiency tend to be cancelled out by the inclusion of additional equipment for increased comfort and by increasingly powerful engines. The Commission is therefore considering a more far-reaching objective, using various technical measures in cars in order to attain a fleet average for new cars of 130 g of CO_2/km by 2012.

CO_2 limits for private cars: In 2006 the UBA developed a proposal for imposing limit values on the CO_2 emissions of private cars, which met with a positive response from experts. Basically two different methodological approaches are possible, although more research will first be needed. Currently the agency has been investigating reference levels suitable for defining CO_2 limits. Answers were sought to the following questions: how close is the correlation between the CO_2 emissions of cars and the parameters of cubic capacity, rated output, unladen weight, interior volume and the surface area of the vehicle? And: how reliable are they in when faced with influencing factors, assuming the manufacturers were to make adjustments in response to the limits on specific CO_2 emissions but without actually reducing fuel consumption?

The reference values of cubic capacity, rated output and unladen weight are not ideally suited to efforts to limit CO_2 emissions. By making selective changes to these parameters manufacturers could relatively easily adhere to the specified limit but without a genuine reduction in CO_2 levels, and would not have to invest in modern technology for reducing CO_2 emissions. If a higher CO_2 emission level were permitted with a larger cubic capacity we could expect developments to proceed contrary to the required trend for smaller, more fuel-efficient engines. A limit based on weight would present manufacturers with an incentive to increase vehicle weights. There is no standardized way of defining interior volume and therefore no such data is available.

According to current research findings it would appear that average CO_2 figures for the cars on the road in 2006 that were determined by the surface area (length by width of a vehicle) would be a more suitable reference figure. The surface area of a car is a figure that suppliers would find difficult to influence because of the constraints imposed by design and user value, and therefore it would provide a stable basis for limiting CO_2 emissions.

What would be the actual environmental advantages of such a procedure? Establishing a CO_2 limit based on the surface area would exhaust the technical potential for attaining CO_2 limit values. If this proposal were to be adopted the UBA would expect to see a rapid increase in the range of far more economical vehicles, resulting in a reduction of some 20 per cent in average specific CO_2 emissions by 2012. On this basis the CO_2 limit values for the European new car fleet average could be cut to around 90 g/km CO_2 by 2020 (corresponding to about 4 litres of petrol). As a result the total amount of CO_2 emissions from private cars in Germany and in the EU would be improved by up to five per cent annually for all newly registered cars by 2020. For a few, high consumption models of car that are unable to reach the limit value for their respective surface area from 20212 onwards, climate protection requirements could be linked with licensing for road use for a transitional period with the aid of financial incentives, such as the imposition of a special charge, to encourage further reductions in consumption.

Vehicle tax: Since 1954 vehicle tax has been based on the cubic capacity of a car. Vehicle tax based on CO_2 levels, as an accompanying measure to the legislation on CO_2 emissions could help to speed up the introduction of more energy-efficient cars. By hastening the introduction of more environmentally friendly road vehicles, a car tax that differentiated between the emission levels for carbon monoxide, nitrous oxide, hydrocarbons and particles is an effective way of encouraging the introduction of low-emission vehicles. The introduction of the Euro 4 standard in 2005 hardly allowed any additional scope for regulating low-pollution vehicles. Lawmakers should also use vehicle tax as an instrument for encouraging the introduction of particularly fuel-efficient cars. Together with the Federal Ministry for the Environment, the UBA is intensively involved in planning a system of vehicle tax based on the fuel consumption.

Fuel consumption readings according to the EU standard: The technical supervisory authority TÜV Nord was commissioned by the UBA to carry out a research project entitled “Updating the EU Directive on the Measurement of Consumption and CO_2 Levels of Cars” for the measurement of the CO_2 emissions produced by cars [93]. The purpose of this project was to investigate the influence of ancillary equipment (air conditioning, power steering etc.) on the CO_2 emissions of cars and to develop proposals for extending the EU directive. The intended procedure would take into consideration the actual carbon dioxide emissions more effectively than is the case with the current EU specifications for obtaining readings. The average increase in consumption of between 10 and 15 per cent when ancillary equipment is used should be included as the base figure for the legislation on CO_2 emissions from cars.

The ago-old dream of flight is imposing increasing burdens on the environment.

Improving efficiency levels in aviation

Due to the growing volume of air traffic, aviation presents an increasing problem for climate protection. Not only carbon dioxide emissions but also those of water vapour and nitrous oxide from aviation are contributing to the warming of the atmosphere. Measures intended to improve efficiency levels (such as more fuel-efficient engines) are unable to compensate for the increase in emissions resulting from the growth in aviation, let alone reduce these levels. In an effort to improve efficiency in aviation the UBA is involved in intensive discussions about including aviation in the European emissions trading system. The EU Commission submitted a proposal in this respect on 20 December 2006, recommending that, from 2011 onwards, the European emissions trading system should initially only apply to flights between EU airports [94]. Beginning in January 2012 this should be extended to include all flights arriving at or departing from European airports. From this date onwards non-European airlines would also be affected. The UBA thoroughly supports the aims of the EU Commission to stabilize emissions from aviation at the 2005 level. However, this proposal does not take into account the overall effects of aircraft emissions on the climate. The intention is to allocate emission rights to the airlines almost entirely free of charge, which is expected to have hardly effect on the price of air tickets and thus on the demand for air travel. For this reason the UBA believes that the additional effects of aviation on the climate should be taken into consideration in the emissions trading process and that emissions rights should not be allocated to the airlines free of charge.

A quieter future: reducing aircraft noise

For many people the quality of life is impaired by the noise produced by cars, railways and aircraft. Exposure to high noise levels can also present a health hazard, with road traffic the primary source of such noise. One of the main tasks of a sustainable transport policy is to reduce the amount of noise emanating from the roads, railways and aircraft. This requires

- a reduction in the noise emissions from vehicles, roads and railways, and from aircraft, and
- improved protection for the public from noise emissions.

Road traffic: Tyres are a major contributory factor in the noise emissions produced by road traffic. For this reason, and over 30 years after regulations on vehicle noise were introduced, with its Directive 2001/43/EC on tyres, the European Commission has also introduced noise limits for vehicle tyres. This directive came into force in 2001 and requires noise limits to be adjusted in response to the latest available technology after three years.

A study carried out on behalf of the EU Commission and based on investigations by the UBA came to the conclusion that existing noise limits should be substantially reduced, by an average in excess of 5 dB(A) [95, 96]. The authors also referred to the suggestion by the UBA that all tyres should be marked with their noise level, which is not yet the case. A label on tyres stating noise levels would offer useful guidance to consumers wishing to consider this factor when buying new tyres.

Rail transport: By the end of 2002 limits had already come into force for high speed rail transport. For the first time the European Commission

Traffic noise – number one annoyance.

has now approved limits for conventional rail transport too. As of 23 June 2006 they apply to new locomotives, coaches, goods wagons and railcars which can be used on the trans-European rail network (so-called interoperable vehicles). The Commission has thus implemented a proposal submitted many years ago by the UBA for making the railways quieter.

One of the most important results of the new limits applies to rolling stock, mainly goods wagons. Grey cast iron brake blocks are a particular source of noise, and where it prove impossible to comply with the limits, these must be replaced by less noisy brake systems. In the long term, on goods routes where the tracks are in very good condition this will enable noise levels to be cut, the effect being equivalent to a reduction in traffic to a tenth of the current volume.

Amendment to the Law on Aircraft Noise: In future improved structural noise reduction requirements will be imposed in the vicinity of larger civil airports and military airfields. This has been provided for by the amendment to the Law on Protection against Aircraft Noise, which the UBA helped to prepare. The lower house of the German parliament, the Bundestag, passed this new law restricting aircraft noise in December 2006, and it received approval from the upper house, the Bundesrat, in March 2007.

The law specifies the designation of noise protection zones at numerous civil and military airfields. The areas in question consist of two day time protection zones and one nigh time zone. Within the Day Time Protection Zone 1 and the Night Time Protection Zone the operators of airfields must provide reimbursement for structural noise protection measures on existing residential buildings. In addition, within the Night Time Protection Zone they also have to meet the costs of ventilation installations in sleeping areas. The amendment also stipulates that, in the case of new airfields and airfields where substantial extension work has been carried out, residents in the seriously affected Day Time Protection Zone 1 must receive compensation for the fact that their use of the external living area (for example balconies or patios) is restricted. Furthermore various restrictions apply to the use of structures in the protected zones.

In consultation with the Bundesrat, the German federal government will regulate various details of the Law on Aircraft Noise in the form of four statutory instruments. These include in particular a new procedure for assessing aircraft noise, which has been prepared by a group of experts under the leadership of the UBA. Included in the assessment process are the noise emission data for the aircraft, the number of aircraft movements in the six busiest months of the year to which the prognosis applies, and the flight paths used by aircraft in the vicinity of the airfield.

Inadequate enforcement in the case of noise from machines and equipment: In some cases the labelling of the noise parameters for products and machinery in accordance with the Directive 2000/14/EC (effective in Germany with 32. BImSchV) is still incorrect. This was the conclusion reached by a UBA research project carried out by Deutsche Landwirtschaftliche Gesellschaft and TÜV Nord Systems, which identified labelling and documentation deficiencies in some 15 per cent of commercially available equipment. During a cooperative test, subsequent readings of the indicated noise levels as guaranteed by the manufacturers also showed that five out of the 24 different groups of equipment exceeded the indicated noise level by between 1.5 and 2 dB(A).

Monitoring and checks on use within the terms of the EC Directive 2000/14/EC are among the most important measures for maintaining commercial competitiveness. The research project revealed the need for improved monitoring of labelling by the federal states with executive responsibility. This demand also applies to other member states of the EU because some of the deficient equipment has been traded there [97].

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DEPARTMENT I 4 "CLIMATE PROTECTION, ENVIRONMENT AND ENERGY"

Reduction in CO_2 emissions by 40 per cent between 1990 and 2020

Climate change has already begun. Current forecasts predict serious dangers for our economy, for the stability of eco-systems and thus for sustainable development too. Mankind must react now, on a worldwide scale, if we are not to exceed the "red line" of a temperature rise that is still just tolerable of two degrees Celsius compared with the pre-industrial level.

To attain this two-degree target the required long term stabilization level of greenhouse gases in the atmosphere is 400 ppmv (parts per million of volume, see box) of CO_2 equivalents (see box). Total global emissions of greenhouse gases must be reduced to half the current level by the middle of this century if this figure is not to be exceeded and, on account of their very high per capita emissions, the present industrialized nations must achieve an 80 per cent reduction compared with 1990. As a step in the right direction the industrialized countries must aim to reduce their emissions by an average of 30 per cent by 2020. By the end of the century per capita emissions must be reduced to a worldwide average of two tonnes of CO_2 equivalents (t CO_2 eq.) if the two-degree target is to be met [98].

In view of its high per capita emissions, its technical skills and the available economic opportunities Germany, as a pioneer in the field of climate protection, should lend its support to efforts to achieve a 30 per cent reduction in greenhouse gas emissions in the European Union (EU) by making a commitment to cut its own greenhouse gas emissions by 40 per cent by 2020, compared with the 1990 level. Germany is already benefiting from its position as

Greenhouse gas emissions: Emissions consist of the release of substances into the atmosphere as a result of human activity. They can arise from various different processes, CO_2, for example, being produced by combustion processes. The Kyoto Protocol refers to the gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the so-called F gases (H-FKW, FKW, SF_6), all of which are damaging to the climate.

CO_2 equivalents: The effects of the various greenhouse gases differ in strength. One tonne of emitted methane, for example, is responsible for 21 times the greenhouse effect compared with the same amount of carbon dioxide, which is itself the greenhouse gas emitted in the largest quantities. The standardized method of assessing global warming potential (GWP) is to convert the effects of the greenhouse gases into those of CO_2 (GWP of CO_2 = 1) and express it as a "CO_2 equivalent".

Parts per million (ppmv): The term parts per million refers in this case to the average concentration by volume of greenhouse gas molecules in the atmosphere: 400 ppmv of CO_2 equivalents means that the amount of greenhouse gases contained in each cubic metre of air is such that their greenhouse effect would be equivalent to that of 400 cubic centimetres of CO_2.

market leader in technologies to reduce CO_2 levels and could further consolidate this position, for example with modern wind farms or the highly efficient combined heat and power system.

The objectives of the Kyoto Protocol for 2012 are certainly within reach but only represent the first step. As part of the burden-sharing by the EU 15 in connection with the Kyoto Protocol, Germany has undertaken to reduce its greenhouse gas emissions by 21 per cent during the period 2008–2012, compared with 1990 levels. According to calculations by the Federal Environment Agency (UBA), by 2005 a level of 18.4 per cent had been reached. With the following measures Germany can also achieve the remaining 22 percentage point reduction and thereby attain the 40 per cent target by 2020.

The Federal Environment Agency's scenario for the 40 per cent target

Energy-related CO_2 emissions account for more than 80 per cent of all German greenhouse gas emissions. The Federal Environment Agency assumes that the 40 per cent target for total greenhouse gas emissions would be attainable – if this, the largest proportion of total emissions, were to undergo a 40 per cent decline by 2020. The 40 per cent target represents annual emissions of a maximum of 571 mi. t CO_2. This means a reduction in carbon dioxide emissions in comparison with 2005 of 224 mi tones of CO_2 annually. This would be possible if we were to achieve very much higher levels of efficiency in the conversion of energy, and use less energy.

Extension sockets with footswitch for turning off appliances on stand-by.

At the same time we must continue to increase the use of renewable energy. The Federal Environment Agency lists eight measures in the end energy sectors of electricity, heat and transport for attaining this objective by 2020.

The selection and weighting of individual technical, organizational and behaviour-related measures for reducing CO_2 emissions are determined in accordance with the following criteria:

- the economic efficiency of individual measures, i.e. the lowest possible avoidance costs per tonne of reduced CO_2,
- the ability to overcome legal and administrative obstacles to the reduction of emissions,
- the prospects for achieving the required changes of behaviour.

The UBA has developed a scenario in accordance with these criteria, in which the required reduction of 224 mi. t CO_2 is achieved.

Efforts to gain market access and penetration for renewable energy have led to technical refinements and a reduction in their performance-specific costs. This development should be continued in the future, which is why, given only moderate additional costs, such technologies can be intensively used for the production of energy [99]. The UBA has therefore excluded the use of new technology which is not yet commercially available from this scenario. This applies in particular to the deposition and storage of CO_2 from power stations, an area for which the agency does not anticipate significant commercial usability until after 2020 [100].

Eight measures for improving the climate

1. Saving electricity

The UBA scenario describes an annual decline of over eleven per cent in overall electricity generation as a result of efforts to save electricity. Compared with 2005 this would enable 40 mi. tonnes of CO_2 emissions to be avoided annually. One third of all Germany's electricity consumption is accounted for by electrical power units in industrial and commercial cross-sector technologies, where the following, economically viable potential for electricity savings exists: compressed air 33 per cent, lighting 24 per cent, pumps and fans 15 per cent.

By applying economies small consumers can cut their electricity consumption (amortization periods of up to five years) by some 15 per cent. The techni-

cal potential for achieving savings is considerably higher: at 70 per cent the largest savings are in lighting and idling losses. Savings of between 25 and 50 per cent are possible on domestic appliances, water heaters and consumer electronics equipment [98].

A number of effective incentives are required to also ensure that such potentials lead to actual savings in the future, for example by means of legally prescribed efficiency competitions between terminals, utilizing the top runner principle. This means that lawmakers determine the two or three most efficient items of equipment (such as televisions, washing machines, refrigerators) available on the market as the yardstick for all other items, and then stipulate in law that all other manufacturers must attain these standards within five years, for example. This approach has already been applied in Japan. Reducing the number of exceptions in energy taxation could enable an energy efficiency fund to be financed, which could in turn provide support for for advisory programmes and start-up funding for innovative technologies [101].

2. Improved efficiency of fossil fuelled power stations and increased natural gas usage

The modernization and replacement of coal-fired power stations could improve their average energy utilization by seven percentage points. Together with the expansion of more efficient and therefore less CO_2-intensive plants burning natural gas this would reduce emissions by up to 30 mi. tonnes annually.

Approximately 90 per cent of the natural gas being used currently in Germany is for heating purposes, and various methods can be applied in the heating sector to save substantial amounts of gas (see below). In the UBA scenario, if more gas were to be used to generate electricity, the entire consumption of natural gas would only increase by three per cent because the possible savings in the heating sector could largely offset the the additional gas required for electricity generation. This would enable gas imports to be kept within reasonable levels even though more natural gas would be used to generate electricity. The use of liquefied natural gas (LNG) can open up new sources, thereby helping to safeguard supplies.

In order to attain the efficiency improvements referred to previously, and to increase the share of natural gas in electricity generation, lawmakers must further reduce the number of CO_2 certificates used in emissions trading. These certificates should no longer be distributed free of charge either. An auction process would strengthen the free market optimization function of emissions trading.

3. Increased use of renewable energy for electricity generation

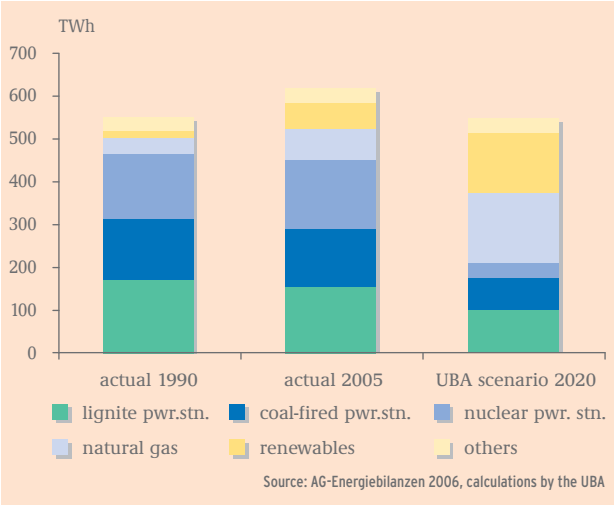
In the UBA scenario the 2020 target for renewable energy use is an annual figure of 140 terawatt hours (TWh/a). This would be linked with reductions in emissions from electricity generation of some 44 mi. tonnes of CO_2 annually. An equally conservative estimate in the new general scenario from the Federal Ministry for the Environment assumes 156 TWh of electricity from renewable energy by 2020 [99]. In this context a major role is played by the continued expansion of energy from wind (onshore and offshore) and the incineration of biomass.

The Renewable Energy Law (EEG) is the most successful instrument for encouraging the use of renewable energy. The principle, one of guaranteed minimum remuneration for an unlimited supply of electricity, has also proved to be more efficient and

More support needed for wind energy – wind turbine in the port of Rostock.

more effective throughout Europe than the other instruments that have been used [102]. Figure 24 shows the changes that have taken place in electricity generation in Germany.

Figure 24: **Electricity generation by Germany's power stations, in terms of energy source material (Actual situation in 1990 and 2005 and the UBA scenario for 2020)**



4. Expansion of combined heat and power

The expansion of combined heat and power (CHP) and the highly effective distribution of heat via the district heating network is a very promising field. This technology not only enables the fuel in power stations to be used for electricity generation but simultaneously for providing heating or cooling too, either for buildings or for industrial processes. In buildings the decentralized oil or gas fired heating systems could then be replaced by district heating and cooling.

Germany has the capability for doubling the amount of electricity generated by CHP from 70 TWh in 2005 to 140 TWh by 2020. Heat production from CHP will be increased, accompanied by an annual reduction in CO_2 emissions by 15 mi tonnes. In order to attain this target substantially improved assistance in the form of the CHP Law is needed and CHP should be given precedence in building planning legislation. This means that where the supply of heating by means of a local or long distance network is provided and is economically acceptable, when approving connection to this network lawmakers should give precedence to the producers of heating (such as waste incineration plants) and to the users of the heating or cooling supply. In future the CHP Law should also encourage new or modernized and highly efficient plants.

5. Conserving heat through building renovation and efficient heating systems, and in production processes

In industry and business the potential efficiency savings in the thermal use of primary energy (especially process heat) is at least 9 mi. tonnes of CO_2 [103]. The greatest potential is in thermal cross-section technologies (such as steam generation).

In households, industry, trade and services renovation of the building stock to improve energy efficiency could lead to a reduction in emissions amounting to 20 mi. tones of CO_2 annually, assuming an annual increase in the rate of building renovation for energy efficiency purposes from the current level of 0.6 to 2 per cent and an accompanying average reduction in CO_2 emissions of 60 per cent as a result of such renovation work. Replacing inefficient heating units in buildings by modern installations enables the degree of utilization of the fuels used to be improved by some ten per cent. Modernization of the heating systems in this way would save some 12 mi. t CO_2.

The main political instruments for implementing these measures, which offer a potential total reduction in emissions of 41 mi. tonnes CO_2 annually, consist of a more exacting Energy Saving Ordinance (EnEV) and its consistent execution, financial assistance from an efficiency fund, a rent law that eases some of the obstacles to the modernization of energy systems, and a considerably augmented programme of building renovation to reduce CO_2 emissions.

6. Heat from renewable energy

If the contribution by renewable energy (biomass, solar heating, geothermal energy) to heat generation were to be increased from its current level of 12 per cent this would reduce annual emissions of CO_2 by private households as well as by businesses, shops and services by six mi tonnes of CO_2 and the figure for industry would be just under four mi. tonnes. Here too legally based assistance is needed along the lines of the Renewable Energy Law.

7. Reducing specific consumption by transport

Aided by technical measures (such as engines with improved fuel economy and reduced output, and lightweight construction) and driving methods that help to reduce fuel consumption, by 2020 specific CO_2 emissions could be cut by 40 per cent. For goods vehicles the corresponding figure is 20 per cent,

achieved for example by using low resistance tyres and oils. Here the potential savings are 15 mi. t CO_2. The main political instruments are fuel tax, a CO_2-based car tax, the extension of the goods vehicle toll to cover all national trunk roads, and binding limits on the consumption figures for new cars.

8. Traffic avoidance and a transfer to railways and ships

Together these measures could lead to a reduction in emissions of a further 15 mi. tonnes of CO_2 annually. By refraining from constructing new roads and an expansion of the rail infrastructure would certainly help to transfer traffic, especially freight, from the roads onto the rails and ships. For example, it it were possible to persuade five per cent of all those making urban car journeys to use public transport, and 30 per cent of all those undertaking car journeys of less than five kilometres to use bicycles, annual CO_2 emissions could be reduced by between three and four tonnes.

Steps must be taken to inhibit the increase in emissions from aviation which, in the absence of any counter-measures, will double by 2020 in Germany. The UBA scenario has not so far produced any quantitive details about air travel and therefore this has not been included in Table 3. However, because of its major importance, its inclusion in future climate protection programmes is a matter of some urgency. The combustion of kerosene produces CO_2, water vapour and ancillary products such as nitrous oxide and particulate matter. The overall greenhouse effect of the emitted substances at the height at which aircraft fly is roughly three times as great as it is at ground level. A return flight to Southeast Asia or the Caribbean produces the per capita equivalent of some six tonnes of CO_2. Aviation has so far not been included in emissions trading. Its inclusion in the European emissions trading system would help to internalize the external costs of aviation. Furthermore, revoking the exemption of kerosene from the tax on oil would lead to equal treatment for all forms of transport. These would both be highly efficient means of limiting the emissions produced by aviation.

Summary

These eight measures show that, by 2020, Germany is capable of attaining the objective of cutting energy-related CO_2 emissions by 40 per cent compared with 1990, provided that politicians create the right incentives. By 2020 this scenario would be tied to a maximum additional annual expenditure of eleven billion euros, compared with a development process that did not involve any additional climate protection measures. This amounts to less than 25 euros per household each month.

Its leading role in climate protection offers some enormous opportunities to German industry because the next few decades will see expenditure of several billion euros on efforts to ensure that energy supplies do not adversely affect the climate. The reductions in CO_2 emissions that are summarized in Table 3 are technically feasible and economically sustainable. However, they can only be achieved if

Table 3: **Summary of proposed measures to reduce CO_2 emissions**

		Reduction between 2005 and 2020 in mi. t CO_2
in electricity generation		**– 114**
1.	Electricity savings (11 %) through more efficient consumption	– 40
2.	Changeover to natural gas and improved efficiency in fossil-fuelled power stations	– 30
3.	Doubling the deployment of renewable energy to 140 TWh/a	– 44
Heating supply		**– 66**
4.	Doubling of combined heat and power	– 15
5.	Heat savings and improved efficiency	– 41
6.	Doubling the proportion of renewable energy to 12 %	– 10
Transport		**– 30**
7.	Reducing specific consumption	– 15
8.	Modal split and avoiding use of transport	– 15
	other measures and effects	**– 14**
Total energy-induced CO_2 emissions		**– 224**

Source: UBA

decisive, rapid action is taken. For example, given the need to renovate buildings in German to improve their energy efficiency, each year that is lost represents as much as 1.5 million tonnes in additional CO_2 emissions. The same applies to the CO_2 emissions from power stations and to the installation of inefficient heating systems. It is therefore imperative that decisive steps are taken now.

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DIVISION II "ENVIRONMENTAL HEALTH AND PROTECTION OF ECOSYSTEMS"

"For humanity and environment" – the agency's motto is particularly applicable to Division II. Experts in the five departments determine the ecological stresses on water, the soil, the air, drinking water and human beings. They also register environmentally related illnesses, impairments to health, ecological changes and the main conditions necessary for maintaining biodiversity. The Federal Environment Agency (UBA) obtains its own data for these purposes (air monitoring network, environmental sample bank) or uses those of the various federal states which are also responsible for monitoring the environment. The departments assess the environment by comparing the differences between actual and theoretical conditions, and supply reports containing this data and their assessments to politicians and scientists at both a national and an international level.

Using risk evaluation the division develops quality objectives and initial classifications to enable the state of the environment to be assessed, with the aim of protecting human, plant and animal life. The intention is not only to determine whether the legally binding limits are being adhered to in Germany but also to identify new hazards and trends. Only in this way can environmental policy measures be developed in time.

In recent years public interest has focused increasingly on the health concerns associated with environmental protection, Within the UBA and through its cooperation with other institutions, for example in the "Environmental Health Action Programme", the division seeks to establish more effective links between the various requirements for protecting the environment and health. This includes advising the federal states and municipalities, and informing the public, through generally understandable publications on "Health and Environment" topics.

Additional details about the work of the Division can be obtained at:
http://www.umweltbundesamt.de/uba-info-e/e-fach2.htm

DEPARTMENT II 1 "ENVIRONMENTAL HYGIENE"

Measuring and observing environmental influence on health

Is environmental pollution harmful to humans? And is it constantly increasing? Are we in Germany subjected to high levels of exposure? Are prohibitions on manufacture or use adequate for protecting us against exposure to pollutants? Health-related environmental monitoring provides answers to these questions. It supplies the relevant information on the ways in which pollutants, noise, dust and allergens adversely impact on health. The aim is to identify and assess the complex interrelations between

the environment and health and in this way to be able to propose suitable measures for preventive behaviour, precautionary action and averting dangers. How does the Federal Environment Agency (UBA) fulfil these tasks?

The basis is provided by Human Biomonitoring (HBM), which records the xenobiotics in human bodies [104]. Blood and urine are the preferred specimens for investigation, but hair, fingernails and teeth may also be suitable for indicating the exposure to various substances. Individual questionnaires are used to obtain the information needed in order to interpret the findings, such as the ways in which the subjects incorporated the substances (the so-called paths), and the possible sources of these substances. The questionnaires also include accompanying details about the subjects' settings and their preferred foodstuffs and other consumer items.

The data are compiled together with other findings (for example, the results of special studies, analysis of exposure factors) to provide a sufficient basis for evaluating the results and for identifying important sources of exposure (see box) and paths. This is one prerequisite for the development of precautionary and risk-minimisation strategies within the overall framework of health and environmental policy measures. The second prerequisite is a scientific basis for evaluating the impact on health of the measured pollutants. The fundamental question is: can the increase in various health problems such as allergies or reduced sperm quality be attributed to current environmental pollution?

Assessing environmental pollution

Over the past 20 years the German Environmental Surveys (see box) conducted by the UBA have been a reliable source of HBM data about the exposure of the German population to pollutants [105]. Using accompanying investigations and extensive analyses of statistical data the German Environmental Surveys describe the extent and the distribution of environmental pollution from various sources as well as the different pathways of exposure, such as lead from water pipes and nickel from drinking water taps and fittings. The experience that has been obtained in this way is still being used to interpret elevated HBM readings (see below).

Repeated analyses of the same substances at longer intervals provide details about time trends. The continually declining readings for lead, arsenic, pentachlorophenol (PCP) and polychlorinated biphenyls (PCBs) indicate the effectiveness of legislative measures such as the ban on PCBs of 29.07.1989. Information about the background exposure (see box) of the public, i.e. the average measurable concentrations of the chemicals in blood or urine, is extremely useful in the interpretation of individual readings, especially where increased exposure to pollutants is suspected. Statistically defined reference values describe the background exposure. However, they do not provide a statement about the health significance. The Human Biomonitoring Commission of the UBA has derived such reference values for 17 substances and groups of substances, where adequate separately for men, women and different age groups.

A health risk assessment of xenobiotics is by far more complicated than simply obtaining a reading of their concentrations in body fluids. A scientific assessment calls for wide-ranging knowledge of the behaviour and effects of the xenobiotics in the human organism. Research into the effects uses special methods and test organisms, but their reactions are only transferable to humans subject to certain reservations. It is particularly difficult to assess long term effects because laboratory animals have much shorter lives than humans.

The Human Biomonitoring Commission therefore has only derived toxicology-based assessment criteria for a few adequately investigated pollutants, so-called "HBM values". These two-stage HBM values ("early warning and alarm") are used by epidemiologists and medical experts when deciding on what action to take and in planning individual therapies. The Commission updates the HBM values in the light of new scientific findings on the effects of these substances. The critical factor is the paucity of data about the toxicity of many industrial chemicals, and available data are sometimes contradictory. Consequently a health risk assessment is often difficult and sometimes hardly possible at all.

Human biomonitoring is primarily suitable for the determination of those xenobiotics which remain in the body for longer periods and show a tendency for bio-accumulation. For humans, as the final link in the food chain, this behaviour by substances, referred to as persistence, means that many of these substances are stored in the fatty tissue and can remain in the body for decades. Examples which have been known for a long time include chlorinated compounds such as DDT, Lindane or PCBs; while among more recent pollutants are perfluorinated tensides and brominated flame retardants.

How should the presence of these "undesirable intruders" in humans be assessed from a health viewpoint? The organ or tissue in which they are stored

can usually be quickly identified and any local changes are relatively easy to observe. Less is known about the effects of these chemicals on the entire body at chronic exposure to low environmental concentrations. The complexity of the interactions with the nervous, hormonal and immune systems make it more difficult to determine whether substances negatively impact on human health. The UBA attaches a great deal of importance to substances which interfere with the hormonal system (so-called "endocrine disruptors"). Children's organisms prior to and shortly after birth are particularly sensitive because the effects of foetal and early childhood exposure do not manifest themselves for several years, and can have an adverse impact throughout an entire lifetime.

In medical terminology (and especially in toxicology) **exposure** refers to the environmental, and especially harmful influences, to which the body is subjected. For example, a miner is exposed to rock dust, a passive smoker to cigarette smoke. Exposure does not necessarily lead to illness but it is a possible cause of disease or of impairments to health.

The Anglo-American meaning of **survey** also includes the process of obtaining an overview by means of enquiries, to undertake an inspection or investigation, as well as an enquiry that can be statistically evaluated. In the present context it refers to the systematic cross-sectional investigation of a statistically representative sample of the general population.

The **German Environmental Surveys** (GerES) that the UBA has been carrying out since 1985 are intended to identify and update representative data about the body burden of pollutants and pollution in the home among the general population of Germany. Due to the expense involved, such investigations can only be carried out at intervals of four to six years, providing current readings ("momentary state") of a priori defined substances ("target analysis"). It is a fact that one only finds what one is looking for.

The **German Environmental Specimen Bank** (ESB) is an archive of environmental and human specimens for the long term monitoring and assessment of general environmental quality and the exposure to which people in Germany are subjected. The concept of the ESB is to regularly obtain samples under standardized conditions, and to analyse part of these samples with respect to certain substances. The remainder of the samples is stored under strictly standardized conditions over a long period, protected against any changes, in the actual specimen bank, and are available for the tests mentioned previously. The human specimens consist of whole blood, blood plasma, urine collected over a 24-hour period, saliva, head and pubic hair from four groups of students (each of between 100 and 150 subjects, roughly half male, half female), some of whom have regularly been submitting samples since 1994 in Münster/Westfalen, Halle/Saale, Greifswald and Ulm. The oldest archived human specimens were from 1981 in Münster.

Biomarkers are measurable products from organisms, which are used as indicators (for example to show environmental exposures or diseases). If environmental influences (for example, solar radiation) or xenobiotics penetrate biological systems, they can lead to changes in metabolic processes. Changes can be demonstrated by measuring the activity of certain characteristic substances, their presence or their concentrations.

Reorganisation of health-related environmental monitoring

Until now the UBA has carried out German Environmental Surveys of a representative cross-section of the population. The agency has also been operating its Environmental Specimen Bank [106], an archive containing many different kinds of samples [see box], since 1986. Both these instruments have their own different strengths in providing a picture of the pollutants to which the population is exposed. The UBA is developing the concept for future, health-related environmental monitoring in such a way that the individual areas of research are more closely linked to the relationship between environmental exposure and health.

The limits to the German Environmental Survey concept (current status, target analyses) are being extended via the Environmental Specimen Bank. The human specimens, some of which have been stored since 1981, allow for retrospective investigations to be carried out. This means that we are now able to measure the amount of hormone-like plasticizers having been present 20 years ago. Other questions that can be answered include: since their harmful effects were discovered, have the levels of exposure declined, or did new exposures emerge as a result of the use of industrial substitutes? Pollutants can thus be recorded retrospectively if new effects of known contaminants or previously unrecognized compounds occur

Taking archived specimen out of a cryo-vessel.

or if methods of analysis permit more far-reaching investigations to be carried out than in the past.

The UBA is now planning to set up a cohort of infants and toddlers that shall be examined as shortly after birth as possible and then at regular intervals, and whose samples can be archived in the human specimen section of the ESB. The aim is to conduct systematic observations of the development of the particularly sensitive group of newborn children, who therefore require greater protection, over a longer period than has been possible in the past.

Compiling individual health information and data about exposure to pollutants over a period of time improves the possibilities for identifying the effects on human health of environmental chemicals. Consequently the new health-related environmental monitoring also includes comparative examinations of groups subjected to high and low levels of exposure. Such projects support the environmental policy objectives of "minimizing material risks", which forms part of the European "Environment and Health Action Plan 2004–2010". Particular importance is being attached to the problems concerning childhood cancer, impaired neuronal development and the effects of endocrine disruptors [107].

Interlinking with international activities

The EU Commission is convinced that it will only be possible to achieve a better understanding of the effects of various environmental factors on human health if the various instruments used for these investigations are linked together. The Commission supports the harmonization of methodological procedures and the establishment of a complementary approach to research to achieve EU-wide research involving close cooperation between all the relevant disciplines. This has been unequivocally stated in the position paper issued by the Scientific Committee on Health and Environmental Risks (SCHER) [108] and is also clearly reflected in the key aspects of activity within the 7th EU Research Framework Programme.

With its many years of experience in the field of human biomonitoring the UBA has an important role to play in European cooperation. For example, it is represented in the Implementation Group on Human Biomonitoring – an expert panel that provides scientific advice to the EC commission – and, as part of the ongoing 6th Research Framework Programme, in a planning project for human biomonitoring (ESBIO) [109]. These activities by the UBA are being extended in a network set up under the 7th EC Framework Programme, which supports the participating research facilities in their efforts to intensify long term cooperation. In addition to carrying out an EC-wide pilot study on human biomonitoring, the network project also encompasses research into the use of new biomarkers (see box on p. 59).

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DEPARTMENT II 2 "WATER"

It all ends up in the sea – what can be done about it?

Some 70 per cent of the earth's surface is covered by oceans. Like the rainforests they fulfil a global function in ensuring the stability of the climate and of ecosystems, as well as serving as a source of valuable natural resources. The many purposes for which they are used have some serious and in some cases irreversible, negative effects: overfishing, the threat to various communities of organisms in the sea as a result of the human deposition of hazardous materials, eutrophication (over-use of fertilizers), the introduction of alien species and habitat loss (such as the ecosystems of the mudflats, coral reefs). The marine environment is also increasingly in jeopardy as a consequence of climate change.

Major successes have been achieved in the past in the protection of the oceans. The approach still being used is to regulate the sectors in isolation that are responsible for these effects, such as agriculture, industry, transport, fisheries, seaborne transport, oil and gas extraction, the military and tourism. Future success in protecting the oceans must be coordinated and combined across national boundaries. There has to be a shift from a sectoral to an integrative approach in order to be able to accurately deal with the different (over) uses and numerous problems faced by marine ecosystems.

With its "Thematic Strategy for the Protection and Conservation of the Marine Environment", published in October 2005, the EU Commission showed that it was aware of the current situation [110]. This strategy contains an integrated concept for protecting the seas around Europe, and focuses on monitoring and assessing the relevant qualitative components of the marine ecosystem, such as algae, invertebrates, fish, sea mammals and seabirds. This approach, emphasizing the ecosystem aspects, is already a well-known feature of the EU Framework Water Directive. The EU Commission's strategy also includes a proposal for a directive leading to the creation of a regulatory framework for community measures for the marine environment (marine strategy directive). On 18 December 2006 the EU member states came to a provisional agreement on policy. The EU Commission, European Parliament and the member states are currently engaged in negotiating more details of this draft directive. To ensure that the directive includes effective measures for the protection of the oceans it is essential, among other things, to achieve harmonization with the instruments contained in the Framework Water Directive and to incorporate the requirements of marine nature conservation.

In an effort to encourage this integrative approach, in June 2006 the EU Commission published its green paper on "The Future Maritime Policy of the European Union: European Vision of the Oceans and the Seas". In considering maritime policy this green paper is not confined to the areas that come within the remit of the General Directorates, such as the environment, fisheries and maritime affairs, agriculture, transport and energy, research, business and regional policy. The aim is to analyze the interconnections between what have up to now been

More attention should be given to marine protection.

sectoral perceptions and measures, to identify synergies, and to develop and implement them. This integrated approach is intended to establish a balanced relationship between the use and protection of the seas. The green paper follows on from the Lisbon Strategy and is primarily concerned with sustainable growth and employment in the maritime sector. The maritime strategy directive therefore forms the underlying environmental component of European maritime policy.

Photo: UBA / Ulrich Claussen

The Federal Environment Agency (UBA) has assessed the draft directive and has issued a statement welcoming its integrative and innovative approach, although it still believes there is room for improvements [111]. Germany is actively involved in collaborating at EU level in ongoing efforts to create the maritime protection directive, and the UBA will also continue to make a substantial technical contribution. Moreover, under the leadership of the Federal Ministry for the Environment, the UBA has successfully carried out a research project as part of the preparations for an integrated coastal zone management strategy (IKZM) in Germany [112]. In its report of April 2006 to the European Commission the German government implemented the corresponding recommendation by the European Parliament and the Council of 31 May 2002 for Integrated Coastal Zone Management in Europe (2002/413/EC). IKZM is a management approach that endeavours to resolve conflicts at an early stage, to maintain environmental quality and, based on the needs of sustainability, to achieve harmonization of the various economic, social and ecological requirements in the development of the coastal region, on both the landward and seaward sides.

Deposits and pollutants

Appendix X to the Framework Water Directive lists 33 priority substances and a prioritization mechanism for hazardous substances. Because of their properties many of these substances are particularly relevant to coastal waters and oceans. In June 2006 the EU Commission published the draft of an ancillary directive to the Framework Water Directive, dealing with environmental quality standards for water policy. In it the Commission proposed various environmental quality standards but declined to specify European-wide measures for reducing emissions, which are the responsibility of the member states.

The UBA has commissioned the Fraunhofer Institut für Systemtechnik und Innovations-forschung to compile a list of important sources of deposits and to draw up possible measures for reducing emissions. In this respect the heavy metals lead, cadmium, nickel and mercury, the polycyclical aromatics, diuron and tributyl tin compounds are of particular relevance [113].

Those chemicals whose presence can be determined in the environment but whose potential environmental risks cannot yet be accurately assessed are known as emerging pollutants. One current example is that of perfluorated tensides, which have been detected in many oceans, even in polar waters, and more recently in Germany in drinking and surface water [114]. In general little environmental data is available about these pollutants. It is often not possible to assess their quality because the required analytical methods are still in the development stage and have not been adequately validated. It is therefore difficult for the relevant authorities to interpret or compare data and to use it as a basis for decision-making, for example about measures to reduce emissions.

The EU project NORMAN (http://www.norman-network.net) was launched in 2005 with the aim of setting up a network of experts in the fields of risk assessment, monitoring and analysis of new pollutants at a European level, thereby optimizing and standardizing this joint project. The UBA is one of 17 partners in this project, which will be engaged until 2008 in setting up this network.

Unobstructed rivers safeguard habitats

Many species of fish migrate between salt and fresh water because this is the only way that they can reach the habitats where they can feed and reproduce. They depend on the accessibility and proper functioning of various habitats, and consequently

their survival is determined not only by the material quality but also by the absence of obstacles in river systems. However, all too often rivers and streams are interrupted by structures built across them, for power generation, to prevent flooding, to allow the passage of ships, to supply drinking water or in order to regulate the groundwater level.

According the Germany's federal states there are over 60,000 such transverse structures exercising an effect on the ecology. The UBA has recorded these details and categorized them according to their functions [115]. The nationwide surveys reveal that, on average, rivers are interrupted every two kilometres by transverse structures. Moreover those rivers used as migratory routes are deficient in suitable spawning grounds and feeding habitats because of frequent degradation of the water. Led by the EU Commission, the member states of the EU, in collaboration with environmental associations and the representatives of other interests have discussed the political and technical possibilities of achieving hydromorphological improvements in harmony with the use of vessels, shipping and flood protection [116, 117].

A research project on the ecological reorientation of the management of Germany's waterways has compiled a list of various available courses of action for improving the morphological properties of larger rivers without interfering with shipping [118]. Unobstructed rivers are also important for sustainable coastal protection. The sensitive mudflats and coastal swamps around the estuaries of the larger rivers are important sites for many plants as well as breeding grounds for numerous birds, amphibians and fish. These ecosystems are being lost in increasing numbers because of the sharp reduction in the amount of solid matter being transported by the rivers. Measures to reactivate the transport of solid matter and to protect against erosion have been summarized in a report by the EU working group "EU Framework Water Directive and hydromorphological pressures on waters" with the active involvement of the UBA [116].

One of the consequences of climate change: acidification of the oceans

The observable changes in the climate are also producing far-reaching, adverse effects on the marine environment. For example, the increased deposition of carbon dioxide (CO_2) has already led to measurable increases in the acidification of seawater. This presents a particular danger to calcium-forming organisms such as corals and also certain algae. Climatic changes (warming, acidification of the oceans and a rise in sea levels) can be expected to alter the composition and function of ecosystems too. This will lead to a decline in the diversity of species and habitat changes (see also p. 29). Commercially important fish species are also affected.

Therefore it is vital to make more efficient use of energy, thereby substantially reducing the combustion of fossil fuels. Another method of reducing the deposition of CO_2 in the environment is to extract it and store it in geological formations on land or under the sea bed (Carbon Capture and Storage, CCS). The view of the UBA is that such technology only represents a transitional solution because, among other things, it consumes large amounts of energy and can also present a hazard to the sea bed [119]. Therefore such technology has to meet clear environmental requirements such as a prohibition on the introduction of CO_2 into seawater, a stipulation on the maximum amount of CO_2 that is allowed to escape annually from storage sites, and the adherence to quality standards for the pollutants accompanying the CO_2. The UBA will be developing concrete requirements for the storage of CO_2 under the sea bed, as well as proposals for a legal framework.

The expansion of wind energy generation on the sea is helping to reduce CO_2 emissions. Although this should be seen as basically a positive technological development, nevertheless the accompanying conditions must also ensure that it does not have a

The diversity of marine species is under severe threat.

negative impact on the ecology of the seas. The UBA is involved in the approval procedures and is committed to ensuring that minimum ecological requirements are met. These include: adherence to underwater noise limits, stipulations on the removal of the installations at the end of their life, precautions in the event of accidents and restrictions on the use of environmentally hazardous substances. In addition, with the aid of various research projects, the agency is planning to continue to develop technical possibilities for reducing underwater noise during the construction and operation of wind farms in the sea.

Biological assessment methods

Assessments of the ecological state of estuaries and coastal waters as well as of rivers and seas are primarily based on biological quality components, supported by chemical, chemical-physical and hydromorphological components. In order to effect the five stage assessment of the biological quality components (macrozoobenthos, macrophytes, phytoplankton, fish) as prescribed by the Framework Water Directive (very good, good, average, unsatisfactory, poor), in recent years national assessment procedures have been developed by research institutes working together with the federal states and the UBA.

While some of these procedures were completed by the end of 2006, other biological methods will require further development and practical tests before they can be used to monitor the state of the water. The UBA provides technical support for the development of these assessment methods for transitional and coastal water as well as for moving water and lakes. In addition the agency coordinates the work being carried out by Germany in the intercalibration process as well as representing Germany's interests in the European working group ECOSTAT (ECOlogical STATus). Intercalibration ensures EU-wide comparability of various ecological assessment procedures for the respective trophic levels (e.g. algae, shrimps, fish). By determining deviations it is possible to harmonize the sensitivity levels of the procedures.

Eutrophication

Signs of eutrophication have been evident since the mid-1970s along the German North Sea coast and in the Baltic and are an indication of anthropogenous nutrient enrichment in the water. Run-offs from agriculture, municipal sewage works, industry and transport into the rivers and from there into the sea create excess nutrients in the form of nitrogen and phosphorus, leading to a proliferation of single-celled algae (phytoplankton), with far-reaching implications for the ecosystems. For this reason, in 1987 at the "2nd International Conference on the Protection of the North Sea" ministers of the environment agreed that the nutrient run-off into the North Sea and Baltic should be halved between 1985 and 1995.

However, this target was only met for phosphorus emissions, and then not until 2000, in German rivers and canals. There has been a 65 per cent reduction in emissions, mainly as a result of the use of phosphate-free detergents and phosphate precipitation in sewage works. Over the same period nitrogen emissions into German surface waters fell by 40 per cent. This too was achieved due to improved purification processes in the sewage works. In contrast the run-off from agriculture into the North Sea catchment area only declined by 15 per cent and by 35 per cent into the Baltic [120].

However, a comparison of nutrient emissions in German rivers and canals with the amount carried by rivers and which eventually reaches the North Sea and the Baltic produced very different findings. The reduction in these emissions since 1985 is only partially reflected by the run-off of phosphorus into rivers and barely at all by the run-off of nitrogen into the North Sea and the Baltic. This is attributable to the following causes:

- The annual amount of nitrogen carried by rivers is linked directly with precipitation, which fluctuates widely from one year to the next.
- The nitrogen run-off from the area above the groundwater route is subject to long periods when it is retained in the groundwater. In the case of the Rhine it can take between 10 and 20 years, and for the Elbe 30 years, before this nitrogen reaches the surface water and is carried by the rivers into the North Sea and Baltic. Consequently the larger rivers will probably not react to the reduced emissions of nitrogen from agriculture for another few years.

In addition to the decisions in connection with the Marine Protection Convention, the environmental objectives contained in the Framework Water Directive are of decisive importance for coastal waters. The aim is to prevent any worsening in the state of the water and to manage bodies of water in such a way that they can be restored to a healthy condition by 2015. The guideline on the assessment of eutrophication that has been drawn up for this purpose also indicates that the effects of eutrophication can also occur a considerable distance away from

the environmental stresses that caused them in the first place. Although type-specific objectives of the body of water may be met at the place where the run-off of nutrients occurs, the eutrophication effects may emerge much further away. Therefore, compared with reductions required locally, further reduction measures may be needed upstream from a catchment area in order to attain a good ecological state in the estuaries and coastal water and in the area downstream of the catchment area. The current pollution of moving and coastal waters reveals that the countries bordering the North Sea and Baltic must continue to reduce eutrophication even after 2015. Only in this way can the objectives of the Framework Water Directive be met. This means that the management plans and programmes which are only now being drawn up for coastal waters must give priority to measures aimed at reducing the transport of nutrients.

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DEPARTMENT II 3 "DRINKING AND SWIMMING POOL WATER HYGIENE"

Healthy drinking water – the right installation materials are important too

The quality of drinking water can be adversely affected in the plumbing system (domestic plumbing) even though the water that comes from the mains supply meets all the conditions of the Drinking Water Ordinance (Trinkwasserverordnung – TrinkwV 2001) [121]. Apart from the design of the system and the way in which it is operated, the materials used can also affect the quality of the drinking water obtained from the taps.

The question of the "right" plumbing materials to use arises not only when new buildings are being constructed but, for example, during repair and renewal, and when kitchens and bathrooms are being modernized. If drinking water quality declines to such an extent in old pipes that the residents no longer find it acceptable, then renewal of the plumbing installations becomes inevitable. This is

frequently the case with galvanized steel pipes which, as the iron corrodes over time, often cause the drinking water to turn brown. Renewal is a matter of urgency if the plumbing installation or domestic connections contain lead pipes. Lead pipes can result in concentrations of lead forming in drinking water, which can present a health risk to infants and small children in particular.

One highly effective solution involves the replacement of all the plumbing in order to avoid exceeding safe limits over an extended period [122]. Constructional changes can be made (such as shorter pipe sections with an improved flow) to prevent the water from stagnating as an additional means of improving water quality at the extraction point (tap).

What materials can be considered for drinking water installations?

Either metal or plastic can be used for drinking water installations. Most of the commercially available products consist of complete systems, the individual items of which such as the pipes and fittings are not always made from the same materials. In many cases the plastic pipes are joined by copper alloy fittings. Most systems (such as the stainless steel installations) are provided with rubber sealing rings. Apart from the materials used in the pipes, the outlets (taps) are also an important feature of drinking water installations. These consist of copper alloys, usually chromium plated, and also containing plastic parts, rubber seals and lubricants. The same applies to thermostat valves, check valves, isolating valves, pop valves, pressure reducers and water meters.

Rusted part on a galvanized steel drinking water installation.

Consequently planners or home owners cannot choose installations made entirely of plastic or entirely of metal. Installations companies frequently specialize in just one or only a few systems. The main factors, apart from customers' specific wishes, are easy workability, the price, and a low incidence of faults and claims.

Lead pipes are a health hazard and should be completely removed without delay.

The certification symbol is also important

§ 17 Section 1 of the Drinking Water Ordinance (TrinkwV 2001) requires that all materials coming into contact with water must be hygienically safe. This condition is considered to have been met if the recognized technical rules have at least been met during planning, construction and operation of the system. This can be ensured by using certified products. Certification for most of the parts used in drinking water installations is issued by the German Technical and Scientific Association for Gas and Water (Deutsche Vereinigung des Gas- und Wasserfaches – DVGW). These requirements apply not only to hygienic safety (microbiological, chemical-toxicological and odour/taste) but also to correct technical functioning (e.g. effectiveness of seals, temperature-resistance, durability). The Federal Environment Agency (UBA) has drawn up a list of requirements for the hygienic assessment of organic materials in contact with drinking water, in the form of a series of guidelines. Microbiological requirements are also contained in the DVGW worksheet W 270 [123]. Manufacturers are required to submit their products to recognized testing agencies, which then issue certificates attesting to the hygienic properties of these products. Metallic materials are subject to the

requirements of the technical standard DIN 50930 Part 6 [124].

However, certification is not available for all the components of water supply systems. Technical rules providing the basis for certification are not available for new developments, and in some cases for products already in use (such as water meters). Cheap products may also be available which do not carry any certification label, and in such cases it cannot automatically be assumed that these products meet the requirements laid down by § 17 Section 1 TrinkwV 2001.

Does it depend on the water?

Water is recognized as an excellent solvent and, depending on the area where it is extracted, drinking water can contain various amounts and different kinds of minerals. It also contains dissolved carbon dioxide and oxygen from the air, which can interact with the materials used in drinking water installations. Certain metallic materials are not suitable for use in distributing all kinds of drinking water, one example being copper, which should not be used with “acidic” (i.e. low-pH) water. The guiding principle is that the choice of material should determined in accordance with this most vital of substances and not vice versa.

Photo: vvgw / BGW

Drinking water – a vital substance for more than one reason.

The Drinking Water Ordinance specify limits on most of the forms of contamination of drinking water by metallic substances. Increased concentrations, even leading to limits being exceeded, can occur from copper leaching from polished copper pipes or lead and nickel from fittings. The results of the readings are assessed using a weekly average concentration. The UBA recommends a method of obtaining samples that enables the weekly mean to be determined [125].

Certified plastic pipes can be used anywhere, irrespective of the properties of the local drinking water. In the majority of cases the organic materials used to make plastic pipes, rubber seals and coatings are derived from high polymer, interlinked molecules which do not dissolve in water. However, materials may contain reaction products as a result of the manufacturing process, or water-soluble substances, which may possibly have an adverse effect on quality. To ensure that the organic materials in contact with drinking water meet the required hygiene standards the UBA has issued several guidelines on the hygienic assessment of organic materials [126]. The guidelines replace the Plastics in Drinking Water Recommendations (KTW Recommedations) from 1977 and also take into account new findings and increased requirements for safeguarding health. The KTW Recommendation 1.3.13 will only remain in force until a new guideline for this group of materials has been completed.

Who helps to decide the right choice of installation material?

Given the many available products made from a variety of materials, it is not easy for owners of a drinking water installation to make the right choice, be it new fittings or a complete system. For this reason only specialist firms listed in the water utilities’ directory of contractors should be used to carry out work on the water supply. As a rule only they have a complete grasp of the many technical regulations and the experience to deal with the various materials. The knowledge that such enterprises have about the composition of the water to be found in a particular area provides additional safeguards for safe and hygienic water all the way to the taps. This is in any case an obligation for anyone connected to the public water supply, according to the Ordinance on General Conditions for Supplying Water (AVBWasserV) [127].

The local health office monitors the quality of drinking water in the supply area and in public buildings, and is the best place for members of the pub-

lic to address any queries about the quality of their drinking water. The public health office also investigates concerns, if necessary it arranges for investigations to be carried out, provides advice for anyone who is affected, and can also order steps to be taken against the owners of drinking water installations if this is necessary in order to eliminate health risks. The public health office also advises the owners of drinking water installations about essential measures for protecting consumers, which may also involve making use of recommendations and guidelines from the UBA.

In June 2006 the UBA published a brochure on this subject for tenants and home owners entitled "Trink was – Trinkwasser aus dem Hahn; Gesundheitliche Aspekte der Trinkwasser-Installation", with information about installing, operating and maintaining drinking water systems [128].

Contacts:

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[121] Regulation on the quality of drinking water for human use (Trinkwasserverordnung – TrinkwV 2001); Article 1 of the Regulation on the Amendment of 21 May 2001 to the Drinking Water Ordinance BGBL I 2001, p. 959

[122] Recommendation by the Federal Environment Agency (2003) on the problems of lead pipes in drinking water systems. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz 46: 825–826. Available on the internet at: http://www.umweltbundesamt.de/wasser/themen/trinkwasser/verteilung.htm

[123] DVGW W 270 (A) (on the proliferation of micro-organisms on materials in contact with drinking water – testing and assessment), (2007)

[124] DIN 50930-6 (2001) on metal corrosion – the corrosion produced by water on metallic materials inside pipes, containers and apparatus – Part 6: The influence on the composition of drinking water. Beuth Verlag, Berlin

[125] Recommendation by the Federal Environment Agency (2004): "Beurteilung der Trinkwasserqualität hinsichtlich der Parameter Blei, Kupfer und Nickel". Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz 47: 296–300. Available on the internet at: http://www.umweltbundesamt.de/wasser/themen/downloads/trinkwasser/probenahme_BMGS.pdf

[126] Guidelines issued by the Federal Environment Agency for a hygienic assessment of the organic materials in contact with drinking water can be found on the internet at: http://www.umweltbundesamt.de/wasser/themen/trinkwasser/verteilung.htm

[127] Regulation on the General Conditions for the Supply of Water (AVBWasserV) of 20 June 1980 BGBl. I 1980, p. 750

[128] The brochure "Trink was – Trinkwasser aus dem Hahn; Gesundheitliche Aspekte der Trinkwasser-Installation" is available on the internet at: http://www.umweltdaten.de/publikationen/fpdf-l/3058.pdf

DEPARTMENT II 4 "SOIL"

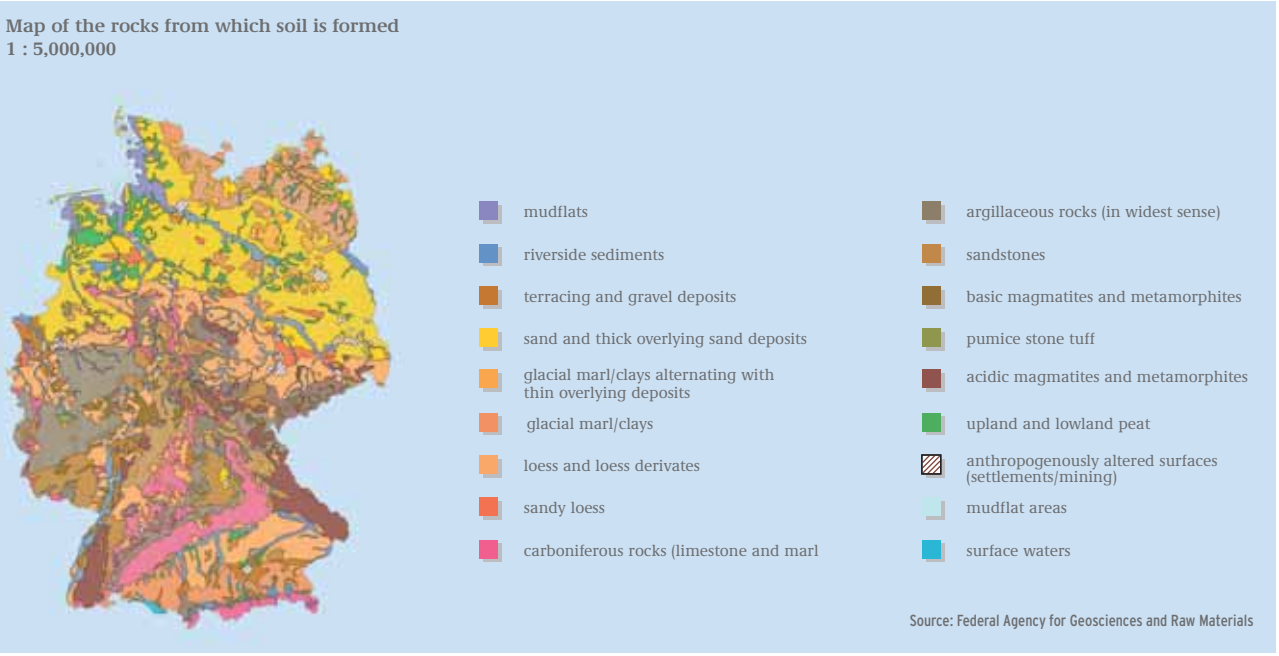
The state of the soil in Germany

Soils are responsible for producing good quality food, help to protect surface waters and the climate, supply raw materials and provide the basis for settlements and transport. They also provide a habitat for an almost unbelievable number of different animals and plants, and are therefore an important basis for biodiversity. Not only is the development of the the soil a long term process but, because it acts as a buffer and filtration zone, also any changes that occur in it take place over long periods too. Consequently harmful changes in the soil cannot be detected until much later, or through expensive and time-consuming analyses. Soils are a vital, non-renewable, natural resource fulfilling numerous functions. Last year we therefore undertook a number of other steps to more accurately describe the soil and the stresses and hazards to which it is subjected.

The state of soils in Germany presents a widely differentiated picture. The map prepared by the Federal Agency for Geosciences and Raw Materials shows the different rocks which form the basis for the creation of soil, from sandy soils in the north to clays in the centre of the country and the hard rock soils in the mountains. The variations in the soils are attributable to the many kinds of rocks from which they are derived, and to the effects of various soil formation processes.

Mankind has been making use of the soil for millennia, and throughout this time this has also had various negative consequences. In earlier times the removal of the humus and litter in the topsoil as a result of ploughing caused the unprotected topsoils to be blown away, leading to their impoverishment. The demand for land (especially where it is sealed), run-offs of pollutants and nutrients, as well as ero-

Figure 25: The rocks from which soil is formed in Germany



sion and compaction are the main negative influences. The more widespread cultivation of biogenic, renewable raw materials to assist with climate protection can also be linked with negative effects on the soil (see also p. 29). In its draft Soil Framework Directive of September 2006 the European Commission focused on eight dangers facing the soil: contamination, erosion, loss of organic substances, salination, compaction, land use, landslips and a loss of biodiversity [129].

When soils become "dirty"

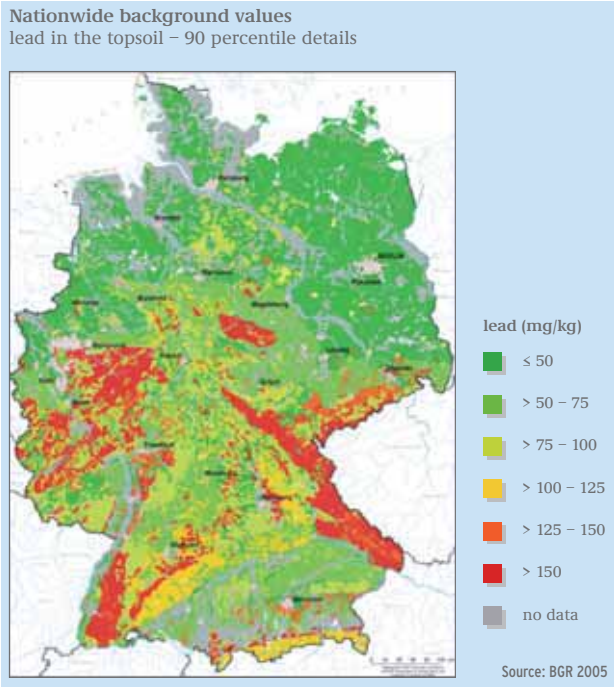
Pollutants can accumulate in the soil via the air (from industry and transport) and as a result of agricultural deposits (mineral fertilizers and manure). This has been demonstrated by investigations into the balance of pollutants such as copper and zinc. However, many substances also occur naturally in the soil and therefore knowledge of the background values (see box) in Germany is necessary in order to be able to interpret the readings. Background values can be researched online using the database for soil protection and environmentally relevant substances (STARS) at www.stoffdaten-stars.de. Details are also available from the Federal Environment Agency (UBA) at http://www.env-it.de/umweltdaten/public/theme.do?nodeIdent=2376.

Insufficient care with environmentally hazardous substances, especially in association with commercial activities, can cause damaging changes to the soil and the accumulation of residual waste. According to the Federal Soil Protection Act (BBodSchG) it is the federal states which bear responsibility for dealing with residual waste. Table 4 (see p. 70) shows the extent to which these details have been recorded and the work that has been done to deal with such waste deposits in Germany and with areas suspected of harbouring them. The federal states have agreed on the use of a uniform set of data which they regularly update [130].

The **background soil values** are based on the readings of the background content (concentrations of substances) and, quoting the statistical parameters and differences between the various soil properties and local conditions, together with the reference values for "use" and "type of region", they are used to indicate the representative concentrations of substances in the soil.

Germany now has comprehensive records showing the areas where the existence of waste materials is suspected. One notable feature is the considerable increase in the hazard assessments that have been carried out using detailed investigations to identify the location of sites where waste is believed to have been deposited. A positive trend is also apparent in the clean-up measures that have been undertaken and completed. In the work of dealing with residual waste Germany is therefore making good progress compared with the timescale that would be laid down as the result of current discussions about the EU Soil Framework Directive.

Figure 26: **Nationwide background values for lead in the topsoil**



When soil is lost

Water action can cause soil erosion, the main factors being the intensity of rainfall, the properties of the soil and the terrain, coverage of the soil and the way in which the soil is worked. Given the sort of precipitation experienced in Central Europe soil erosion on pasture and woodlands does not present any problems. However, the soil may sometimes be less well covered on arable land, depending on the rotation of crops, and heavy rainfall can then cause large quantities of soil material to be washed away. Models can be used to determine the risks of soil erosion. Together with statistical data about land usage and models of the terrain it is possible to identify the areas at risk [131].

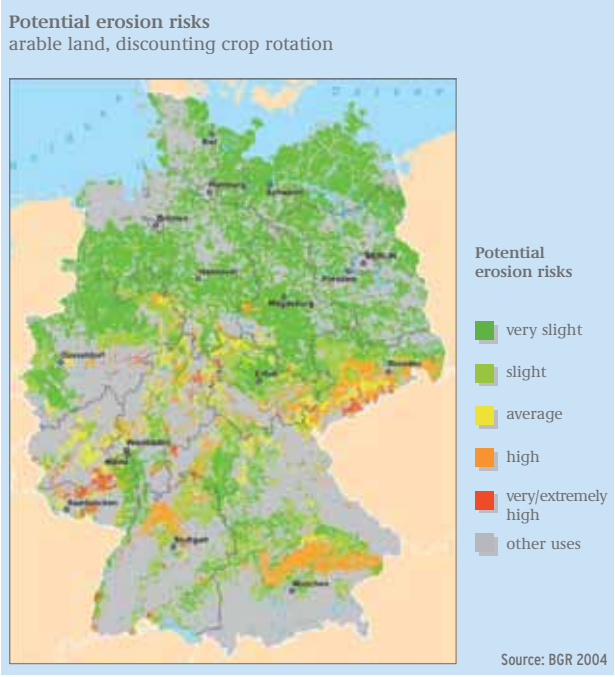
When soils become "impoverished"

Organisms in the soil convert the remains of plants into humus, which is combined with mineral particles in the soil to form aggregates. These are what gives the soil its structure and are a guarantee of the soil's productivity and its ability to maintain a correct balance. Without this formation of aggregates there would not be any cavities in fine-grained soils to enable them to "breathe" or to allow the passage of water. The uppermost soil layer containing the humus is also known as "mother soil" because it effectively retains nutrients and also pollutants. Maintaining the best possible levels of humus in the soil is therefore a prerequisite for ensuring the correct balance of materials in the soil. Inappropriate uses such as the complete removal of plant growth for use as biomass leads to a reduction in the humus content. As a consequence the soil re-

Table 4: **The federal states' statistics on residual waste for 2006**

Federal state (as per)	Areas suspected of containing residual waste	Completed hazard assessment	Residual waste	Restoration completed
Baden-Württemberg (12/2005)	11,570	9,450	1,450	1,500
Bavaria (3/2006)	16,030	3,470	1,450	1,030
Berlin (7/2006)	3,840	no data	680	120
Brandenburg (3/2006)	21,160	3,750	1,430	3,320
Bremen (6/2006)	3,330	550	360	460
Hamburg (6/2006)	1,920	2,830	420	420
Hessen (7/2006)	740	830	460	540
Mecklenburg-Vorpommern (12/2005)	6,650	380	1,130	840
Niedersachsen (6/2005)	69,070	1,550	1,160	1,010
Nordrhein-Westfalen (1/2004)	48,450	10,700	2,180	3,770
Rheinland-Pfalz (6/2005)	13,410	1,360	400	710
Saarland (8/2005)	1,940	740	460	40
Sachsen (3/2006)	22,120	5,620	1,010	2,140
Sachsen-Anhalt (5/2006)	18,900	2,140	120	1,110
Schleswig-Holstein (12/2005)	17,500	2,230	250	870
Thüringen (3/2006)	15,550	2,320	600	720

Figure 27: **Potential erosion risks for arable land in Germany**



tains less carbon and is more susceptible to erosion, and yields decline or can only be maintained by increased applications of fertilizers.

However, among the criteria determining the quality of the soil it is not just the quantity of organic substances that counts. Other important factors include the ability of litter to decompose, and the ratio of carbon to nitrogen. The greater the amount of nitrogen, the more of this element is released by soil organisms through the conversion of organic substances. During vegetation periods plants make use of the nitrogen, while in mild winter months the ground water receives increased amounts of nitrates because of the reduced demand for mobile nitrogen.

The signs of increasing climate change along with the deposit of atmospheric nitrogen on forests and intensive tillage of the soil lead to a loss of organic matter in the soil, with various severe consequences. Higher soil temperatures cause organisms in the soil to convert organic matter more rapidly, which means that nitrogen and carbon can escape from the soil in the form of greenhouse gases (nitrous oxide and carbon dioxide) and are no longer available as nutrients. The stability of the aggregates declines, leading to reductions in water retention and fertility.

When soils become salinated

Excessive or incorrect irrigation can cause salination, in some cases leading to irreparable damage to the soil and to its associated functions. Soils in the Mediterranean region and in South Eastern Europe are particularly susceptible. This particularly affects regions with a shortage of precipitation and where the water reaches the ground surface vertically. Even the use of only slightly saline water for irrigation increases the concentration of salt if it is not adequately washed out by precipitation. Above a certain concentration and composition the salts that accumulate in the soil inhibit the way that plant roots draw up water and nutrients. This reduces yields and leads eventually to crop failure.

When the soil "runs out of air"

The heavy machinery used in agriculture and forestry can compact the soil to such an extent that it literally runs out of air. The Federal Soil Protection Law defines harmful changes in the soil at the point when the proportion of pores with a diameter of 50 micrometres in the subsoil falls below five per cent, the saturated water conductivity[2] is less than ten centimetres per day and the relative density exceeds 1.65 gram/cubic centimetres [132].

Soil compaction becomes evident from the decline in the pore volume and the destruction of the pores in the soil which carry air and water. This leads to reduced yields, as well as a decline in soil fertility and in biological activity in the soil. A lack of oxygen in compacted soils also releases nitrous oxide and methane, thus contributing to climate change. Moreover, following heavy rainfall the water cannot easily soak away but runs off the surface with an increased risk of erosion. Various different models exist for assessing the actual threats produced by compaction of the subsoil and therefore these must be discussed by experts to provide a fuller picture. The interaction of the different effects must be analyzed and validated at a representative section of locations throughout Germany under field conditions.

Groundless

The consumption of land refers to the conversion of undeveloped, agricultural areas into residential, transport and industrial areas. This consumption is accompanied by complete or partial sealing, i.e. covering over the soil with roads, paths, houses, busi-

2 According to Darcy the k-value (water conductivity) is the proportionality factor between the filtration rate and the hydraulic gradient. It is given as a speed and is dependent on the soil characteristics.

ness and commercial properties. The sealing process is linked with a complete loss of the various functions of the soil, and its destruction, because all the functions of soil formation and the conversion of material are halted. Even partial sealing, using suitable materials, has a substantial impact on soil structure and the properties of the humous top soil, because its cuts down long term processes in the soil (such as the creation of new groundwater and a reduction in the occurrence of peak flooding). Another accompanying feature of land consumption is the fragmentation and isolation of the land and of habitats, with concomitant risks to many species of animals and other living creatures. Although it is decreasing slightly, daily consumption of land in Germany currently amounts to over 100 hectares (ha) per day, with a forecast reduction to 30 ha per day by 2020.

Making good the soil: the Federal Soil Protection Act

The purpose of the Federal Soil Protection Act is to protect soil against harmful stresses and pollution and to retain its functions. It has to compete with other national laws and consequently is only applied in cases where no special instruments or laws are used to regulate the effects on the soil. The basic obligations enshrined in the Soil Protection Law are intended to ensure that the various functions of the soil are retained over the long term for the benefit of mankind, animals and plants, and are safeguarded for future uses:

- provisions to protect against material and physical effects in order to main the ecological effectiveness of the soil.
- Work to restore soils that present a danger to humans and the environment.
- Landowners and users are obliged to avoid endangering the soil.

The law also focuses in particular on regulating efforts to clean up residual waste. The authorities in the federal states have an obligation to record details about residual waste and areas suspected of containing such waste, to investigate and to assess them. The law also specifies provisions for de-sealing areas, for obtaining and introducing materials and, as “good professional practice”, for agricultural use.

The Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) stipulates the requirements for examining and assessing areas where damaging changes to the soil or the existence of residual waste are suspected. It is a specific means of taking precautions against threats to the soil and specifies the necessary safeguards and clean-up methods. Soil values are provided for various uses which are intended to ensure uniform and rapid enforcement of the law and provide the legal safeguards when clean-up operations are being considered.

Long term observations and monitoring of the soil

Long term observations of the state of the soil form an important instrument for assessing environmental conditions in Germany. The purpose of long term observation is to ensure an up to date record of the state of the soil, to monitor changes over an extended period and to identify development tendencies. In these respects long term observation of the soil differs substantially from the maintenance of soil mechanics records by the state authorities and mapping, which are used to obtain details about the properties of the soil with regard to the availability of natural materials. The main features of long term observations of the soil are:

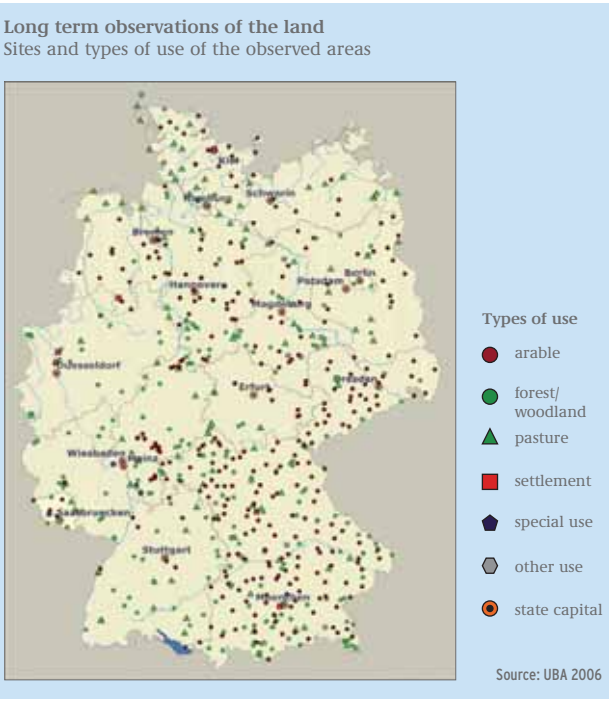
- to act as an early warning system in the event of harmful changes in the soil;
- to serve as an instrument for monitoring environmental policy measures;
- to preserve evidence;
- to provide a reference point in the assessment of burdens on the soil;
- to offer a basis for environmental research and the development of methodologies.

The former West German states began designating and maintaining areas for long term soil observations (known as BDF) in 1986. In the new federal states (i.e. former East Germany) this process began in the early 1990s. The long term observations, which now involve 800 sites, were initially organized on the basis of specific programmes for each state, each with its own set of requirements. In order to achieve uniformity in the form of a nationwide evaluation of the data, in 1991 a federal/state working group known by the name of Bund-/Länder-Arbeitsgemeinschaft Bodenschutz (LABO) 1991 prepared a concept for establishing BDF observation areas, which came into effect at the end of the 1990s [133].

Second survey of soil conditions in forests

In April 2003 the conference of head foresters of the federal states decided to conduct a second Sur-

Figure 28: Types of use of the areas under long-term observation in Germany



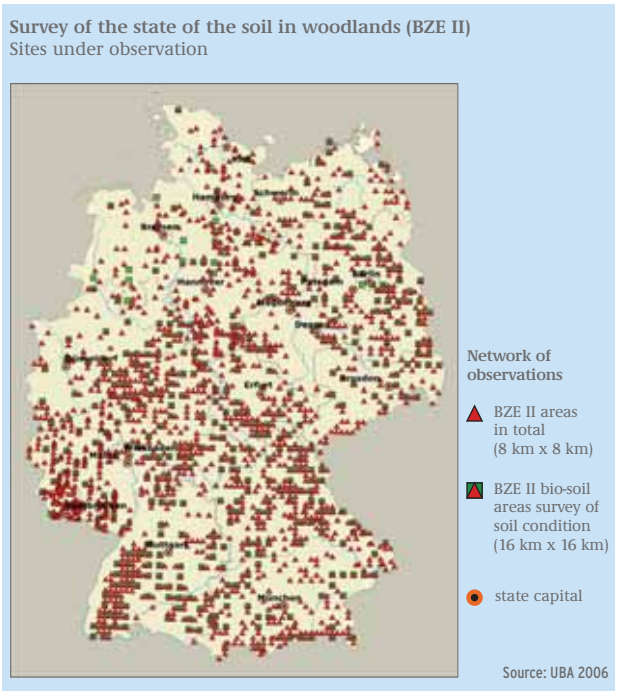
vey of Soil Conditions in Forests, beginning in 2006 (BZE II, see box). In this same context the environmental departments of the federal and state authorities decided to make use of the BZE II survey in order to conduct a systematic investigation into the background content of organic trace materials (organics) and trace elements (heavy metals) in forest soils. The UBA is responsible for the uniform and ongoing processing of samples and for examining organics, while the Federal Agency for Geosciences and Raw Materials (BGR) has taken on the work of investigating for heavy metals.

Targets and concept for the second Survey of Soil Conditions in Forests (BZE II)

The data obtained from the BZE is to be used in order to conduct integrated evaluations. At the same time taking into account findings from other aspects of the environmental investigation into the forests also provides a much more comprehensive interpretation of the data obtained from the BZE. As with BZE I, the tree crown condition indicator and accompanying analyses of conifer needles and leaves on the BZE sample network are an integral part of the BZE II. This also provides a more solid basis for conclusions to be drawn and for recommendations for action to be made [134].

Due to their persistence, distribution and in some cases their harmful effects, organics have a significant environmental relevance. Several of these substances or groups of substances, such as DDT, polychlorated biphenyls or polychlorated aromatic hydrocarbons (PAH), are listed in the Stockholm Convention on persistent organic pollutants (POPs), which names the 12 most dangerous POPs and came into force in 2004. The basic data is intended to give insights into the extent to which forest ecosystems have been contaminated by organics. In addition to the use of the samples for the BZE analysis of organics they are also stored in the national Environmental Samples Bank in case they are needed later. This ensures that a sample bank is available for future repeat and comparative investigations and as the basis for the creation of time series.

Figure 29: Network of observations as part of the survey of forestry soils in Germany



The proposed European Soil Framework Directive

There are currently no legal or financial instruments at EU level for the direct protection of soils (primary protection). However, the Nitrate Directive (91/676/EEC) and the Directive on Sewage Sludge (82/278/EEC and 91/271/EEC) are of use in helping to protect the soil. Protection of the soil is also the aim of "good agricultural practice", the support for rural development (1257/99/EC – agri-environmental policy) and the decree on the Common Agricultural Policy Single Payment and Support Schemes (Cross Compliance).

Legal regulations, strategies and guidelines for improving the condition of the soil and for the prevention of further soil degradation already exist in some member states. The European Commission presented its Thematic Soil Strategy in September 2006. Soil protection strategy received an important boost at the 1st European Soil Forum 1999 in Berlin, of which the UBA was a major co-organizer. In April 2002 the Commission published its notification "Towards a thematic strategy for Soil Protection". With the 6th Environmental Action Programme of July 2002 the Commission established a Soil Protection strategy as one of the seven thematic strategies for its programme of work for 2002–2012. The Commission approved the Soil Protection Strategy on 22.09.2006 and passed the details on to the participating institutions.

The Soil Protection strategy consists of the "Strategy for the continued development of soil protection in Europe" and the proposed Soil Framework Directive. The documents which have been submitted largely reflect the preparatory discussions that took place in the five technical working groups, on which the Commission had lent its assistance between July 2002 and June 2004. Experts from the UBA played an active part in this preparatory technical work.

Under the German presidency the Council Working Group on the Environment undertook to give a first reading to the Commission's proposals. The Framework Soil Directive presents the first opportunity for creating a solid legal basis for comprehensive soil protection at EU level. Soil protection can only succeed if it is able to create an appreciation of the soil and the dangers it faces in the minds of the main players and the general population. Because of the competition for soil or land areas by users with different and in some cases divergent interests (farmers, real estate managers, road planners, nature conservationists), the levels of knowledge about the soil and the dangers are not uniform.

In addition to annual events during the International Soil Day on 5 December the UBA has therefore published various information sheets. Along with water and air, the soil forms one of the bases of life and is a main prerequisite for maintaining prosperity and the diversity of foodstuffs in Central Europe. Mankind lives from and on the soil.

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Sources:

[129] The draft, together with other documents, is available on the internet at:
http://ec.europa.eu/environment/soil/index.htm

[130} The nationwide overview of residual waste statistics is available on the internet at:
http://www.umweltbundesamt.de/altlast/web1/deutsch/1_3.htm

[131] Additional information about soil erosion:
http://www.env-it.de/umweltdaten/public/theme.do?nodeIdent=3167

[132] Lebert, M; Brunotte, J.; Sommer, C. (2004): Ableitung von Kriterien zur Charakterisierung einer schädlichen Bodenveränderung, entstanden durch nutzungsbedingte Verdichtung von Böden/ Regelungen zur Gefahrenabwehr. UBA-TEXTE 46/04
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DEPARTMENT II 5 "AIR QUALITY"

Maximum national emission ceilings as an instrument of clean air policy

The national maximum emission ceilings impose a limit on a country's total annual amount of an emitted pollutant. As a clean air policy instrument (see box) they can be traced back to the Geneva Clean Air Convention of the Economic Commission for Europe of the United Nations (UN ECE) from 1979. Then as now the challenge was to tackle transboundary air pollution in Europe. The Economic Commission for Europe of the United Nations, together with the European Union, gave a more substantial form to a concept for limiting national emission freights by means of protocols and the Directive 2001/81/EC of the European Parliament and the Council on the national maximum

emission ceilings for certain atmospheric pollutants from 27.11.2001 (Directive on National Emission Ceilings, NEC).

Clean air policy instruments

The objective of **emission ceilings** is to reduce emissions in specific sectors in accordance with the latest available technology. For industrial plants limits are defined for concentrations of pollutants in exhaust gases or for the amount of pollutants relating to the amount of a product. Comparable stipulations also exist for mobile sources.

Air quality standards (immission limit values) protect human health and ecosystems.

National emission ceilings impose limits on the annual emission rate (tonnes per year) from all the emission sources of a country with the aim of also reducing transboundary environmental damage.

A number of protocols have been agreed since the convention came into force. The 1st Sulphur Protocol (1985), the Nitrogen Protocol (1988), the VOC Protocol (1991), the 2nd Sulphur Protocol (1994) and the Multicomponent Protocol (1999) are aimed at reducing emissions of sulphur dioxide (SO_2), nitrous oxides (NO_x), volatile organic compounds (NMVOC) and ammonia (NH_3). In varying combinations these pollutants are responsible for acid rain, acidification of surface waters, excessive concentrations of fertilizers (eutrophication) as a result of nitrogen run-off, and Los Angeles type "summer" smog due to high concentrations of low altitude ozone, all of which damage health and the environment. All the protocols call for certain sector-specific measures to reduce emissions.

Initially the protocols demanded identical percentages for the countries' national emission reductions (first generation protocols). In the case of the 2nd Sulphur Protocol, the Multicomponent Protocol and the NEC Directive it was already possible to specify national emission ceilings, based targets for protecting ecosystems, the so-called critical loads. The scientific bases for this effect-based approach were not available at the time of the first generation of protocols.

EU member states must meet the specifications of the NEC Directive

The NEC Directive commits the member states of the European Union to stricter emission reductions than the Multicomponent Protocol, but allows them to decide for themselves what measures they intend to apply in order to adhere to the emission ceilings in 2010 and beyond. As a means of documenting the progress made with compliance, annual emission inventories and a National Programme have to be submitted, clearly indicating what measures still need to be undertaken. The German federal government has appointed the Federal Environment Agency (UBA) with this task. Beginning with a reference prognosis the agency established whether the targets laid down by the NEC Directive were attainable without employing any other measures (see Table 5). This reference prognosis takes into account the measures to be conducted now in order to limit emissions, as well as the expected economic development.

Calculations by the UBA clearly show that, in accordance with the reference prognosis, Germany should be able to adhere to the emission ceilings for SO_2 and NMVOC in 2010 using the measures that have already been introduced, but that in the case of NMVOC it can expect the ceilings to be exceeded again after 2010 because of an increase in the use of products that release NMVOC. The measures already introduced in the sectors of transport, industry and agriculture no longer suffice for keeping within the emission ceilings for NO_x and NH_3. Consequently there is a need for measures to be undertaken in transport, for stationary sources (industry, business and private households) as well as implementing the programme for reducing agricultural emissions of ammonia. A detailed presentation of the emission prognoses and measures can be found

Table 5: **Emission ceilings and predicted yearly emission rates in kilotonnes per annum (kt/a)**

	SO_2	NO_x	NH_3	NMVOC
Emission ceilings laid down by NEC Directive	520	1,051	550	995
Reference prognosis	459	1,112	610	987
Prognosis value minus emission ceiling (coverage gap (+))	− 61	+ 61	+ 60	− 8
With measures in scenario	459	1,050	550	986

in the National Programme for Compliance with the NEC Directive [135–137].

Updating the national emission ceilings

When the national emission ceilings were set in 1999 the aim was to protect 95 per cent of the ecosystem areas in Europe against acidification and 45 per cent against the over-use of fertilizers by 2010. Damage to vegetation as a consequence of continuous and excessive low altitude ozone concentrations should be reduced by one third by 2010 compared with 1990. An improved distribution model, the application of ecosystem-specific critical loads (p. 19) and above all the rates of deposition for specific land use (deposit of materials which take in to account the use of the land, for example as forest or meadow), indicate that these objectives are unattainable, even if the emission ceilings are adhered to. Environmental pollution remains at a high level, especially in Central and Western Europe (eutrophication and damage resulting from excessive exposure to low altitude ozone).

It was against this background that the European Union, in its Thematic Strategy on Air Pollution, 2005, defined differentiated environmental interim objectives which should be attained by 2020, and which include the aim of achieving long-lasting improvements compared with 2000:

- reducing acid deposition until it only impacts on 26 per cent of the current affected forest area,
- reducing the deposition of nutrients until they only impact on 57 per cent of the current affected forest area,
- a reduction of ozone concentration so that they only impact on 85 per cent of the current affected forest area.

At present the European Commission is preparing a cost-optimized proposal for updating national emission ceilings by 2020 in order to meet the specified targets. For this purpose it is making use of the national data about energy requirements, and the resulting emissions, that has been provided by the UBA. In a new development, in addition to existing protection targets, the European Commission is also examining the health hazards resulting from concentrations of fine dust particles in ambient air. Because the air carries secondary fine dust particles, i.e. formed in the atmosphere from precursor substances such as SO_2, NH_3 and NO_x, over distances of several thousand kilometres, national measures alone will not suffice [138]. These precursor substances are already included in the NEC Directive and in the Multicomponent Protocol. In addition emissions of fine dust particles must now be reduced as well, which the definition of national emission ceilings is intended to achieve. Considerable efforts will be needed, however, in order to implement this plan, especially in the enquiry into emissions of fine dust particles, because these have not been quantified with sufficient reliability until now.

The air transports secondary fine dust over thousands of kilometres.

Stress to human health through contamination by fine dust substantially reduces life expectancy. The European Commission is therefore aiming to cut the reduction in life expectancy in the EU caused by contamination with fine particulates by 47 per cent between 2000 and 2020. In the case of Germany this means that by 2020 the reduction in life expectancy in built up areas as a result of the contamination with fine dust particles in the ambient air should be reduced from two years to ten months.

The UBA provides scientific support for the amendment to the NEC Directive and is compiling this information in the form of a national emissions scenario. As soon as the European Commission has proposed national emission ceilings for 2020 the UBA will assess whether there is a sufficient potential for reducing emissions and what measures are needed in order to cut emissions and meet these objectives.

Effects on air quality

Measures to reduce emissions, resulting in limits being imposed on national emission ceilings for SO_2, NO_x, NMVOC and NH_3, lead to a wide-ranging im-

provement in air quality and to better protection of ecosystems against acidification, eutrophication and ozone damage. However, this does not yet ensure adherence to air quality standards (see Table 6) for fine dust particles (PM_{10}) or nitrogen dioxide (NO_2) at every location.

Table 6: Air quality standards

	PM_{10}-limit value from 2005 (daily mean)	NO_2 limit value from 2010 (annual mean)
Air quality value	50 µg/m³ exceeded on maximum of 35 days	40 µg/m³

PM_{10} pollution in conurbations where traffic is a particularly serious problem exceeds the specified limit at 40 per cent of traffic measuring stations, while the limit that will come into effect in 2010 is exceeded at 60 per cent of these stations. The local traffic emissions accumulate here to produce pollutants in quantities which the air then transports over long distances, and even across national borders. After all on average 40 per cent of the emissions contributing to PM_{10} pollution in conurbations will be transported from outside into these areas, compared with less than 20 per cent in the case of NO_2. Long-range transport is of almost importance in the pollution by fine dust particles, making this an important reason for including it in a revision of the NEC Directive.

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Sources:

[135] Luftreinhaltung 2010. Nationales Programm zur Einhaltung der Emissionshöchstmengen für bestimmte Luftschadstoffe nach der Richtlinie 2001/81/EG (NEC RL) [National programme for observance of emission ceilings for certain atmospheric pollutants in accordance with Directive 2001/81/EC]. UBA-Texte 37/02. Federal Environment Agency, Berlin 2002. ISSN 0722-186X. Available on the internet at: http://www.umweltdaten.de/publikationen/fpdf-l/2250.pdf

[136] National programme for complying with emission ceilings, available on the internet at: http://www.bmu.de/files/pdfs/allgemein/application/pdf/nationales_programm_ozon.pdf

[137] Additional information about the NEC Directive: http://www.umweltbundesamt.de/luft/reinhaltestrategien/nec.htm

[138] Fine dust particulates – a continuing challenge in the efforts to maintain air purity in: Annual Report 2005. Federal Environment Agency, Dessau 2006. p. 16–24. Available on the internet at: http://www.umweltdaten.de/publikationen/fpdf-l/3073.pdf

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DIVISION III "ENVIRONMENTALLY COMPATIBLE ENGINEERING – PROCESSES AND PRODUCTS"

Technical processes in the production and use of products and also at their end of their lives are important as ways of making adjustments to the protection of the environment and health. The three departments of Division III investigate questions that arise in this context: in the use of new consumer goods and the exploitation of older items how can production processes and technical methods be designed to exert the minimum possible impact on the environment and health, while at the same time increasing the competitiveness of German companies and creating jobs? What requirements must be met by environmentally and hygienically compatible products, how can their degree of acceptance and their sales be increased, and how can waste and sewage be dealt with and disposed of without harming the environment?

Among the most important concerns of environmental policy are the identification of the causes of environmental pollution and the development of proposals for its avoidance and reduction. The scope of services provided on this subject by this division covers various different approaches, including instruments such as the Blue Angel eco-label and environmentally friendly procurement, priority product groups (e.g. building products, electrical appliances), selected environmental problems (health risks, energy efficiency, breakdowns). One overarching aspect is that of sustainable consumption and, in order to lend its support, the Division organizes a national dialogue and uses communication on specific topics. Domestic appliances and lighting were subjected to close scrutiny during the year covered by this report.

Another major aspect involves environmental protection as an integral part of production. Using knowledge of the causes of the pollution in production, during preceding stages and during disposal, the division develops criteria, requirements and standards as well as identifying ways of relieving pollution. The guiding rule is the model of production and products that are sustainable, i.e. ensuring long-term environmental acceptability. Experts are engaged in developing concepts for the different sectors of industry and evaluate innovative technologies to establish their potential for relieving the pressures on the environment or for harbouring potential risks. Examples include nanotechnology and so-called white biotechnology. Other main areas of work consist of: seeking to constantly improve the safety of industrial plants at a national, European and international level, and the development of a sustainable waste and sewage management system. The Federal Environment Agency (UBA) is assisting the Federal Ministry for the Environment in drawing up strategic objectives and in preparing the steps for the creation of a waste management system by 2020 based on the flows of materials and the protection of resources, and is also developing measures for its implementation.

Additional details about the work of the Division can be obtained at:
http://www.umweltbundesamt.de/uba-info-e/e-fach3.htm

DEPARTMENT III 1 "ENGINEERING AND PRODUCTS ASSESSMENT"

Improving the quality of life with low-emission products

The developers and users can justifiably be pleased with the improved quality of life to be found in a newly built prefabricated house, a freshly renovated older building or a modern office with all the latest equipment. However, nowadays many people are not only concerned with how tastefully decorated the interiors are but also with good quality as its applies to the environmental and health aspects, and they are right to do so, on account of the chemicals and preparations (such as softeners) or preserving agents) contained in many floor coverings, adhesives, sealants and also furniture. Over extended periods these can evaporate and pollute indoor areas. However, the air inside buildings is not only adversely affected by building products and fittings but also by office equipment, as a result of printing functions (such as printers, copiers, fax machines or multi-purpose equipment. Their operation releases volatile organic compounds (VOC), dust and possibly ozone.

Many signs of illness (such as allergic dermatological reactions, bronchitis, asthma and disturbances of the nervous system) as well as symptoms such as fatigue and headaches may be due to poor air quality inside buildings. The Federal Environment Agency (UBA) therefore recommends reducing the emissions from products used indoors. The right choice of products enables serious pollutants to be largely avoided indoors, both in the home and in business premises. How can consumers and investors recognise low-emission alternatives?

The Blue Angel combines protection for the environment and health

The Blue Angel is the most important means of information for environmentally aware shoppers. The world's oldest eco-label performs its function where consumers and companies need it most. In the case of products in the home or working environment this is primarily a matter of health of tolerance. Indoor products are only granted the Blue Angel if they can meet strict health protection requirements and ensure a high degree of environmental protection.

The UBA prepares the ground for awarding the Blue Angel and, prior to the official hearing it introduces a process of discussions about the subject matter with those involved, such as testing institutes, manufacturers and experts in the fields of environmental and consumer protection. The results are certainly worth seeing: Many indoor building products, fittings and items of office machinery have now been awarded the Blue Angel (see Fig. 30).

Figure 30: **Blue Angel and health protection**

Two new product guides from the UBA on healthy living and working provide comprehensive information about the product groups which were awarded the Blue Angel by an independent panel of judges. This "environmentally friendly shopping list" enables everyone to search selectively for products bearing the Blue Angel [139]. Basic details about how this eco-symbol is awarded can be found on the internet at www.blauer-engel.de. A new brochure has also been published entitled "Building Products: Determining and avoiding pollutants and odours – results from a research project", with extensive details about indoor emissions from building products, as well as ways of assessing and avoiding them [140].

The Blue Angel for building products and furnishings

Building products and furnishings often take up a great deal of space indoors. Consumers making use of low-emission products thereby largely avoid being exposed to volatile organic compounds (such as solvents) and formaldehyde. In so doing they are protecting not only the environment but also their health. The situation was quite different in the 1980s. The public first became aware of the subject of indoor air at that time when chipboard became the subject of discussions, due to the health risks from its high emissions of formaldehyde, a colourless, pungent gas which can irritate the mucous

membranes and is also a carcinogen. Nowadays there are statutory limitations on the emissions of formaldehyde from chipboard.

Products applying for the Blue Angel have to successfully undergo numerous emission tests in recognized laboratories before they can receive the eco-label (see box). Conditions for the award of this label now exist for items such as elastic floor coverings, parquet and laminates, floor covering adhesives, sealants, paints and lacquers, wooden materials, box furniture, panels, upholstered furniture and mattresses.

Blue Angel for building products and furnishings – the advantages for the environment and health:

- low in emissions, therefore can be safely used in and around the home;
- particularly low levels of VOC and formaldehyde;
- free of carcinogens or substances that can cause hereditary changes;
- contain no harmful preserving agents or halogen-organic compounds such as softeners and flame retardants which are hazardous to health;
- manufactured in an environmentally friendly way, for example using timber from sustainably managed forests and low-emission reclaimed timber;
- contain no harmful substances such as heavy metals, which could otherwise adversely affect use.

The Blue Angel can be found on a wide range of low-emission products made of wood and wood materials, such as furniture, flooring, wall and ceiling panels (eco-label RAL-UZ 38). The Blue Angel is based on the AgBB assessment scheme (AgBB: Committee for Health-related Evaluation of Building Products, see p. 6), whereby the requirements of the Blue Angel with regard to total emissions are significantly stricter than those required under the AgBB assessment scheme. The UBA is committed to ensuring that the AgBB criteria also serve as the benchmark for the European standards for building products.

In 2006 the panel approved a new basis for awarding the eco-label for low-emission sealants based on silicon and acrylic resins (RAL-UZ 123). Although manual workers and DIY enthusiasts do not use sealants on a large scale, nevertheless these products can release pollutants in quantities that represent a threat to health, according to investigations that have been carried out by the Bundesanstalt für Materialforschung und -Prüfung, BAM (Federal Agency for Materials Research and Testing).

The right colour is essential when renovating.

Progress was also made with the existing bases for the award of this symbol. In the case of the new eco-label for mattresses (RAL-UZ 119), the Blue Angel was awarded for the first time to eight foam mattresses and one pocket sprung mattress. With the widening of the scope of the Blue Angel for flooring adhesives (RAL-UZ 113) to include stoppers, since 2006 it has been possible to install an entire flooring system, i.e. stopper, filler, adhesive and floor covering, using low-emission products.

In order to meet the increasing demands being placed on products, the existing principles for the award of the label are also under scrutiny. For example the Blue Angel concept for low-pollutant paints (RAL-UZ 12a) is revealing its limitations, being based on an assessment of the recipe for these products, which means that it is extremely complex and is not an ideal indicator of their health properties. Working together with the manufacturers the UBA is currently examining a new assessment concept.

The Blue Angel in the office

Like most other copiers, laser printers use toners in powder form. The printing process creates ozone, as well as releasing VOCs and dusts and, although the extent to which they present an acute health hazard is disputed, the Blue Angel imposes strict targets for the emission of these substances.

"Low-emission" means that printers bearing the eco-label must also operate quietly and must not exceed a noise level (L_{WAd}) of 63 decibels (dBA), because loud equipment interferes with concentration and long term exposure to it can cause illness.

Blue Angel for office equipment with printing functions – the advantages for the environment and health:

- reduced contamination of the air in rooms from emissions of VOC, ozone and fine dust;
- quiet operation aids concentration;
- no poisonous or hazardous substances such as heavy metals or certain organic flame retardants in toners or the plastic housings;
- reduced energy required when idling;
- suitable for recycled paper;
- duplex system enabling high performance units to print on both sides of the paper.

The new conditions for the award of the eco-label for office equipment with printing functions (RAL-UZ 122) have been in force since 1 January 2007, replacing the previous conditions for copiers, printers and multifunctional equipment (RAL-UZ 62, 85, 114). The Blue Angel thus takes into account the growing complexity of these devices. For colour printers specific target values are defined for volatile organic compounds (VOC) and ozone, VOC emissions during stand-by are restricted, and the ozone emission targets for black printing are reduced.

In future refilled toner modules bearing the Blue Angel (RAL-UZ 55) should be subject to the same requirements as office equipment containing original parts. Interested suppliers and testing authorities are currently revising the necessary standardized requirements for examining the serviceability of refilled toner cartridges. The UBA supports this project by the Information Technology Standards Committee of the standards organization Deutsche Institut für Normung (DIN). The revised conditions for the award of the eco-label are expected to come into effect in 2009.

It stinks! What can odour measurements show us?

The smell of paint or adhesives is not offensive in a newly renovated home, but if it persists after several weeks it becomes unpleasant. These smells do not just cause discomfort, they can also make us ill, irritating the respiratory tract, triggering headaches and nausea, and leading to a loss of concentration or impaired sleep. That is why it is important that materials used indoors should be as odour-free as possible

Testing the odours produced by building products is an important aspect of the AgBB scheme although, due to technical uncertainties in the measuring process, the AgBB has until now been unable to find one that is suitable for testing and assessment purposes. Odours are made up of numerous chemical substances, often consisting only of traces, which is why routine operations using normal analytical methods are barely able to detect them.

Emissions testing: Chamber with a volume of 20 litres (exicator) with a material sample consisting of a chipboard panel.

Emissions testing: Chamber with a volume of one cubic metre with a printer.

In a research project that was completed in 2006 the Hermann-Rietschel Institute at the Technical University Berlin developed a suitable procedure for measuring odours, thereby creating the first stage in the test process as envisaged by AgBB [140]. In subsequent projects the UBA is developing the foundations for assessment criteria for use on the odours produced by building products, to determine which odours are acceptable and which are not.

Environmentally friendly and low in emissions – unlimited scope for action

The UBA has set itself the target of being able to offer the Blue Angel for all indoor products for which emissions are a matter of concern. Only a few "gaps" remain, such as the requirements for carpeting and wallpaper. Now the main aim is to make the Blue Angel more widely known as a symbol for healthy living and environmentally friendly offices, and thus to continue to increase the number of labelled products. It will then be easier for consumers to familiarize themselves with the Blue Angel. A platform for publicizing the Blue Angel already exists, when it celebrates its 30th birthday in 2008, and preparations are already in progress.

The UBA is also looking beyond Germany's borders. It is important to establish the AgBB assessment scheme on an EU-wide scale, and joint ventures with other national eco-labels and with the European environmental symbol have already been set up or are in preparation. In 2006 the European Committee for Standardization (CEN) set up a standardization committee (CEN/TC 351 "Construction Products: Assessment of release of dangerous substances"). Its purpose is to develop processes for measuring the emission from construction products to enable the relevant institutions in the member states, in Germany the *Deutsches Institut für Bautechnik* (German Institute for Building Technology), to assess various aspects such as compliance with the requirements of the AgBB scheme.

The UBA has signed agreements with the eco-labels Ecomarkt (Japan) and Nordic Swan (Scandinavia) to intensify cooperation on printing equipment and to examine the possibility of introducing common criteria for environmental labels. The aim is an ambitious one and as early as 2009 jointly developed, harmonized core criteria should be available to form the basis for this environmental label. The requirements apply to recyclable construction, demands on plastics, print media (recycled paper), photo feed drums, reliability of repairs, maintenance, taking back equipment, toners and ink cartridges, the material requirements imposed on inks and toners, emission requirements concerning VOC, ozone, dust and noise. The UBA is also cooperating with China Environment Labelling. In addition to developing joint environmental and health criteria the intention is also to introduce reciprocal recognition of certification for the award of environmental labels in future in selected product groups such as construction products and IT equipment. This would not only facilitate access to the German market for eco-friendly Chinese products but also enable German products bearing the Chinese eco-symbol to be sold more easily on that country's markets.

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Sources:

[139] The Blue Angel product guides "Umweltfreundlich bauen. Gesund wohnen" and "Umweltfreundliches Büro. Gesund arbeiten" are available as PDF documents at:
http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3148 or
http://www.blauer-engel.de/downloads/Ratgeber_Buero.pdf

[140] The final report of the research project "Environmental and Health Provisions for Building Products – Identification and Evaluation of VOC emissions and Odour Exposure" is available as a PDF document at:
http://www.umweltbundesamt.de/building-products/schadstoffe-gerueche.htm or
http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3247
A brochure published to accompany this project, "Building Products: Determining and avoiding pollutants and odours – results from a research project" is also available as a PDF document at:
http://www.umweltbundesamt.de/produkte/index.htm or
http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3123

DEPARTMENT III 2 "PRODUCTION"

Towards sustainable production: the IPPC Directive

For more than 30 years approval for the operation of industrial plants in Germany where emissions are a relevant issue has been granted under the terms of the law known as the *Bundes-Immissionsschutzgesetz* [141]. The EC Directive concerning integrated pollution prevention and control (IPPC Directive) [142], which came into force in 1996, is an EU-wide obligation for new industrial installations with a particular environmental relevance to apply the best available techniques (BAT, see box). From 30 October 2007 this will also apply to existing installations, which have a particular environmental relevance.

The IPPC Directive takes all environmental media into consideration equally (water, soil, air). The BAT stipulations also cover resource and energy efficiency, avoidance of waste and the costs of environmental investments. A responsible authority coordinates the permitting process and involves all the other authorities and agencies that are affected. This accelerates the permitting procedure as well as ensuring that all major questions are considered. As an important component in the precautionary environmental protection practiced by the EU, the IPPC Directive, with an integrated approach that encompasses the various different media, is intended to promote sustainable production.

The IPPC Directive defines the Best Available Techniques (BAT) as *"... the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole".*

Additional information about the BAT:
http://www.bvt.umweltbundesamt.de

Information and involvement as the basis for modern environmental protection

The IPPC Directive relies to a large degree on information from those concerned, and their involvement, i.e. by industry, public authorities, associations and the public. The relevant instruments of the IPPC Directive are detailed briefly in the following sections:

- the Seville Process,
- involvement of the public in permitting procedures,
- the EU-wide register of pollutant emissions and
- reports by EU member states to the EU Commission about the implementation of the IPPC Directive.

The Seville Process: A technical working group is set up for each sector of industry, where experts from all the important interest groups (EU member states, industrial and environmental associations) can work together. Directed by the European IPPC bureau in Seville, the working groups determine the BAT for their own sectors of industry, which they describe in a reference document. These BAT reference documents also list actual consumption and emission figures. The responsible authorities in the member states take these consumption and emission figures into consideration as the basis for issuing permits for plants. In the past it was hardly possible to implement demanding emission limit values for industrial installations, and the BAT therefore points out a new way for meeting strict requirements. In Seville Process working groups the BAT is determined by verifiable data and facts, and as a rule the BAT reference documents tend to contain valuable benchmarks and conclusions. There are currently a total of 33 BAT reference documents (see box). The Federal Environment Agency (UBA) represents the Federal Republic of Germany in the Seville Process.

The BAT reference ducuments

- Waste treatment industries
- Waste incineration
- Common waste water and waste gas treatment and management systems in the chemical sector
- Chlor-Alkali manufacture
- Iron and steel production
- Energy efficiency
- Smitheries and foundries
- Glass manufacture
- Large combustion plant
- Manufacture of large volume inorganic chemicals – ammonia, acids and fertilizers
- Manufacture of large volume inorganic chemicals – solid and others
- Manufacture of speciality inorganic chemicals
- Manufacture of organic fine chemicals

- Manufacture of large volume organic chemicals
- Cooling systems
- Intensive livestock farming
- Ceramic manufacturing industry
- Emissions from storage of bulk or dangerous materials
- Tanning of hides and skins
- Management of tailings and waste-rock in mining activities
- Monitoring systems
- Food, drink and milk processes
- Non-ferrous metal processes
- Surface treatments using solvents
- Surface treatment of metals and plastics
- Economic and cross-media issues under IPPC
- Production of polymers
- Refineries
- Ferrous metal processing
- Textile processing
- Slaughterhouses and animal by-products
- Pulp and paper manufacture
- Cement and lime production

All BAT reference documents are also available on the UBA website in English, and some have also been partially translated into German [143].

Results of current research are incorporated in the Seville Process

Many federal research programmes support the development of innovative technologies that help to protect the environment. Financial assistance is provided, for example, by the Federal Ministry for Education and Research (BMBF) or the Federal Ministry of Economics and Technology (BMWi). So far, however, the results have not been systematically incorporated in the Seville Process. At the request of the BMBF the UBA was therefore filtered out technologies from the 4,000 or so projects assisted by the BMBF, which appeared to be suitable for the BAT reference documents, and compiled them for use in the Seville Process. In this way numerous innovative technologies from the sectors of foundries, surface treatment of metals, the use of solvents and ceramics have already been included in the BAT reference documents.

To encourage more companies and research institutes to include their innovative technologies in the Seville Process themselves in future the UBA has developed a guide on the best available techniques, entitled "Beste verfügbare Techniken – Made in Germany: Machen Sie Ihre Umwelttechnik zum europäischen Maßstab" [144]. It gives sources of information and contacts in Germany and at the IPPC bureau in Seville, as well as explaining the workings of the Seville Process.

After the UBA had successfully completed this research project on behalf of the BMBF, the BMWi decided to finance a similar project, also to be carried out by the UBA. Because the BMWi also offers several programmes promoting innovative technologies to protect the environment, in this case too, many of the suitable technologies are to be incorporated in the Seville Process.

Informing and involving the public: The public is also involved in the official permitting process for an IPPC installation. The application documents are made publicly available, as is the subsequent permit, its updates and the associated monitoring data. In this way anyone who is interested can find out about the operation of an industrial installation and the possible environmental impact. In Germany public participation has been a regular part of the legal permitting process for decades. There is also an EU-wide register which provides local information about the emission of pollutants by large industrial installations (European Pollutant Emission Register, known as EPER for short). It lists the most important pollutants and presents them in an easily understandable way on the internet [145]. The EU Commission is currently transferring the contents of the EPER into the new Pollutant Release and Transfer Register (PRTR), which will also be used to register details about diffuse emissions from industrial installations [146].

Safeguarding the way success is monitored: A regulation can only be successful if its application can be examined. That is why, in addition to informing the public, EU member states also submit regular reports to the EU Commission on the ways in which they have implemented the IPPC Directive in law, and the requirements to limit emissions that they have derived from the BAT. The second report was due on 30 September 2006. In its predecessor the stated limit values largely defied comparison and could not therefore be assessed. This was due to

factors such as the missing of details concerning the differences in measurement methods, averaging periods and the units for indicating emissions in EU member states. In order to make it easier to compare the requirements imposed by various EU member states on industrial installations, the current report contains a more detailed description of the permit and emissions situation in the installations under examination, although it only concentrates on examples from two sectors. This is intended to show how more informative reports can be produced in future at a relatively low cost. All the reports and their assessments are available on the internet [147].

Continued improvement of BAT reference documents and the IPPC Directive

For the first time BAT reference documents were available, with one exception, for all sectors at the end of 2006. Work on revising the oldest BAT reference documents had begun in 2005. Because of the constant improvements in industrial techniques all the BAT reference documents involved in the Seville Process are regularly updated with the intention of filling in any gaps in the data. Some of the requirements of the IPPC Directive as listed in the BAT reference documents are not sufficiently well defined, for example the efficient use of resources and energy, and avoiding the creation of waste. Regular revisions of the BAT reference documents ensures that the current environmental requirements keep pace with the latest technology.

In collaboration with those involved the EU Commission is also examining the IPPC Directive with the aim of developing it further and of establishing its principles and objectives in a more permanent way. The focus is on the following question: what steps can be taken to make the IPPC Directive more effective? With this in mind the EU Commission has ordered a number of studies over the past two years, which will assess certain aspects of the IPPC Directive. All the details about the revision of the IPPC Directive can be found in English on the homepage of the EU Commission [148].

The UBA does not believe that a final assessment of the effectiveness of the IPPC Directive is possible yet because the directive will only apply to existing installations from October 2007. That is why considerable care is being exercised in making changes to the IPPC Directive, and the emphasis should be on optimizing the instruments described above. A harmonization of the various EU reporting obligations for industrial installations is vitally important and is one of the objectives being pursued by the UBA. The UBA is also committed to extending the catalogue of installations affected by the IPPC Directive via including important types of installations whose emissions are a relevant factor (such as composting plants, biogas plants and intensive cattle farming). Moreover, in the opinion of the UBA, in future the IPPC Directive should not only apply to installations with particularly intensive emission levels but also to smaller installations whose emissions are nevertheless a relevant factor. For this latter category, however, a sim-


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Revision of the BAT reference documents, using the cement and lime industry as an example

Revision of the first BAT reference document on "cement and lime production" began at the end of 2005. Led by the UBA the German contribution was produced by a number of the national experts including representatives of the federal states, and the industry associations Verein deutscher Zementwerke e.V. and Bundesverband der Deutschen Kalkindustrie. It contains current data about emission values that are attainable through the use of BAT. One of the main aspects concerns the use of waste as a raw material or fuel in cement and lime production. The German contribution forms an important basis for the comprehensive "new edition" of the BAT reference document, which is expected to be completed in mid-2008 [149]. In this way the UBA is helping to establish a high level of environmental protection for cement and lime works.

plified permitting process should apply, without involving the public (as already exists in Germany), because a formal permitting procedure would impose excessive burdens on small installations and would involve them in unnecessary expense.

As the national focal point the UBA applies the instruments of the IPPC Directive at the EU level and produces proposals for its continued development. Within Germany the UBA coordinates the collaboration between the federal and authorities of the Länder in the Seville Process, for the new PRTR register of pollutants and for the reporting.

How can the IPPC Directive be made even more effective?

The IPPC Directive seeks to attain a high general level of protection for the environment, but without specifying fixed emission limit values for pollutants. Whether it can attain this objective with its "soft" instruments depends on how well they are used.

The BAT reference documents must be of an ambitious standard to achieve uniformly high environmental standards for industrial installations. They should also describe the BAT in the most precise and complete way possible, because all the permits for industrial installations throughout the EU are based upon them. Moreover the Seville Process depends on the active participation of all those involved, including the UBA, because solid data about modern techniques is required in order to implement ambitious BAT requirements. The members of the Seville working groups must collect the data from the EU member states, prepare it for the Seville Process, and defend it within the technical working group. The efforts that this requires will be worthwhile, bearing in mind that the BAT reference documents describe ambitious environmental standards which are effective in the EU and beyond its borders. BAT reference documents have since become a highly sought-after source of knowledge about industrial environmental protection in international efforts to safeguard the environment too. For example, in its protocols on the Convention on Long-range Transboundary Air Pollution [150] the UN ECE also uses information from the BAT reference documents for its technical appendices and in order to define limit values for environmentally harmful pollutants. Thus the BAT reference documents provide an important impetus for the worldwide development of industrial environmental standards.

The supply of information to the public, and its involvement, can also provide progressive industrial enterprises with additional incentives to help to protect the environment, because members of the public will recognize and acknowledge the contributions that these enterprises make to the environment. Moreover pressure is growing on those who currently lag behind in the work of protecting the environment. It is important that the public makes use of its information rights and becomes actively involved at local, national and EU levels. The IPPC Directive provides a good basis for this.

Member states report to the EU Commission on the ways in which they apply and meet the requirements of the IPPC Directive. However, an increasing number of EU Directives on environmental protection with ensuing reporting obligations would sooner or later impose impossible burdens on the EU states, with the result that reports of inadequate quality would not provide any useful statements. During the last round of reports efforts were made to make it easier to compare them, thus making them more informative.

The UBA is trying to persuade the EU Commission to harmonize reporting obligations in the EU more effectively, with regard to both timing and content, in the future. In the opinion of the UBA uniform reporting obligations on the emissions from industrial installations covering all relevant legal regulations are necessary, and this is a fundamental task in the revision of the IPPC Directive.

The aim of the IPPC Directive is to constantly reduce the amount of environmental pollution by industrial installations in the EU. The consistent, stricter application of its instruments will enable a high level of environmental protection to be achieved in all EU member states. This will create a level playing field for all industrial enterprises in the single EU market and will also benefit companies in Germany.

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[148] Additional information about the revision of the IPPC Directive: http://ec.europa.eu/environment/ippc/ippc_review_process.htm

[149] The German contribution to the BAT reference document on cement and lime ("Zement und Kalk") is available on the internet at: www.bvt.umweltbundesamt.de/mat.htm

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DEPARTMENT III 3 "WASTE AND WASTE WATER MANAGEMENT"

Energy from biogenic waste – an important contribution to climate protection

Among the various climate-friendly, renewable fuels, biomass is becoming increasingly important. Energy from biomass accounts for an increasing share in the production of electricity, heat and fuel. Mention of "using biomass" is often associated with the burning of wood from forests or the production of biogas from maize or other energy-producing crops. However, waste is also a large potential source of biomass.

Many biogenic flows of waste and residual matter are available to provide energy. Examples include separated bio-waste from private households and waste food from restaurants and large kitchens, ancillary vegetable and animal products from the food industry, such as potato peelings, the residues from processed apples and from beer production, molasses, abattoir waste products and animal fats. Other sources include waste wood from the construction industry and from bulky waste. Quantities of wood are also left over from forestry operations, sawmills, wood processing and the furniture industry. Sewage sludge and residual household waste also provide useful amounts of biomass. Large flows of residual matter are also obtained from agricultural food and livestock feed production. The energy potential of these various biomass flows are currently being used to differing extents in Germany.

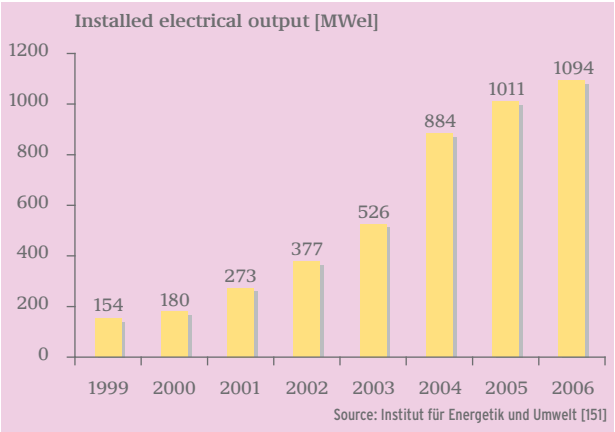
The ecological and economic advantages of waste biomass compared with the cultivated biomass from agriculture and forestry, also referred to as renewable raw materials, is that they are available as materials or to provide energy without incurring any additional production expense. The use of waste and residual matter obtained from agriculture does not have the same undesirable environmental effects as those resulting from working the soil or applying fertilizers and pesticides. All that is needed in making use of waste biomass is to collect and transport it to the processing point and possibly to condition it.

Obtaining energy from waste wood

There has been a sharp rise in the use of energy obtained from waste wood since the introduction of the Renewable Energy Law (EEG) and the Biomass Regulation. Burning waste wood in so-called biomass (combined heat and) powerplants has been a viable option since these regulations compelled the suppliers of electricity to accept delivery of it, with increased payment for electricity produced in this way. The sharp rise in the number of biomass (combined heat and) powerplants in 2003/2004 was a response to increased demand, which led to higher prices for waste wood. Contaminated waste wood no longer has to be disposed subject to payment of a charge but can now be sold. Nowadays separating waste wood from building waste and sorting through bulky waste are economically viable. Furthermore, the cheap option of disposing of mixed waste in landfill has no longer been possible since June 2005. As a result of these developments the potential offered by waste wood has been largely exhausted. Increasingly plant operators have to obtain fresh, and expensive, timber from forests. The anticipated construction of additional biomass (combined heat and) powerplants to take waste wood will decline sharply over the next few years.

At the end of 2005 there were 143 biomass (combined heat and) powerplants in operation, meeting 64 per cent of their fuel requirements from waste wood. By the end of 2006 their numbers had increased to 162, and they were only able to meet half of their fuel requirements with waste wood. At the present time some 3.8 million tonnes (mi. t.) of waste wood is being used annually in biomass (combined heat and) powerplants [151]. The 17th Ordinance of the Federal Immission Protection Law (17. BImSchV – Verordnung über die Verbrennung und die Mitverbrennung von Abfällen) permits plants to use contaminated waste wood, and they thereby meet the requirements imposed on waste incineration plants. However, such plants have hardly any scope for burning waste other than waste wood because then they would not qualify for the increased payments for supplying electricity in accordance with the Renewable Energy Law (EEG). This would threaten the economic viability of most of these plants.

Figure 31: Development of installed electrical power output from biomass (combined heat and) powerplants in Germany



Obtaining biogas through the fermentation of waste biomass

Because of its high water content, wet biomass, such as food leftovers, manure, grass cuttings or silage, is less suitable for direct incineration. However, in this form too biomass can be used to obtain energy, and this is made possible by fermentation in biogas installations.

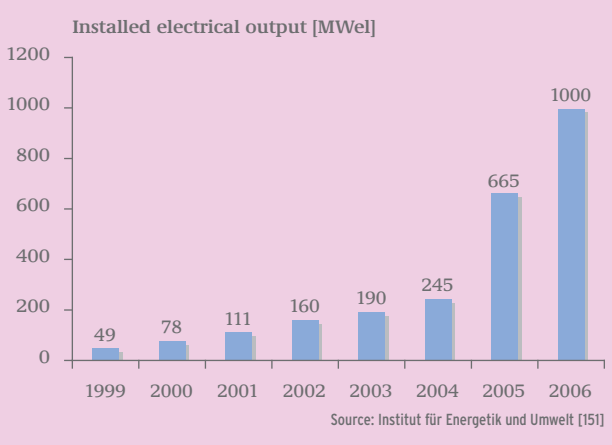
Each year some six million tonnes of bio-waste are produced by households and businesses, but fermentation plants are currently only using some 15 per cent to produce energy. The vast majority of it is composted. According to the findings of a research project conducted by the Federal Environment Agency (UBA), a changeover in bio-waste treatment from composting to fermentation would reduce CO_2 emissions substantially if the combustion of biogas was used not only to produce electricity but also heat. Assuming an optimized fermentation at around 68 per cent of separately collected bio-waste with efficient use of the energy contained in the biogas, compared with purely composting a saving of around 800,000 tonnes of CO_2 equivalents could be achieved [152]. In addition to the direct use of biogas in combined heat and power (CHP) units at the present time, biogas is being treated in a biogas plant in Pliening near Munich, for example, and is subsequently fed into the natural gas supply network. Like composting, the material utilization of the fermentation residues as fertilizer or for manufacturing plant substrates is possible, subject to adherence to the specifications of the Bio-waste Regulation, and especially the limiting values on heavy metals. In the past the high levels of copper and zinc deposits in some of the fermentation residues in manure meant that the limits were exceeded.

Despite the advantages for climate protection that have already been referred to, at present it seems that hardly any efforts are being made to expand fermentation capacities for bio-wastes. This is because composting plants already exist, and a changeover to fermentation would only be of economic interest if these plants were extended or new ones built. The collection of biowaste is not being extended at the present time either. In 2005 bio-waste accounted for around eleven per cent of the

Biogas installation for renewable raw materials...

substrate used in biogas plants in Germany, while industrial and agricultural residues (excluding manure) represented 16 per cent of the substrate being used. A considerable increase in fermentation capacity is taking place for renewable raw materials, with corn silage currently the main material used. Wheat and grass silage are also being used. In 2005 renewable raw materials accounted for some 22 per cent of the substrate used [153].

Figure 32: Development of installed electrical power output of biogas plants in Germany



Manure is an agricultural residue offering a great potential as a source of energy. Animal excrement (manure and dung) provided 51 per cent of the substrate used in biogas plants in 2005. The disadvantage of manure is its low energy density, in other words the gas obtained from one unit of mass of manure is very small compared with other substances used. This is a major reason why biogas plants so far only make use of around ten per cent of the energy potential of manure. Estimates by the Institut für Energie- und Umweltforschung, Heidelberg (Ifeu), and the Darmstadt Ökoinstitut indicate that, apart from the annual reduction in emissions achieved so far through the fermentation of manure amounting to some one million tonnes of CO_2 equivalents, a further 4.8 mi. t of CO_2 equivalents could be saved each year if manure were mainly treated in biogas plants [152]. However, in order to protect our soils, solutions must be found for dealing with the high heavy metal content (especially zinc and copper) in the residues from the manure.

...or for wastes. Size is not the decisive difference

Activities are currently taking place at a number of different locations to advance the technology employed in agricultural biogas plants. This is being done by means of the VDI Directive 3475, Sheet 4, which is being drawn up at the present time in the field of immission control. This directive deals specifically with the requirements imposed on agricultural plants operating with manure and renewable raw materials. The subjects under discussion concern the odours and emissions of ammonia from biogas plants and above all the need to avoid emissions of methane, which is particularly harmful to the climate.

In addition, as a result of a number of a number of accidents, the subject of the safety of biogas plants has acquired greater importance. A working group at the farming association Bundesverband der landwirtschaftlichen Berufsgenossenschaften is currently revising the standards that will apply in future to the safety of biogas plants. A start has already been made. The UBA and the Bundesverband have jointly published an information paper on the safety of biogas plants entitled “Informationspapier zur Sicherheit bei Biogasanlagen” [154]. It focuses on technical safety measures such as ventilation and warning equipment in order to prevent accidents involving gas, and provides advice on the resources used which, on account of their chemical and physical properties, could lead to the creation of toxic gases.

Possibilities offered by incineration of domestic waste

Waste incineration plants currently have an annual throughput of over 17 million tonnes of waste. Some 60 per cent of the carbon contained in the waste consists of renewable materials of vegetable and animal origin. Taking into account the different calorific values it is evident that around half of the energy contained in the incinerated waste comes from a regenerative source. Obtaining more electricity and heat from waste incineration plants could

make a major contribution to replacing fossil fuels. Possible savings of between one and a half and three million tonnes of CO_2 emissions could be achieved annually [155].

At a workshop held on 6 and 7 November 2006 at the UBA representatives of politics, business and associations agreed that there was a need to do more to exploit the energy potential of waste incineration [156]. Together with experts from neighbouring European countries they discussed the various instruments that could be used to enable a more efficient use of residual waste as a resource. The aim is to connect waste incineration plants more effectively to the district heating network. In order to achieve this participants in the workshop suggested changes to the Combined Heat and Power Law and an obligation to use heat produced by waste incineration plants.

The competition surrounding biogenic waste

Material use is being made at present of some of the biomass obtained from waste. Examples include the utilization of pomace and marc as cattle feed or to produce pectin, animals fats to make chemical fats, ground bones as cattle feed, waste wood for making fibreboard, and garden waste for composting. In individual cases ecological balance sheets can be drawn up to answer the question of whether material use is of more value than using waste for energy purposes. If this proves to be the case, then material recycling of waste would take precedence over its use for producing energy.

There could also be competition between the different processes used in obtaining energy. Wood offers one example, either directly to produce electricity and heat or through its conversion into a biofuel (biomass to liquid). Experts at the agency are engaged in intensive discussions about the various competing uses. It is expected that these discussions will be completed by the autumn of 2007, when the UBA will publish details about its position on the sustainable use of biomass.

Summary

According to estimates by Ifeu and the Ökoinstitut, by making the best sustainable use of the waste biomass and residual agricultural matter, additional savings could be made on gases affecting the climate in the region of 15 million tonnes of CO_2 equivalents annually [152]. In addition to the fermentation of biowaste and manure there is also a large energy potential in agricultural and forestry residues, such as straw, residual wood from forestry, beet and potato leaves and also the waste from landscape conservation (pruning and mowing). If these climate protection efforts are to be successful it is essential that the maximum possible use is made of energy obtained from biomass. It is not sufficient to simply produce electricity without making use of the heat generated, as has been the case in the past in a number of plants.

Through research projects and technical working groups the UBA continues to develop methods of exploitation in order to support use of the various flows of biomass in ways that help to protect the environment. Moreover the agency is developing instruments which should help to make energy production more efficient.

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DIVISION IV "CHEMICAL AND BIOLOGICAL SAFETY"

Chemicals are a permanent feature of our everyday lives. Large quantities of chemical substances are regularly consumed in the form of industrial chemicals, washing and cleaning agents, medicines, pesticides or biocides. Laws have been passed to give a level of protection against this increasing burden on the environment and on mankind. Before substances and products are launched commercially examinations are carried out by experts from Division IV of the Federal Environment Agency (UBA) to determine the risks that they present to ecosystems. If necessary conditions, and even prohibitions, are imposed on their use in order to minimize risks and keep the burdens on mankind and the environment within acceptable limits.

Several hundred assessments are carried out annually, forming the basis for our work. A great deal of expertise is called for, because not all chemicals are the same. The differences lie in the intended purpose, i.e. whether a company intends to market an inert dye for the autumn fashions or a new poisonous pesticide to combat pollen beetles. There are also new biocidal marine paints, antibiotics for humans, anti-parasite treatments for animals, tensides for detergents or rat poisons.

Environmental assessment is undergoing dynamic expansion. Hormonal effects, persistent and bio-accumulative properties or probabilistic assessment approaches are not just recent additions to the terminology of materials assessment. In this area the UBA's perception of its role as an investigating environmental authority is combined with the necessary degree of skill in a dialogue with companies to assess the properties of substances and materials. The UBA presents its views in EU committees, in the World Health Organization (WHO), in the United Nations Environment Programme (UNEP) and in the Organization for Economic Co-operation and Development (OECD). The background to the technical advice is provided by the investigations that the UBA carries out in its own laboratories, such as the facility for simulating flowing and still water.

Additional details about the work of the Division can be obtained at:
http://www.umweltbundesamt.de/uba-info-e/e-fach4.htm

DEPARTMENT IV 1 "CHEMICAL SAFETY"

Biocides on the land, in the water, in the air ... and in the refrigerator

Humans have always had to deal with animals, plants, fungi and bacteria that have the potential to harm them, such as mice, mosquitoes and fungal mould, and for just as long efforts have been made to combat such organisms. Even in ancient times boats were coated with tar or lead and copper plates as a chemical means of preventing fouling and attack by marine worms. These were the first

biocides, and nowadays companies apply numerous industrial and commercial biocides. Biocide products are also found in most homes, as well as in many consumer goods, such as the preservatives in paints and lacquers, as antibacterial additives in household cleaners or as an antibacterial coating in refrigerators. Under the heading of "Biocides" the Chemical Law lists 23 specifically defined product types, which it divides into the main groups of disinfectants, protective substances (including those used on timber), pest control substances (such as rat poisons) and anti-fouling agents. In terms of their types and applications biocides are an extremely heterogenous range of products.

On account of their intrinsic properties, i.e. for destroying or deterring pests or rendering them harmless, by chemical or biological means, biocides are per se a potential hazard for the environment and to human health. Nevertheless, in Germany too it is possible for biocide products to be marketed without having been officially certified. Implementation of the Directive 98/8/EC concerning the placing of biocidal products on the market in German law in 2002 introduced a general statutory licensing obligation for the first time. This closed a significant gap in the regulations relating to environmental and health protection. The licensing authority for biocidal products in Germany is the Federal Agency for Employment Protection and Industrial Hygiene (BAuA). The UBA is the sole examining authority for the assessment of environmental risks and also participates in the work of determining risk reduction measures. The UBA also deals with questions concerning the effectiveness of biocides for specific types of product, such as the disinfectants used in drinking water and swimming pools, or pest control.

Positive list for the environment

One of the licensing conditions for biocide products in Germany is prior inclusion by the EU Commission of the active ingredients that it contains in a "Positive List of Permitted Active Ingredients" (Appendices I, IA of the Biocide Directive). By 2010 national authorities will subject the active ingredients of biocides that were commercially available before May 2000 to systematic examination in order to ascertain their risks to humans and the environment. The EU member states share the work of assessing the test dossiers on the effects of active ingredients on the environment and health that are submitted by the manufacturers of biocides. As part of the EU programme for existing active ingredients Germany is assessing some 140 such dossiers. The UBA began by examining the active ingredients in wood preservatives and in substances for combating rodent infestation. It soon became apparent that there were unresolved questions in the EU at all decision-making levels concerning the assessment of biocides. This applies, for example, to general testing strategies, emissions scenarios, aspects of risk management and the way in which an ingredient is entered in the Positive List. Despite many initial difficulties, by the end of 2006 a total of 35 assessment reports were available for discussion at EU level, three of them from Germany. The Positive List already contains two approved ingredients (as per January 2007).

This Positive List describes the identity and minimum purity of the ingredient as well as specific restrictions on its use, such as limiting it to a particular group of users. More far-reaching recommendations and warnings are included in the assessment report for ingredients for which product approval is required in Germany. These can be in the form of risk management measures or an assessment involving comparisons with alternative ingredients presenting a lower risk. Such comparative assessments were first proposed by European authorities for two active ingredients of wood preservative and three ingredients of substances to deal with rodent infestation.

Reciprocal recognition, with obstacles

The procedure for reciprocal recognition simplifies the cross-border licensing of biocide products. Although the Biocide Directive specifies the criteria for the decision-making process, it cannot be ruled out that various authorities assessing the same product nevertheless arrive at different results. This is particularly evident if the examination of the ingredients does not take all possible applications into consideration. The authorities must then work out the missing exposure scenarios during the product approval process. In the course of reciprocal recognition the authorities in EU member states make a rapid comparison of the different approaches.

Currently some 290 active ingredients are commercially available in Germany (EU: approx. 350), distributed among a total of more than 18,000 biocide products. A decline in the number of available biocides is already foreseeable, because companies are deliberately dispensing with some of the ingredients in order to obtain data for the safe use of the products. As a result applications for approval can no longer be made for such biocides. It is difficult to foresee whether the biocide law will have a seri-

ous impact on the overall quantities used, sold and consumed. The authorities must observe reporting obligations when collecting such data because manufacturers may invoke the right to company secrecy. Making approval subject to restrictions and prohibitions reduces the risks that hazardous biocidal ingredients can pose for humans and the environment. Moreover the rules contained in the law on hazardous materials may apply, or biocides may come within the scope of the Framework Water Directive.

Transitional regulations for wood preservatives: Until the introduction of product approval under the Biocide Law, companies offering wood preservatives for private use will voluntarily allow them to be tested to determine the effects on humans and the environment. This is based on the 1997 voluntary agreement between the industry and the Federal Ministry for the Environment. The UBA assesses the impact on the environment but has not conducted the environmental assessment of wood preservatives for commercial use since 1 October 2006 because there were no longer any significant advantages in its continuation until the biocide produce approvals take effect.

Problematical ballast

Sea-going ships carry water ballast in special tanks to provide stability when running light. The water that they take on also contains living organisms, which are thus transported around the world. In February 2004 the International Maritime Organization (IMO) signed a convention providing for the treatment of ballast water by destroying (or separating out) these “stowaways”. On-board management of ballast water is needed to prevent organisms being carried to oceans in other parts of the world.

Companies have now developed ballast water disinfectants and processes and an application for an approval process has been lodged with the IMO. The UBA is also involved, assessing applications to determine the environmental compatibility of such installations and active ingredients, and working towards the creation of technical guidelines for conducting appropriate examinations. It is also important that the IMO-approved method of treating ballast water should also satisfy the “Biocide Directive”. The UBA has already gained some initial experience, and of the nine applications for ballast water treatment systems submitted so far, two have come from German companies (as per January 2007).

Non-environmentally friendly marine paints

The principle of preventive environmental and health protection also requires that the authorities should fundamentally reduce the amount of biocides used, as well as examining and, if appropriate, encouraging the use of biocide-free or low risk alternatives. The authorities are drawing up assessment criteria to promote the use of environmentally friendly alternatives.

In recent years the emphasis has been on examining suitable substitutes for tributyl tin (TBT) in marine anti-fouling paint containing biocides. TBT accumulates in the environment, is toxic and causes hormonal damage, which is why it has been banned. In some surface waters one of the possible alternatives, Irgarol, has been found to have reached concentrations that are harmful to organisms. These were the findings of investigations carried out in the UBA’s own installation for simulating flowing and still water, and analyses of surface waters that were conducted by the agency.

A feasibility study by the UBA has led to the development of criteria for biocide-free anti-fouling paints [157]. Silicon coatings are one possibility for meeting these demanding criteria, and the UBA has prepared a report investigating their environmental impact [158]. The findings only offer limited hopes: silicon oil does not easily break down, and once it

Stowaways on board: species of animals from other regions find their way into local waters in discharged ballast water.

has leached out of the coatings it can present a danger to the marine environment. Bio-available metabolites are also produced, in small quantities, and become widely distributed, accumulating along the food chain and presenting a considerable toxic risk. This example shows that examination by the authorities also has an important part to play when recommending alternatives, otherwise there is a danger of "throwing the baby out with the bathwater".

What about the future?

In a few years time the only biocide products on the market will be those that have been tested and approved, and which satisfy the strict requirements for protection of the EC Biocide Directive. Market adjustments have already taken place: of the 1,000 active ingredients prior to 2000 no more than 350 now remain. Products containing these "lost" ingredients may no longer be traded after 1 September 2006.

In 2007 the EU Commission prepared a report on experience gained with the directive and its effects on the biocide market. The relevant authorities and the companies that manufacture biocides are currently discussing a number of issues, including the following gaps in the EC Biocide Directive:

- regulations concerning the import of products that have been treated with biocides (e.g. textiles, shoes) and the lack of compulsory labelling in the EU single market;
- data protection questions;
- clarification about the scope of application;
- the amount to be charged for submitting applications;
- the question of whether suitable biocide products should be available to fight infections and for cleaning ancient monuments, and in what quantities.

It will then be possible to submit proposals for changes to the Biocide Directive, the results of which should find their way into the amendments to the Biocide Directive which are planned for 2008.

Prohibitions demonstrably reduce the burden on human beings

The investigations that have been conducted over the past 20 years by the UBA in its German Environmental Survey have included the search for pollutants in the blood and urine of the German population. One example is provided by the highly toxic pentachlorophenol (PCP), which does not easily break down. Due to its fungicidal effect PCP was used in both East and West Germany, especially in wood preservatives. The manufacture, marketing and use of PCP has been prohibited in the former West German states since 1989, and this was extended to all of Germany in 1990.

The success that the ban has had on the PCP levels in the urine of adults is plain to see. Examination of the urine samples from the Federal Specimen Bank of the UBA reveal a significant decline between 1990/92 and 1998 from an average of 2.7 micrograms per litre (µg/L) to 1.0 µg/L. In 1985/86 adults in West Germany showed PCP levels of 4.4 µg/L. The contamination of children with PCP has also declined sharply. The German Environmental Survey of Children (GerES IV) that took place between 2003 and 2006 revealed an average PCP content in the urine of children to be below the detection limit of 0.6 µg/l.

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Dr. Caroline Hoffmann, Section IV 1.6 (Ballast Water)

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DEPARTMENT IV 2 "RISK ASSESSMENT"

Information technology: Innovation factor for the Chemicals Law

More than almost any other branch of science, information technology plays a major part in our lives. In particular it directs, regulates, measures and warns in unseen places, hidden in switchboards, mobile phones, cars and domestic appliances. Information technology is also the heart and the pacemaker of the modern "information society", which is making rapid inroads into modern authorities such as the Federal Environment Agency (UBA). Staff have been linked by a network of computers since the early 1990s. Computers and software assist them in their daily work, whether they are answering questions from the public or carrying our extremely complex model calculations to determine the spread of contaminants in the environment. It is not always easy. The internet, for example, is not simply revolutionizing communication in private households. In public sector authorities media interfaces are needed to make environmental information and other services accessible to the public. The UBA website, currently comprising some 10,000 pages (as per January 2007), gives details of our work in protecting the environment and people from harmful environmental impacts.

The danger of delay: fast track information about hazardous materials

An accident involving a tanker in the North Sea, a suspect truckload of chemicals discovered by customs at the border, or a call from the fire brigade fighting a blaze on an industrial site, requesting information about the suspected escape of substances. In most cases, in an emergency, decisions have to be made immediately on the measures to be taken in order to protect people or the environment. The required information about environmentally hazardous materials is available from the Rapid Information Service on Hazardous Materials (GSA) at the UBA. With only a few clicks of a mouse the GSA can supply a precise and technically reliable picture of the hazards represented by some 30,000 commercially available materials. It can be accessed by various federal agencies and authorities, the federal states and other institutions regulated by public law. The aims of the Rapid Information Service on Hazardous Materials are:

- to provide information of a high quality;
- to assist with information when breakdowns and accidents occur involving environmentally hazardous materials;
- to examine the storage and transport of environmentally hazardous materials;
- to advise on ways of avoiding dangers and damage caused by environmentally hazardous materials.

Publicly available information about chemical substances

Some of the information about chemical substances can be accessed by interested consumers via internet portals: the main German databases on the various materials, the "Stoffdatenbanken der Bundesrepublik Deutschland" (http://www.stoffdaten-deutschland.de/) link the different suppliers. This is also the home of the national database of hazardous materials (Substance Data Pool Federation/ Länder – Gemeinsamer Stoffdatenpool des Bundes und der Länder, GSBL), which the federal and state authorities have been maintaining and updating since 1994. In its current version the GSBL lists 40,000 single-ingredient substances (pure substances), 320,000 multi-component substances (mixtures and preparations) and 190,000 categories of residual substances (statutory regulations). Provided it is not confidential, all registered data in Germany about new substances is included in the substance data pool, the only one of its kind in Europe.

The UBA's Rapid Information Service for Hazardous Materials at work.

Data at a glance: the Chemical Safety Information System

Prior to the commercial introduction of new chemical substances the UBA assesses the material risks to the environment. For this purpose the manufactur-

Who makes use of the Substance Data Pool Federation/ Länder (GSBL) and for what purposes?

- Police authorities, for example the river police and highway police use the GSBL to make a quick and reliable assessment of the risks from hazardous goods transport;
- for firefighters the GSBL provides reliable details in the event of a fire involving or releasing hazardous substances;
- environmental authorities at all administrative levels make use of GSBL data in factory inspectorates, employment protection and in dealing with and disposing of hazardous materials;
- at a political level the GSBL provides information for use in assessing and developing new statutory regulations.

ers provide data about the effects and behaviour of their substances in the environment. On this basis the UBA examines whether it can issue environmental approval, for example, for a pesticide, biocide or veterinary medicine. What if all three of the products named contain the same active ingredient? This does not simplify the procedure because the three products are examined in accordance with three different sets of legislation (Plant Protection Law, Biocide Law and Veterinary Medicines Law), and the assessment of environmental risks is different in each case. Moreover, apart from the actual use specified in the application, other environmental burdens are not considered.

However, information is available from a wide range of legislation to enable individual applications to be assessed. For the past 15 years the strategy of the UBA has been to edit information about chemical substances in the modular Chemical Safety Information System (ICS) in preparation for comprehensive enforcement of the law across the legal spectrum. For example, if a company applies for a licence for a (highly toxic) synthetic pyrethroid as a biocide product, the agency's experts only need to consult the ICS database in order to discover the findings of a completed assessment of pyrethroids when used as a pesticide or veterinary medicine. This data can also be used in assessing a biocide product. In carrying out an effective and thorough assessment of a substance it is useful to make data and assessment findings about various different products available in their entirety and at a glance. The ICS at the UBS has developed into a system unique in Europe and currently holds details about more than 117,000 substances (see table 7).

Table 7: Substances and products in the Chemical Safety Information System

Residual wastes (80 % of which with a structural formula)	100,203
New substances (applications)	10,746
Pesticides (preparations)	3,563
Active ingredients of pesticides	1,202
Pesticides (EU examination)	685
Active ingredients of biocides	165
Human medicines (preparations)	249
Veterinary medicines (preparations)	136
Active ingredients of medicines	243
Metabolites	581

Source: Federal Environment Agency

Paradigm change with REACH

REACH stands for the Registration, Evaluation and Authorization of Chemicals. It will result in a fundamental change to chemical legislation in the European Union as well as standardization. At the heart of the new chemical law is the reversal of the disclosure obligation. Where as in the past it was the authorities' task to prepare environmental risk assessments for industrial chemicals, this task now devolves to the companies. This paradigm change affects some 30,000 substances which are produced or imported in quantities of more than one tonne per year. Only well organized information technology will be able to deal with the influx of data that will reach the European Chemicals Agency in Helsinki over the next few years.

That is why the relevant authorities in EU member countries, companies in the chemical industry and the European Commission will be using the REACH Implementation Plan (RIP) 2.1 to set up a complex and interlinked information and communication system which has two fundamental components. REACH-IT is the web portal of the European Chemicals Agency, which is used to regulate the application procedure. This is where tens of thousands of companies apply to register their substances and incorporate the necessary data in the chemical agency's workflow system.

IUCLID 5 (International Uniform Chemicals Information Database) is the name of the central database which administers the details about these substances, which are used to back up the preparation of the relevant documents. A database of hazardous substances, such as exists already in Germany with the GSBL, will then be provided for Europe too. The REACH-IT portal will enable the public to obtain de-

tails about chemicals which represent a hazard to humans and the environment. Each stage in the process, from the application to registration and the response to queries about the substance, takes place in a paperless form. In this way the EU Chemicals Agency sets the pattern for the implementation of other legislation. The UBA also intends to transfer the application process for biocides from paper onto a digital system in the near future.

Components of the electronic application process:

IUCLID 5 formats & software: web-based technical information system for collecting and passing on data to the European Chemicals Agency in Helsinki.

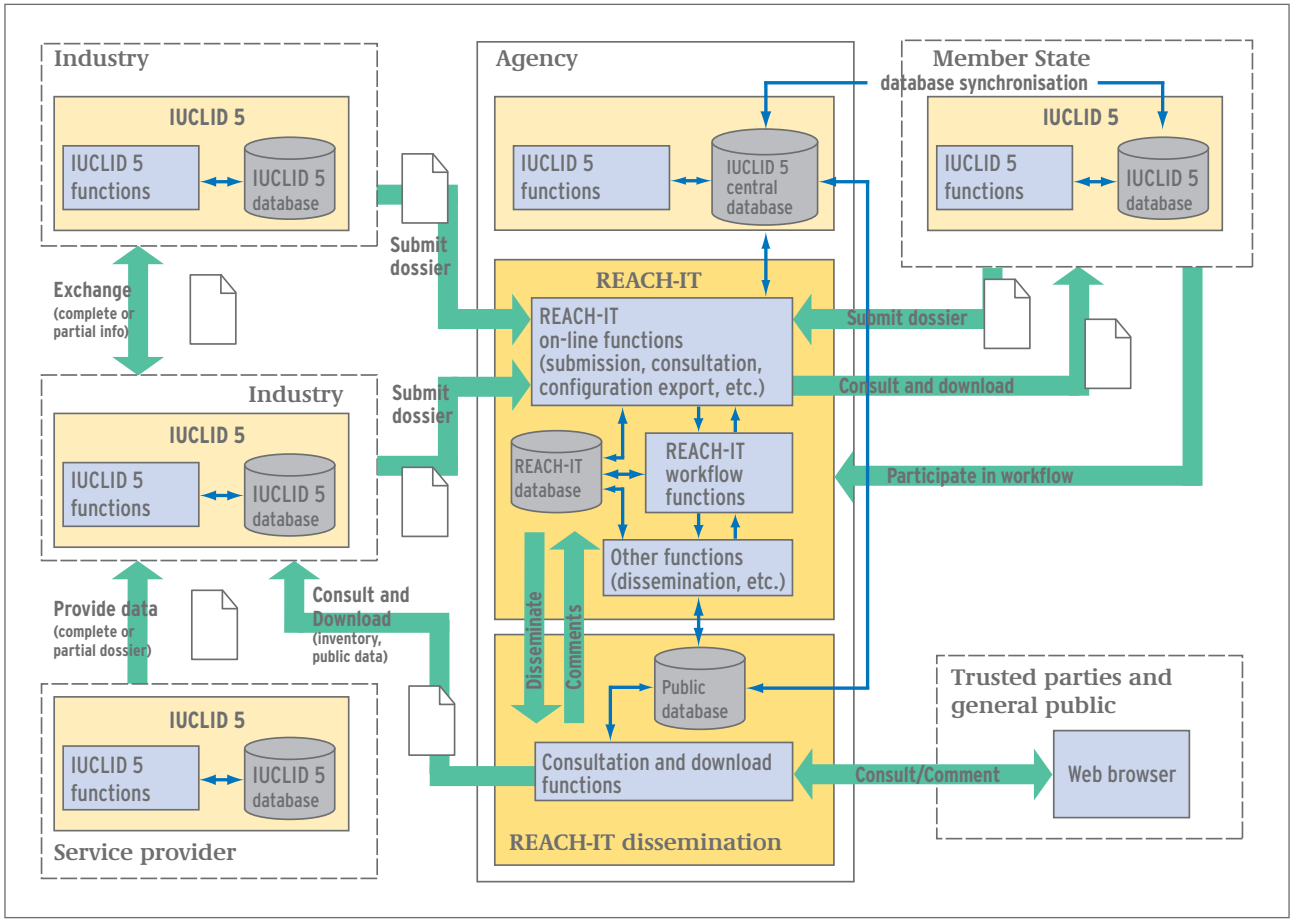
IUCLID 5 data repository: index module with information about registered substances.

REACH-IT: workflow management system for the registration and administration of the data of all those involved (agency, member countries, industry).

A bridge between an old and a new world: web services on the internet

The new Environmental Information Law (UIG) complies with the objectives of the Aarhus Convention, which seeks to involve the public more in environmental protection decisions [159]. Under the terms of the UIG all offices in the public administration sector are obliged to make their environmental data clearly understandable. In this way legislators intend to give the public greater influence in matters of environmental protection. The authorities will be required to respond to queries within one month, In addition the new regulations impose an obligation on the authorities such as the UBA to make the environmental information that they hold increasingly available to the public through electronic databases.

Offers and services that can be understood by users and are also accessible using internet technology prepare the way for a wide range of environmental information. In the “old world” of internet technology a program supplied a user directly with information. In the “new world“ applications make a note of the links to other clients, from whom they can al-



so access data and information. These services offer a wide range of information. Through multiple use environmental data that has been collected once acquires added value.

Federal and state projects are facing these challenges. Thus a number of these applications were set up last year at or with the support of the Division IV "Chemical and Biological Safety" of the UBA. They cover information about materials as well as data about the environment and exposure. As an example: The cooperative project "Federal and State Dioxin Database" provides just such a web service, supplying the public with details about measurement programmes and data about persistent organic pollutants (POPs). If required other federal or state authorities can also access this range of information and incorporate it in their own portals and information systems.

Databases providing more clarity in the assessment of materials

Information about substances to protect against hazards – the Substance Data Pool Federation/ Länder:
http://www.gsbl.de/

An archive of environmental quality in Germany – the German Environmental Specimen Bank:
http://193.174.169.38/wwwupb/servlet/upb

Provides measurement programme, background information at a glance – the Federal and State Dioxin Database:
http://www.pop-dioxindb.de/

Visualization and analysis of spatial, environmentally relevant information – the Geographical Information System about the Environment (GISU):
http://osiris.uba.de:8081/gisu/start?lang=de

Information technology is a means to an end. The main challenge is, on the one hand, to achieve a balance between the professional application of information technology, and on the other, the processing of the information for various user groups in an understandable as well as an intuitively accessible way. Using information technology to provide a targeted range of services enables the content of these services to be interlinked more effectively. The creation of such networks creates new knowledge which is so vital, especially in the interdisciplinary environmental sector.

Contacts:

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Thomas Krämer, Section IV 2.1 (Substance Data Pool Federation/Länder)

Sources:

[159] Additional information about the Environmental Information Law:
http://www.bmu.de/buergerbeteiligungsrechte/downloads/doc/2879.php

DIVISION E "EMISSIONS TRADING. GERMAN EMISSIONS TRADING AUTHORITY"

Since 2004 the German Emissions Trading Authority (DEHSt) has been organized as Division E of the Federal Environment Agency (UBA), providing a range of services in accordance with the requirements of the EU Emissions Trading Directive, the Greenhouse Gas Emissions Trading Law (TEHG), the Allocation Law 2007 (ZuG 2007) and the Project Mechanisms Act (ProMechG). The DEHSt is largely responsible for the setting up and organization of the European emissions trading system for companies in the energy sector and for energy-intensive industries in Germany. It is also the responsible German authority for the application of the project-based mechanisms of the Kyoto Protocol Joint Implementation (JI) and Clean Development Mechanism (CDM).

The DEHSt examines applications by plant operators for emission allowances which it issues to them annually. Together with the responsible authorities in the federal states it examines the annual reports about actual emissions from industrial plants. It also maintains the national registry of emissions and is responsible for filing reports both nationally and internationally.

Within the international climate process it is the Designated National Authority (DNA) for CDM projects and the Designated Focal Point (DFP) for JI projects and as such the DEHSt provides an additional statutory service by approving or rejecting such climate protection projects in accordance with the Kyoto Protocol, as well as examining and confirming the verification reports on JI projects if these are applicable to Germany. The DEHSt is financed entirely from the revenue from fees.

Additional details about the work of Division E/DEHSt can be obtained at:
http://www.umweltbundesamt.de/uba-info-e/e-fache.htm

DEPARTMENT E 1 "INDUSTRY ALLOCATIONS, CUSTOMER SERVICE AND LEGAL MATTERS"

Investing in climate protection with bilateral projects

In addition to emissions trading between industrialized nations, the Kyoto Protocol also provides two other, flexible mechanisms for climate protection: Joint Implementation (JI) and the Clean Development Mechanism (CDM). The Law on Project-Based Mechanisms (ProMechG) enables German companies to implement cost-effective climate protection projects together with companies from Central and Eastern Europe (JI projects) and, in developing countries, in the form of Clean Development Mechanism projects [160]. Within the scope of the emissions

trading system companies can use emission certificates from climate protection projects in order to meet their emission reduction obligations, or they can sell such certificates. Since autumn 2005 the German Emissions Trading Authority (DEHSt) at the Federal Environment Agency has also been acting as the approval authority for climate protection projects in which Germany is involved.

Innovation through climate protection projects

Global climate warming can only be counteracted if the the community of nations undertakes a massive reorganization of its energy supplies: abandoning the fossil energy sources of coal, oil and gas, and adopting renewable energy systems powered by the sun, wind and water, as well as substantially improving energy efficiency levels. Bilateral climate protection projects can play an important part in the renewal of the energy industry in those countries where such projects are carried out, the so-called "host countries". Through the transfer of renewable energy technologies it is possible to introduce innovative alternatives for the supply of energy in these countries. In this way JI and CDM climate protection projects not only provide the emission certificates for those industrialized nations which are subject to emission reduction obligations but they also serve as model projects for more economical methods of climate protection and for sustainable energy supplies.

Flexible mechanisms

Under the Kyoto Protocol the industrialized signatory nations can meet some of their emission reduction obligations abroad [161]. To enable these commitments to be met in the most economical way possible, the protocol contains three so-called "flexible mechanisms":

- emissions trading between industrialized nations,
- Joint Implementation (JI) of climate protection projects by industrialized nations,
- climate protection projects involving industrialized and developing nations (Clean Development Mechanism, CDM).

However, the signatory nations have also agreed that, in the efforts by the industrialized nations to achieve reductions, domestic emissions should have priority, and that the flexible mechanisms should only be supplementary to domestic measures. Under the Kyoto Protocol (Marrakech Accords) the construction of nuclear power stations is no longer recognized as JI or CDM.

What is a climate protection project?

The principle of the climate protection projects is to award emission certificates, free of charge, for reductions in emissions measured against a strictly defined reference case (business-as-usual scenario). Examples of such projects include a wind farm in Bulgaria that is financed by German investors (JI) or a biomass power plant in India (CDM). Applicants have to provide a precise description of the project activities using project documentation that conforms to internationally agreed standards (Project Design Document, PDD), and must also show a reference scenario. The monitoring plan laid down in the PDD should ensure that there is complete and traceable documentation of the greenhouse gas emissions produced. The recorded data forms the basis for a subsequent examination of the reduction in emissions that the project seeks to achieve. The volume of annual reductions varies considerably from one project to another. A large landfill gas project produces up to one million emission certificates annually, while a so-called small project involving the use of biogas creates an emission reduction volume of up to 30,000 certificates annually.

One important international condition for recognition as a climate protection project is its "additionality", which means that climate protection projects will only qualify for approval if the reduction in emissions takes place because of the additional financial incentive offered by a JI or CDM. For example a project that is economically profitable and conforms to customary practice, or simply implements the legal, environmental protection requirements in force at a particular location, will not be classified as "additional".

Approval for climate protection projects

The main contribution by the DEHSt as the Designated National Authority (DNA) for CDM projects and Designated Focal Point (DFP) for JI projects is to approve or reject applications for climate protection projects. International recognition and implementation of these projects initially requires the the approval of the state in which it is being conducted, and of the state providing the investment. In addition the CDM Executive Board at the UN secretariat of the Framework Convention on Climate Change has to recognize and register a CDM project. The

approval of the DEHSt enables Germany to act as the investor country. In the case of a JI Germany can also be the location for the project (JI projects in Germany).

CDM PROJECT "BANDEIRANTES LANDFILL GAS TO ENERGY PROJECT"

Host country: Brazil

Investor country: Germany

Project activity: Methane is obtained from landfill gas and burnet as a fuel to generate energy.

Reference case: The continued, unrestricted release of methane and the production of energy from fossil fuels.

The main features of additionality: There are no legal regulations in Brazil for keeping records of landfill gas and using it to produce energy. If it were not for the revenues from the sale of certificates it would not be possible to operate the plant economically. It is the first project of its kind in Brazil and could serve as the pattern for other companies in the field of decentralized energy production.

Number of anticipated certificates: With an area measuring 1.35 million m^2 an average 1,071,000 certificates per year can be generated over a seven year period [162].

Thorough project documentation (Project Design Document, PDD) and a validation report from an expert agency serve as the decision-making basis for obtaining approval for a project [163]. The DEHSt then conducts a formal examination of the applications and their content to ensure that they are consistent, plausible and coherent. As a rule approval decisions for a CDM project are made quickly. For projects which have already been registered with the UN Climate Secretariat the DEHSt will issue its approval within three of four weeks.

The DEHSt also issues letters of recommendation on the basis of a project description. This may be useful if, at an early stage, it is necessary to check whether the project receives basic recognition. The DEHSt seeks to provide a fast and reliable service for companies submitting applications. Comprehensive guidelines for the preparation and implementation of JI and CDM projects are intended to assist this process [164].

Since the DEHSt began this work in October 2005 there has been a continuous rise in the number of applications for climate protection projects: 99 applications had already been received by the beginning of January 2007 (see Table 8). These include applications for approval for projects as well as those applications intended to provide advance support for projects (letter of endorsment). The projects concentrate on renewable energy and a reduction in the output of methane, a gas which is harmful to the climate. Contrary to the general expectations during the early stages in September 2005, at present the majority of applications are for the so-called "JI domestic projects", in which Germany is the host country for a climate protection project, rather than CDM projects.

Table 8: Overview of applications: JI and CD projects

	Total	CDM	JI abbroad	JI domestic
Total	98	35	5	58
Support applied for	18	3	5	10
approved	3	1	2	
rejected	1			1
in preparation	13	2	3	8
dormant	1			1
Approval applied for	80	32		48
approved	13	13		
rejected	0			
in preparation	58	13		45
dormant	6	6		
withdrawn	3			3

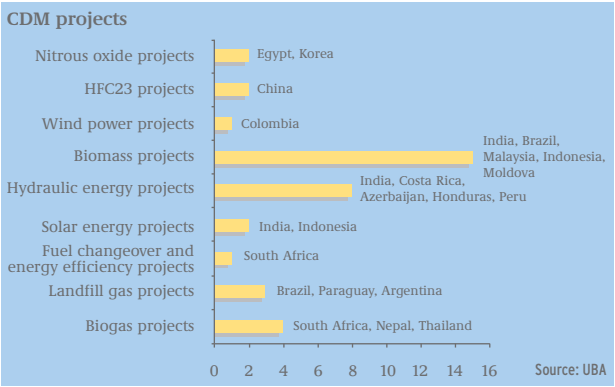
Clean Development Mechanism

Looking at the regional distribution of CDM projects the dominant areas are Asia and South America: most of the 38 projects which have been applied for are to be carried out in the newly industrialized countries of China, India and Brazil; a total of 18 countries are represented. Only a few projects are being planned in Africa at present. The largest project category is that of biomass, followed by the use of water power and biogas.

The "Directive (2004/101/EC) establishing a scheme in respect of the Kyoto Protocol's project mechanisms at a European level (linking directive)" and

the ProMechG are closely based on the international specifications of the Kyoto Protocol and subsequent agreements, and in particular the Marrakech Accords [165]. However, for water power projects with a generating capacity in excess of 20 megawatts, the European directive differs from the international specifications. In this respect, in the EU the recommendations of the World Commission on Dams (WCD) also have to be observed [166]. In 2007 the DEHSt prepared a set of guidelines to assist applicants in applying the WCD recommendations.

Figure 33: Regional distribution of CDM projects in which Germany is involved



Joint Implementation

So far few applications have been received for the project type "JI abroad" because international rules on implementation under the umbrella of the United Nations were only approved in November 2006 and in many cases the agreements between countries (Memoranda of Understanding, MoU) or the statutory basis in the respective countries where the projects are to be conducted are lacking. Moreover there has been no clarification of the continued development of the JI mechanism within the Kyoto Protocol from 2013 onwards because of the lack of a subsequent agreement following on from the Kyoto Protocol after 2012. The host countries for these projects are primarily Russia and the new EU member countries of Central and Eastern Europe. So far the DEHSt has given its recommendation for the first three JI foreign projects in advance of the submission of the application.

In contrast to many other European countries the law permits the implementation of JI projects taking place in Germany. With 57 applications, this type of project (JI domestic) accounts so far in number for most of the output by the DEHSt on project-based mechanisms. This total includes applications for approval as well as enquiries about a non-binding advance estimate based on project outlines. Most of these projects refer to the exploitation of methane from disused mines in the state of Northrhine-Westphalia. Projects for changing to other fuels and to promote energy efficiency also have an important part to play. The JI domestic projects give rise to many questions, including some entirely new technical and legal issues, especially regarding the additionality criteria.

In future the flexible mechanisms of Joint Implementation (JI) and Clean Development Mechanism (CDM) will play an important part in national and international climate protection. For example, from 2008 onward, within the scope of EU emissions trading, the federal government is planning to enable German companies to meet 20 percent of their emission reduction obligations by trading in certificates from JI and CDM projects. In addition the Federal Ministry for the Environment is encouraging the involvement of German companies in the CDM as part of a "CDM Initiative". In this way it is assisting with the export of German environmental technology as well as making an important contribution to environmental protection. The DEHSt therefore expects to see a substantial rise in the number of climate protection projects with German involvement. The DEHSt will meet this challenge by providing in-depth support for the participating companies.

Outlook: harmonization of the requirements for submitting applications in Europe

So far the so-called EU Linking Directive specifies few material requirments concerning the type of projects or their quality. Only in the case of projects for the construction of large dams does it establish standards and provisionally excludes certain project categories. Competition between the various licensing authorities in Europe in terms of differing requirements must be avoided because of the danger that applicants would tend to choose the authority that imposes the laxest standards. The CDM in particular should not be a purely economic instrument for protecting the climate but should encourage sustainable development and environmental protection, especially in those countries where CDM projects are taking place. It is therefore advisable to define content-related criteria for examining such projects at a European level. In the forthcoming revision of the EU Emissions Trading Directive the UBA will therefore support the use of exacting technical test criteria in the approval process for climate protection projects at a European level.

Responsibility for the contents:

Malin Ahlberg, Wolfgang Seidel, Section E 1.5 "Process Control, Quality Control, Fees, Implementation of the Project Mechanisms Act (ProMechG)"

Sources:

[160] The Project Mechanisms Act can be found on the internet at:
http://www.dehst.de/cln_027/nn_91278/SharedDocs/Downloads/DE/Gesetze__und__Verordnungen__dl/ProMechG.html

[161] Additional information about the Kyoto Protocol:
http://unfccc.int/kyoto_protocol/items/2830.php and
http://www.dehst.de/cln_027/nn_91278/SharedDocs/Downloads/DE/Gesetze__und__Verordnungen__dl/Kyoto-Protokoll.html

[162] The project documentation can be downloaded from the internet at:
http://cdm.unfccc.int/Projects/DB/DNV-CUK1134130255.56/view.html

[163] The accredited certifying companies for JI can be found on the internet at:
http://ji.unfccc.int/AIEs
and for CDM at:
http://cdm.unfccc.int/DOE

[164] Guidelines of the preparations for and implementation of JI and CDM projects can be found on the internet at:
http://www.dehst.de/cln_027/nn_91278/SharedDocs/Downloads/DE/Emissionshandel/Leitfaden_20f_C3_BCr_20Projekte.html

[165] The report by the Conference of the Signatories on their seventh meeting in Marrakech in 2001 can be found in the appendix to the Project Mechanisms Act (see Item 160).

[166] Additional details about the World Commission on Dams WCD at:
http://www.dams.org/

DEPARTMENT E 2 "ENERGY SECTOR ALLOCATIONS, RESERVE MANAGEMENT AND REGISTRY"

Emissions trading: CO_2 emissions in 2005

In 2006, operators of plants that participate in the EU emissions trading system for the first time reported on their CO_2 emissions. By 30 April 2006, the plant operators had to submit their emission allowances equivalent to the amount of actual CO_2 emissions from their plants in 2005. If the amount of emissions produced by a plant exceeded the allowances previously for that plant, the operator then had to purchase additional emission allowances. Otherwise, if the actual emissions are lower than the amount of allowances granted, the operator was able to sell the spare allowances.

The German Emissions Trading Authority (DEHSt) monitors whether plant operators submit a sufficient amount of emission allowances on time, corresponding to the actual CO_2 emissions from their plant. In cooperaton with the relevant state authority, the DEHSt also carries out spot checks on the underlying emission reports. The emission reports and submission of emission allowances take place annually. In the event of objections the DEHSt requires the plant operator to amend the emission report and, if necessary, to submit additional emission allowances. If the operator fails to meet this obligation, the DEHSt imposes an additional compulsory payment of 40 euros per tonne of CO_2.

Every effort is made to ensure that the process of emissions trading is clearly understood by the public. From 15 May each year the so-called compliance status of each plant subject to emssions trading can be inspected by the public in the electronic emissions trading register. This reveals how many free emission allowances a plant has received from the DEHSt and how much CO_2 it actually emitted during the previous year. Status information reveals whether the company returned emission allowances equivalent to the amount of actual emissions [167].

Checking the emission reports

In order to ensure that the reported emissions correspond to the actual emissions, plant operators must comply with the standard definitions of the European-wide, statutory requirements when recording and reporting on their emissions [168, 169]. Increases in a plant's emissions require that the records and reports are even more accurate. This is essential to ensure the integrity of the system: e.g., in the case of a lignite plant emitting ten million tonnes of CO_2 annually, an inaccuracy of one per cent corresponds to annual emissions of 100,000 tonnes of CO_2, which is considerably more than the total emissions of most other plants covered by the system.

The emission reports are scrutinized to ensure that plant operators use standardized methods of recording and reporting their CO_2 emissions. The work of examining the reports is shared among specially trained, publicly appointed and certified experts on greenhouse gas emissions, the responsible authorities in the federal states, and the DEHSt. The most important investigations into the details supplied by a plant operator, and their comparison with suitable proofs, takes place at the operator's premises and involves verification by a qualified expert.

By means of an additional examination, the DEHSt ensures that the operators of all plants falling under the scope of the emissions trading system have complied with statutory requirements for recording their emissions. They also investigate whether the reported reductions in emissions are genuinely due to climate protection measures, rather than to differences in the measurement methods used. The DEHSt also checks whether all the statements are plausible and comprehensive, and whether they have been obtained using identical methods for each year of the trading period. Although emissions reporting only began in 2005, most of the reports that were examined were of a good quality. However, room for improvement remains in the documentation of the procedures used to determine and report on CO_2 emissions. In some cases it was not initially clear whether the operators have determined the emissions in accordance with statutory specifications.

Evaluating the emission reports

Another main task of the DEHSt is to provide information to the main players on the emissions trading market, i.e. traders and plant operators. During the first half of 2006, the DEHSt therefore presented a background paper evaluating the actual emissions for 2005, based on the entries in the Verified Emissions Table (VET) [170]. These entries may differ from those obtained after the emissions reports have been examined. However, the total number of objections for all the plants participating in the emissions trading were insignificant, so that they did not affect the overall picture of the published evaluation. The overall evaluation of emission reports for 2005 revealed that emissions trading is working and has become an effective instrument for climate protection.

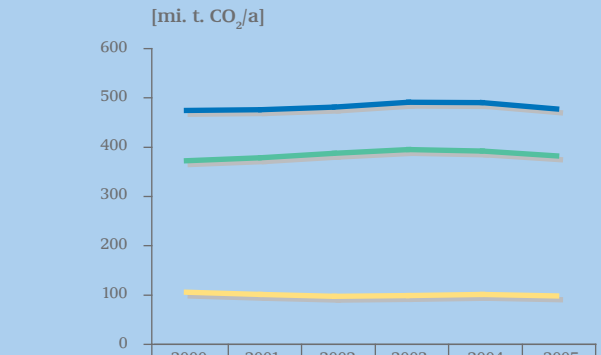
CO_2 emissions four per cent below budgeted expenditure

In 2005, the total emissions of all plants covered by the emissions trading scheme amounted to just below 474 million tones of CO_2. This was some 21 million emission allowances (around four per cent) less than the budgeted expenditure for 2005 of 495 million tones. Plant operators were thus left with a surplus of 21 million emission allowances. However, they could not freely dispose of this surplus, as a part of this surplus is subject to the proviso of so-called ex-post corrections. According to the Allocation Law of 2007, ex-post corrections are intended for those cases in which the actual production by a plant was less than the amount registered in the allocation procedure.

Data survey 2012

In addition to the emission reports and in preparation for the second trading period from 2008 to 2012, plant operators were required to report emissions for 2003 and 2004 and partially for the period 2000 to 2002. Together with the data on emissions from the allocation procedure this provided a complete overview of how the CO_2 emissions from plants covered by the emissions trading scheme developed during the years 2000 to 2005. An evaluation of this data revealed that emissions during 2003 and 2004 were substantially higher than in previous years. However, as of 2005, the first year of emissions trading, they declined significantly.

Figure 34: Annual CO_2 emissions during the base period



	2000	2001	2002	2003	2004	2005
ET sector	471.8	473.4	478.3	488.4	487.4	474.3
Energy	369.3	375.5	384.3	392.5	388.8	379
Industry	102.6	98	94.1	95.9	98.6	95.3

Source: UBA

The European Commission objected to this arrangement, which is now the subject of proceedings in the first instance at the European Court. The enforcement of the ex-post corrections has therefore been postponed until the first legal ruling, which is expected in late 2007.

Surpluses in all branches and activities

At the sectoral level, all economic branches that fell under the emissions trading scheme had surplus certificates. At the plant level, the emission allowances issued were sufficient to cover the 2005 emissions of two thirds of all plants, whereas one third of plants emitted more CO_2 than they had been granted in terms of free emission allowances. With two thirds of all plants and just below 80 per cent of the allowances in the scheme, the energy industry is the biggest player in German emissions trading. Selected industrial branches with high CO_2

emissions accounted for the remaining third of the plants and just above 20 per cent of the allowances issued [171]. Compared with high-emission industries, the energy industry required over 3.5 times as many allowances to cover its emissions (Fig. 35).

Option rule responsible for more than half of the surplus

Depending on the chosen basis for allocation, different groups of plants and their respective allowance surpluses and deficits can be distinguished. Those existing plants that had received their allocations on the basis of production forecasts in combination with emission standards (also known as benchmarks according to §7 Abs.12 ZuG 2007, the so-called option rule), achieved the largest surpluses relative to the allocated amounts. Those plants that had received their allocation based on past emission levels also accounted for a large share of the total emission allowance surplus. Using this rule as a basis, the DEHSt allocated more than 400 million annual emission allowances to two thirds of the plants participating in the emissions trading scheme. Plants which began operating in 2003 and 2004 also received their allocations on the basis of production forecasts in combination with emission standards. From the total surplus of allowances, this relatively small group of plants accounted for around 1.8 million emission allowances (Fig. 36).

Figure 35: Distribution of surpluses and deficits among plants required to engage in emissions trading

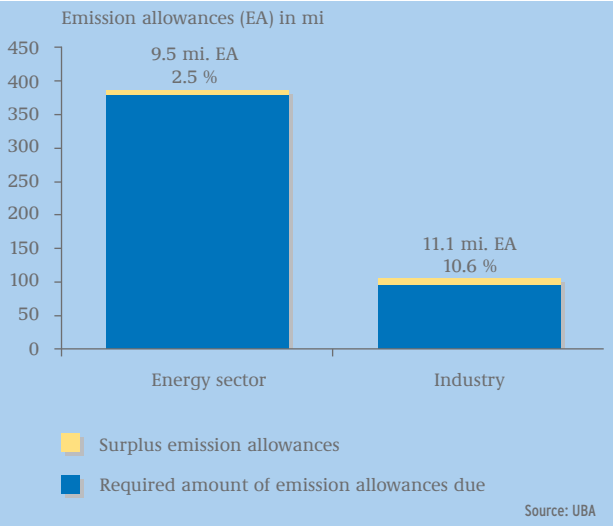
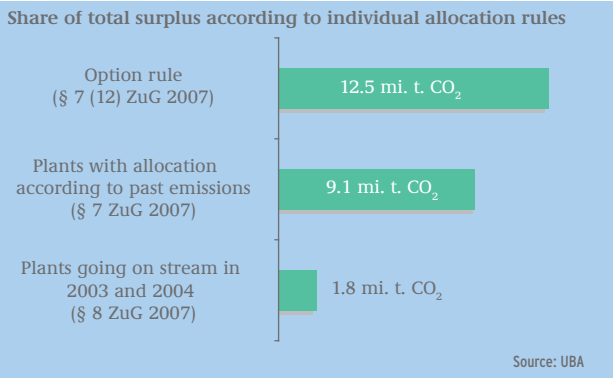


Figure 36: Distribution of surpluses and deficits according to the bases for allocation



Responsibility for the contents:

Lars Langefeld, Section E 2.2 “Energy Industries II”

Thomas Langrock, Section E 2.3 “Reports, National Allocation, Reserve Management”

Sources:

[167] Additional information about the accounts for the plants is available on the internet at: https://www.register.dehst.de/EXReport/public/publicReportList.do

[168] The “Monitoring Guidelines (RULING BY THE COMMISSION from 29/01/2004 for defining the guidelines for monitoring and reporting with regard to greenhouse gas emissions in accordance with Directive 2003/87/EC of the European Parliaments and the Council)”, available on the internet at: http://www.umweltbundesamt.de/emissionshandel

[169] The “Leitfaden zur Erstellung von CO_2-Emissionsberichten“ (Guideline for Compiling CO_2 Emission Reports) of 22 May 2005, DEHSt; “Emissionshandel: CO_2-Emissionen des Jahres 2005” from 15 May 2006 is available on the internet at: http://www.umweltbundesamt.de/emissionshandel

[170] Se also “Emissionshandel in Deutschland: Verteilung der Emissionsberechtigungen für die erste Handelsperiode 2005–2007“ on the DEHSt website: http://www.umweltbundesamt.de/emissionshandel

[171] See also Item 167

Enforcement and other tasks of the Federal Environment Agency (selection)

Participation in the enforcement of the Leaded Petrol Law (BzBlG) as examining authority

Enforcement authority in accordance with the Law on the Implementation of the Environmental Protection Protocol of 4 October 1991 to the Antarctic Treaty

National Focal Point for the Environmental Committee in accordance with Art. 11 of the Environmental Protection Protocol of 4 October 1991 to the Antarctic Treaty

Participation in the approval process for marine wind farms

Appointment of experts to determine the yield from a wind farm in accordance with §10 Section 4 of the Renewable Energy Law (EEG)

Enforcement of the Law against Aircraft Noise

Work in connection with the preparations for the accession of Central and Eastern European countries to the European Union

Emission and pollution reports in the course of implementing the Kyoto Protocol and other European and international agreements (EU, UN, UN-ECE, HELCOM, OSPAR)

Participation as examining authority in the enforcement of the Ocean Dumping Law and the Drinking Water Ordinance (TrinkwV). Maintaining a list of conditioning substances and disinfection processes in accordance with § 11 TrinkwV 2001 and a list of alternative processes in accordance with § 15 TrinkwV 2001

WHO Collaborating Centre for Research on Drinking-water Hygiene

WHO Collaborating Centre for Air Quality Management and Air Pollution Control

National EU Air Quality Reference Laboratory

Enforcement tasks under the Soil Protection Law and Soil Protection Regulation, in particular the derivation of uniform national screening, test and implementation values

Programme of action for environment and health, office at the UBA

Operation of the environmental sample bank and reporting on the results of analyses, environmental survey

Contact office for the Basel Agreement (Agreement on the Control of Trans-boundary Movements of Hazardous Waste and its Disposal). Approval authority for the transit of waste

Central Registration, Reporting and Evaluation of Accidents (ZEMA)

National agency with responsibility for the European Environmental Symbol

Consultation agency for exceptional approvals for the use of halon in accordance with § 6 Section 2 Regulation Prohibiting the Use of CFCs and Halon

Support, together with KfW Förderbank, for the “Investment Programme for Reducing Environmental Pollution”

National Focal Point for implementing Art. 16 of the EU Directive on the integrated avoidance and reduction of environmental pollution (IPPC Directive)

Preparation of proposals for developing the latest technology in the implementation of European and international agreements (especially EU, UN, UN-ECE, HELCOM, OSPAR)

Work in connection with the European Environment Agency (EEA):

- German contact point (coordinating German involvement)
- German contact office for the areas of air quality, atmospheric emissions, inland waters, the marine and coastal environment, soil, waste and energy
- Climate change sub-group of the European Topic Centre on Air and Climate Change

Office for the assessment of new materials in accordance with the Chemicals Law and the office for the assessment of waste substances in accordance with the EU Regulation on the Evaluation and Control of Existing Substances

Participation as the approving authority in the enforcement of the Law on Pesticides, the Law on Biocides, and the Law on Medicinal Products

National Focal Point for the Stockholm Convention on Persistent Organic Pollutants (POPs)

Office of the “Commission for Assessing Substances Harmful to Water” as well as the information and documentation centre for substances harmful to water

The assessment office involved in the testing of insecticides and disinfectants for environmental purposes and to determine their effectiveness in accordance with §18 of the Law on Preventing Infection

Office of the Commission for Assessing Disinfestation Products and Procedures in accordance with §18 of the Law on Preventing Infection and for determining the effectiveness of products and procedures for dealing with pests which are a threat to health

Coordinating Office for assisting the work of the Substance Data Pool Federation/Länder (GSBL)

Enforcement authority in accordance with the Law on the Trade in Entitlements to Emit Greenhouse Gases (Greenhouse Gas Emissions Trading Law, TEHG) from 15 July 2004

Enforcement authority in accordance with the Project Mechanisms Act (ProMechG)

Assessment body for applications in accordance with Item 5 of the Regulation 648/2004/EG on detergents

Office of the Federal-State Working Group on Environmental Information Systems


Photo: Limart Unger

CENTRAL ADMINISTRATION

The Central Administration of the Federal Environment Agency (UBA) is responsible for traditional administrative tasks. These include areas such as personnel and budgets, organization and administration of real estate, and administrative supervision of research projects. The Central Administration is engaged in bringing together technical and resource responsibilities in the various technical units with the aim of achieving further improvements to the efficiency of the agency. In future the organizational units, which already bear technical responsibility, will make their own decisions about the deployment of the necessary resources (budgets), within the framework of the agency's output.

Organizational structure of the Central Administration:
http://www.umweltbundesamt.de/uba-info-e/e-zentral.htm

Budget and permanent positions/positions

In 2006 the UBA had at its disposal a sum of around 108 million euros. Table 9, p. 108 shows the amounts allocated to selected areas.

For its enforcement work financed by fees, in the 2006 budget the UBA was granted a total of 21.5 new permanent positions for civil servants as well as positions for salaried staff, of which 15 had been approved for the period up to 31 December 2008. In addition the number of positions and permanent positions was increased by making use of the arrangement enabling those nearing retirement to work part-time, because a substitute (permanent) position was provided for employees entering the period of exemption provided under the aforementioned arrangement. At the same time the agency has eliminated some 20 positions as part of its obligation to achieve economies in accordance with the Budgetary Law (HG 2006).

Administrative project support

The unit Z 6 "Project Administration" allocates the following, in the form of subsidies or as commissions:

- research projects under the environmental research plan (UFOPLAN), commissioned by the Federal Environment Ministry (BMU),
- other national and international projects funded by the BMU and
- reports as part of statutory enforcement tasks and orders for services supported by UBA budgets.

In order to make efficient and economical use of the funds available each year projects have to be planned, followed and executed as comprehensively as possible in accordance with budgetary specifications. In 2006 the unit dealt with a total of 673 projects for payment (see p. 109) – of which 285 were newly awarded. The others consisted of commissions and subsidies that have been ongoing for several years.

Table 9: **Budget of the Federal Environment Agency**

	Target 2005 in 1,000 euros	Target 2006 in 1,000 euros
I. Budget of the Federal Environmental Agency		
I.1 Total expenditure	85,205	73,532
comprising		
▶ Personnel expenditure	55,457	49,315
▶ Investment expenditure	10,428	3,484
▶ Scientific publications and documentation	355	355
▶ Information and documentation system about the environment (UMPLIS)	2,247	2,365
▶ Information technology	4,184	4,025
I.2 Commissions from federal authorities and others		
▶ Federal authorities*	1,172	523
▶ EU, others*	2,723	1,615
II. For management of funds assigned from other sectors		
▶ investments to reduce environmental pollution	24	34
▶ Award of research projects (UFOPLAN)	18,065	17,246
▶ Environmental Specimen Bank	4,331	4,331
▶ Subsidies for associations, federations, other organizations		
• Institutional assistance	1,821	1,821
• Assistance for projects	5,580	5,956
▶ Explanatory measures	1,153	1,180
▶ Advice about environmental protection in the countries of Central and Eastern Europe and in the Newly Independent States (NIS)	2,195	2,211
▶ International cooperation	897	392
Sum total of the funds assigned for management from other sectors	**34,066**	**33,171**

* *actual expenditure*

Table 10: **Permanent positions/positions**

Year	Total	Civil servants	Salaried employees	Workers
1998	1,043	476	490	77
1999	1,032	397	556	79
2000	1,015	390	549	76
2001	1,001	387	538	76
2002	1,009.5	390	542.5	77
2003	1,000	393	534	73
2004	1,024.8	369	582.8	73
2005	1,136.0	410	653.8	72.2
2006	1,126.5	410	647.3	69.2

The unit Z 6 also provides administrative support for projects with outside financing, for example from the European Union (research projects, investigations, advice and expert reports), with which the UBA has been commissioned. In 2006 the UBA obtained project funding totalling 0.79 million euros (Fig. 37). These projects are intended to meet the UBA's research obligations in the environmental field, as well as the hygienic requirements of environmental protection.

Figure 37: **Funding obtained by the Federal Environment Agency in 2006, by donors**

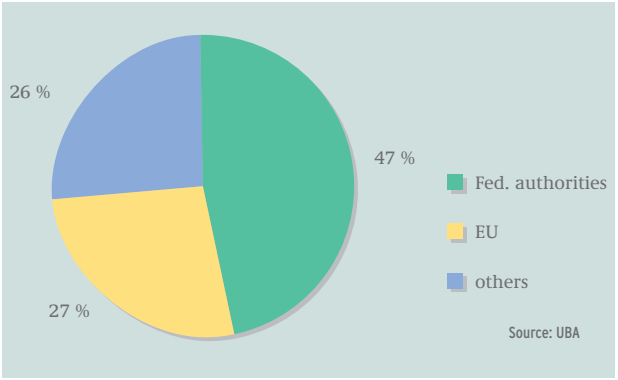


Table 11: **Projects for which unit Z 6 provided administrative support in 2006**

Designation	Expenditure in millions of euros	Number of projects
Environmental Research Plan (UFOPLAN 2006)	16.19	460
Support for UBA/BMU in fulfilling their tasks by making use of external specialist knowledge	2.81	119
International environmental cooperation	0.13	10
Operating the National Environmental Specimen Bank	4.1	7
Advice on environmental protection for the countries of Central and Eastern Europe and the Newly Independent States	1.6	35
Operation of a network of stations for monitoring cross-border atmospheric pollution	0.5	18
Institutional assistance ▶ Verein Deutscher Ingenieure (Kommission Reinhaltung der Luft) *[German Engineers' Assn. (Air Purity Commission)]*	1.3	1
▶ Support for the standardization activities of the standards organization Deutsches Institut für Normung (DIN) ▶ Support for the activities for assessing chemicals requiring regulation ▶ Support for efforts to ensure the inclusion of environmental protection aspects in industrial standards	2.7	15
Other projects ▶ UNEP course "Environmental Management for Developing Countries" ▶ Programme of Climate Technology Initiative (CTI) ▶ Measures for implementing Law for Protection against Aircraft Noise ▶ Support for membership of UBA/BMU in various associations and federations	0.88	8

Award of the "Audit Beruf und Familie" by Hertie-Stiftung

In June 2006 the foundation Hertie-Stiftung recognized the commitment shown by the UBA to family-friendly working conditions with the award of its "audit berufundfamilie®" certificate. In Berlin the Federal Families Minister Dr. Ursula von der Leyen and Federal Minister for Economics Michael Glos presented the foundation's award to a total of 143 companies and adminstrations. The agency's certificate was received by Dr. Thomas Holzmann, Vice President of the UBA. "The award confirms our efforts to ensure that the work taking place at the agency is family-friendly. And it is also an encouragement to do even better", said Dr. Holzmann.

In conducting its audit Hertie-Stiftung examined, for example, how the UBA arranges working times for employees with children or with family members in need of care, whether working processes and places of work have been designed to assist parents, and whether senior staff act in a family-conscious way. Many of the things that make it easier for staff to combine a career with having a family and fulfilling care obligations have already been accomplished by the UBA. For example, all employees' working times are flexible, on the basis of defined service periods, and home-working is another op-

UBA President Andreas Troge inauguration of a work room for parents with children in Dessau.

tion open to all staff who have to look after children or other family members. From now on parents encountering difficulties in finding someone to look after their children can work in offices at the agency's premises in Dessau and Berlin which have been designed to meet the needs of children and are also provided with a play area. This arrangement is particularly helpful to parents who have to bring their children to work because of the unavailability of childcare facilities.

Over the next three years the UBA aims to heighten awareness about family-friendly personnel management among its senior staff. Sponsorship of staff while they have children to care for is intended to strengthen contacts within the workforce. The work also benefits, because invaluable knowledge is not lost and it is easier to resume one's career. The agency wants to maintain and improve staff motivation and efficiency, promote equality between men and women and also reduce the burdens of work. "And it also helps the agency to attract more qualified staff, because private interests and family requirements are an increasingly important influence on career planning", according to the Vice President of the UBA.

In our society the number of children being brought up by single parents, and older family members requiring care, is constantly increasing, and therefore the combination of a career and the family has become a major challenge to companies that want to retain the technical knowledge and motivation of their employees for as long as possible. In recent years well over one hundred businesses and public sector institutions have obtained this family audit, including Dresdner Bank, Commerzbank, Bertelsmann Stiftung, the Universities of the Saarland, Kiel and Oldenburg, the *Bundesversicherungsanstalt für Angestellte* (Federal Insurance Office for Salaried Staff), the aerospace centre *Deutsches Zentrum für Luft- und Raumfahrt* and the Federal Ministry for Economics.

Additional details about Audit berufundfamilie at:
http://www.beruf-und-familie.de

Innovative software for dealing with orders at the Federal Environment Agency

The marketplace operations of MACH AG, which were set up at the UBA in January 2006, combine all the ordering and storage requirements that have to be dealt with by agency's buyers. This is a fully web-based system and in addition to an easy-to-use shopping basket function and catalogue it also incorporates automatic and easy-to-view control of the ordering process. All procurement processes can be dealt with from any location. This ensures that purchasing is both quicker and clearer. Everyone involved in the procurement process has access to a standardized database with a constant supply of information. Because it is entirely web-based, users can apply any of the procurement functionalities from any computer equipped with a web browser. Installation is not complicated, requiring only a browser in the computer that enables central installation of the latest software version.

The software allows for simple and quick entry of any requirements via a centrally provided catalogue, even by staff with little purchasing experience. Registration is completed by entering just a few data. All further details, such as the price and supplier, are automatically linked with the respective item. With the aid of a fixed schedule, procurement can be adjusted to meet the individual requirements of the authority. The way in which the structure and processes at the UBA are organized is reflected by the system in the form of an entitlement concept. This regulates the responsibility of persons or organizational units with regard to the continuing processing of orders, for example by means of a hierarchical structure of superiors and appointees.

The new procurement software creates synergies, because once data has been registered it is permanently available for subsequent processing. For example the approval of a proposed order from the market place provides a simultaneous link with the funds from the relevant budget. This ensures budgetary control at an early stage. The UBA has successfully introduced the web market place, which has met with a good response by staff.

photo: creativ collection Verlag

PRESS AND PUBLIC RELATIONS WORK

Environmental protection is booming. The work of the Press Office

Environmental protection was a subject of particular interest to journalists again in 2006: the Press Office received 3,311 enquiries from the media (2005: 3,327) and arranged 302 interviews with various agency experts (2005: 328). There was no let-up in the demand for information about the Federal Environment Agency (UBA) in the second year following its relocation from Berlin to Dessau.

Although the number of enquiries remained the same, the media tended to report on the agency and its subjects with greater frequency. Coverage of the UBA increased on the radio and on television, in the press and trade publications, by new agencies and online services alike. The reports revealed a wider diversity too, with media coverage of almost 500 topics about the agency. Ongoing subjects included “Fine Dust Particles”, “Fungal Mould in the Home”, “Pollution Caused by Traffic” and “Energy Conservation”. Information was also sought on other topics in the area of “Environmental Protection and Health”, such as the indoor use of aromatic substances, perfluorated compounds in drinking water or the noise produced by motor vehicles and aircraft. The new EU chemicals law REACH also attracted widespread interest in the mass media as did details about bird flu in the early part of 2006, and the increased summer ozone readings.

The dominant subject was definitely that of climate change and its effects. In April the UBA organized discussions with the press on “Future Climate Change in Germany”, which met with an excellent response. In the same month as the German government’s energy summit, during the hot summer and on the occasion of the World Climate Conference in Nairobi in the autumn, the views of the UBA on the implications of climate change in Germany were widely sought.

The Press Office provided the media with 81 press releases (2005: 77) and 16 papers with background information for the press (2005: 7). The media and interested members of the public clicked on to these papers on the internet 291,800 times in 2006. The Press Office will be extending its range of electronic services even further in 2007, for example with podcasts. The electronic newsletter “UBA aktuell. Informationen aus dem Umweltbundesamt” is already well established and is read by more than 5,700 subscribers, twice as many as at the launch of the newsletter in 2004.

In the summer of 2006 the UBA, together with the television station Super RTL and the Federal Agency for Nature Conservation, staged a competition for children on the subject of environmental protection. More than 150 children’s daycare centres from all over Germany took part, submitting objects or paintings they had made, helping the comic figure of “Bob the Builder” to plan a more environmental-

ly friendly town in Sunflower Valley. An activities folder with advice about environmental protection specifically for children had previously been sent to more than 30,000 nurseries and daycare centres.

Environmental information and the Central Answering Service

Public approval and active support are vital if Germany's ambitious climate protection objectives are to be attained. The UBA therefore places the rational use of energy at the heart of its environmental information work, with the aim of explaining that conserving energy does not have to mean less comfort and a reduction in the quality of life, but in fact brings many advantages. It enables the public to make considerable savings, protect finite resources such as gas and oil, and helps to protect the climate too. In 2006 the agency received some 103,000 orders for brochures and other sources of information, particularly on "Energy Conservation", "Healthy Living" and "Eliminating Fungal Mould". "Rational Energy Use", "Conserving Energy" and "Using Renewable Energy Sources" were the main themes at numerous trade shows and other events in which the UBA participated, such as the Hannover Fair and the federal government's Open Day.

There continues to be keen interest in the agency's new headquarters in Dessau, and more than 15,000 (2005: 20,000) visitors obtained information about its ecological and architectural concepts during the past twelve months. Several organizations in Dessau provide guided tours of the building and surrounding site, an offer that was taken up by nearly 6,000 people in 2006.

Photo: UBA / Volkhard Möcker

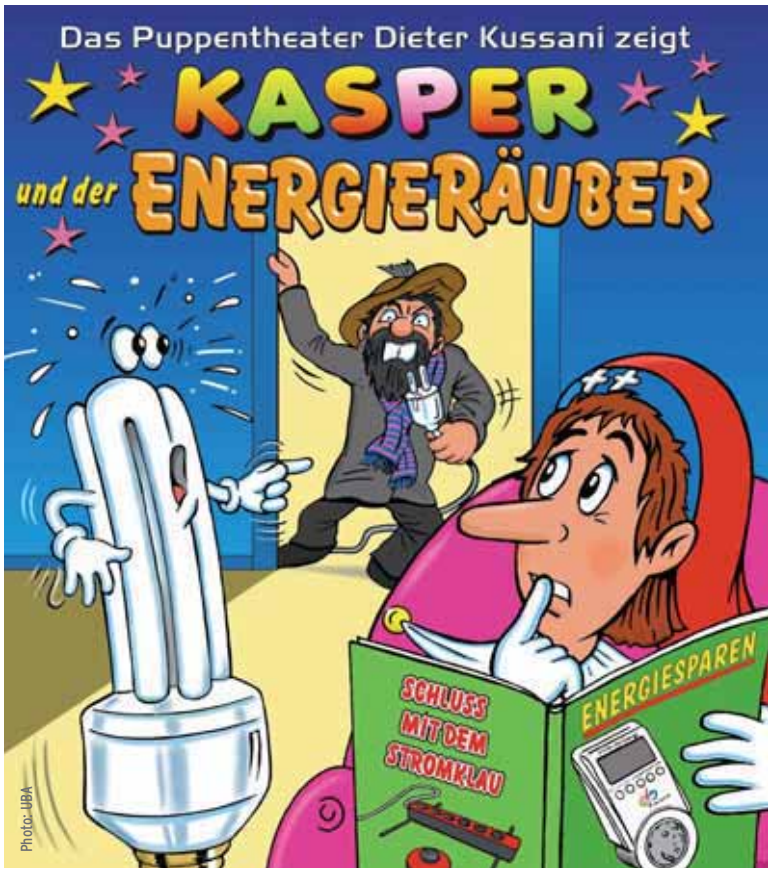


Photo: UBA

Poster for the puppet show tour

Puppet show "Kasper und der Energieräuber" on tour: Puppet shows are an established form of environmental information in which children tend to place a great deal of trust. Together with the Kussani puppet theatre in 2006 the UBA set up a tour to present the puppet show "Kasper und der Energieräuber" (Kasper and the Energy Thief). The "Energy Punch" attracted a total audience of more than 26,000 at 65 locations. The local promoters (schools, municipal administrations and local authorities) together with the large and small members of the audience were entirely positive in their reactions to the puppet show. The Conference of Ministers of Culture rated the Kussani puppet theatre as educationally valuable and granted general approval for all the performances on school premises. The tour is due to continue in 2007.

Energy Conservation Box for schoolchildren: Each year in Germany electricity with a value of four million euros is wasted as a result of idling losses, equivalent to the total electricity consumption of Hamburg and Berlin. In order to introduce the subject of wastage through idling into school lessons the UBA and the "Aktion No-Energy" campaign have prepared a teaching module with the title of "Energiesparkiste" (Energy Conservation Box). It is particularly suitable for use in junior and middle schools.

Pupils can track down idling losses using electricity meters (energy cost monitors), a halogen lamp with a separate power pack, and a plugboard with a cable-connected on/off switch. The box also contains information for teachers as well as 50 copies of the brochure "Energiesparen im Haushalt" (Conserving Energy in the Home).

In this way pupils can familiarise themselves with electricity meters, using them to identify various forms of idling loss, calculate electricity consumption and energy costs for the appliances tested, and reflect on their use of electrical energy too. The "Energiesparkiste" can be loaned to schools free of charge.

Environmental information abroad: Environmental protection "Made in Germany" provides a model, especially for countries in South-East Asia. In order to present German environmental policy abroad and to strengthen the transfer of expertise in the field of environmental protection the UBA has been commissioned by the Federal Ministry for the Environment (BMU) to create a special show on the "Sustainable and Rational Use of Water and Energy". This travelling exhibition is aimed primarily at senior executives, company environmental officers, representatives of public authorities who deal with environmental issues, journalists, the representatives of associations, teachers, students and members of the public with an interest in environmental matters.

The world's leading trade show for the environment and waste disposal IFAT took place in China in 2006. It provided an ideal platform for presenting German environmental policy and technology in the form of a travelling exhibition. The highlights were:

- the demonstration of anaerobic treatment of residual waste using a combined mechanical and biological waste treatment plant as an example,
- obtaining electricity and heat from refuse,
- detoxification of sewage sludge and the subsequent production of fertilizers from the detoxified end-product,
- an innovative method of purifying waste water using microfiltration,
- the use of systems that do not create waste water, using the world's first waste water-free car wash as an example,
- a treatment system for bathing water that is hygienic and helps to protect the environment,
- limiting idling losses on electrical appliances and
- the use of solar power stations.

Ecological living – poster display in two languages offers examples: Living in harmony with nature and the environment is a widely discussed topic. But what is the practical situation in Germany? The Federal Ministry for the Environment, the UBA and the environmental foundation Deutsche Bundesstiftung Umwelt have examined the reality of the situation in Germany and have come across some interesting findings. Many ways are already available for living ecologically. The Blue Angel is not the only important indicator of products that are kind to the environment. Others include Fairtrade products such as coffee, tea, bananas, carpets and footballs. The FLP label of quality (Flower Label Programme) identifies flowers produced in a way that respects human dignity and the environment. Eco-labels on textiles are a guarantee of environmentally friendly cultivation and processing. Organic production labels help consumers to find high quality agricultur-

IFAT 2006: Parliamentary Under-Secretary at the Federal Ministry for the Environment Astrid Klug and the Bavarian Minister for the Environment Werner Schnappauf (2nd from left) visiting the BMU and UBA information stand.

al produce. Fish that have been caught in a sustainable way can be identified by the seal of the Marine Stewardship Council, while the Forest Stewardship Council (FSC) certificate is awarded to products from sustainable forestry management.

The poster display organized by the UBA entitled "Sustainable Consumption – Examples from Germany" consists of 25 large format bilingual (German/English) posters (format: 68 x 98 cm), dealing with the aforementioned examples. The exhibition can also be viewed on the internet and can be requested free of charge from cultural and educational institutions. The Goethe-Institut is supporting the project by presenting the poster exhibition around the world at its institutes.

Supporting associations: In 2006 the UBA was commissioned by the Federal Ministry for the Environment to provide support for 30 new and 36 ongoing environmental projects by associations and other groups with a total value of 3.6 million euros, with the aim of strengthening the work of the associations in the field of environmental protection, and of creating a greater environmental awareness among the public in general. Assistance is being provided for environmental consulting, the thematic linking of environmental associations, a range of information, projects for children and young people with a wide-ranging effect, and projects on topical issues concerning renewable energy, energy efficiency, the efficient use of material and resources, the climate, transport and noise.

Additional details about project support work can be obtained at:
www.umweltbundesamt.de/projektfoerderungen/index.htm

The Environmental Library

The Environmental Library is the largest of its kind in the German-speaking world. It provides up-to-date information and an extensive range of literature for the agency's staff as well as for interested members of the public. A long-distance lending service enables its books and publications to be borrowed by readers outside Germany too. The library has smaller branches at other UBA locations in Berlin, Bad Elster and Langen. Special events are organized for schools in the region as part of the library's efforts to also familiarize children and young people with environmental issues. A range of picture books for children and literature aimed at young people dealing with the subject of the environment is intended to arouse the interest of the younger generation.


Photo: UBA

Art and the environment

In 2006 the UBA is continuing its series of events entitled "Art and the Environment". **"Sighting Resources – Ten Positions"**: The exhibition by GEDOK Brandenburg in September and October of 2006 used photography, painting, installations and new media to examine how mankind deals with the world in which we live. Isolde Loock, Sophie Kreidt, Katarina Veldhues and Lisa Schmitz presented their video installations in the foyer of the UBA in Dessau. Andrea Küster and Irene Jourdan-Koch used large canvases to experiment with painting and drawing. Tamara Ebert used water colours to transform outline plans into fantasy-laden maps. Britta Lauer's aerial views from the Arctic revealed amazing patters in the water and ice, Eugenia Gortschakova addresses contemporary concepts of paradise, and Jutta Geier joined her photographs of woods to form metre-long strips.

"Wasser" (Water), sculptures, drawings, photographic work by Walther Mertel: "Grosser Strudel" (Large Whirlpool), "Vom relativen Meer" (From the Relative Ocean) and "Stilles Gelände am See" (Quiet Landscape by the Lake) were the titles of some of the large, hanging paper sculptures presented at the UBA in Dessau by Walther Mertel, a pupil of Joseph Beuys. In ink drawings, collages and photographic work he endeavours, in his own words, to penetrate and display the "temporary, chaotic element".

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For Humanity and Environment

The Federal Environment Agency's headquarters in Dessau and its offices in Berlin and in Langen (Hesse) are registered participants in EMAS, the European eco-management and audit scheme, and have an environmental management system certified to ISO 14001.

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