FEDERAL ENVIRONMENT AGENCY
ANNUAL REPORT 2005

Umwelt Bundes Amt
For Humanity and Environment

Published by: Umweltbundesamt (UBA)
Federal Environment Agency
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Designed and printed: KOMAG mbH, Berlin (Germany)

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BMU / Brigitte Hiss
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UBA / Dirk Maletzki

The Annual Report 2005 of the Federal Environment Agency is available, free of charge, in printed form from GVP Gemeinnützige Werkstätten Bonn, In den Wiesen 1–3, 53227 Bonn, telephone +49(0)1888/305-3355, fax +49(0)1888/305-3356, e-mail: uba@broschuerenversand.de.

The report can also be downloaded from the internet as a PDF document at www.umweltbundesamt.de, under the headings of "Press" or "Publications".

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Dear Reader,

Environmental policy encourages innovation and creates employment. The facts: environmental protection currently provides employment for some 1.5 million people in Germany, around 3.5 per cent of the workforce, and this is an upward trend. In 2003 Germany led the world in the export of goods and products for environmental protection, with sales worth 31 billion euros, accounting for an 18.8 per cent share of the world market, and all estimates predict that it maintained this position again in 2004. Germany also leads the field in Europe in the number of patent applications for innovative environmental technologies. German companies are world leaders in the development and manufacture of wind turbines and solar panels. Although often repeated, the claims that environmental protection inhibits innovation and destroys jobs have no foundation. On the contrary: those who present such antiquated arguments are missing out on the opportunity to make a positive contribution to the lives of people here and elsewhere in the world and to open up even more economic prospects for German companies.

Today protection of human health and the environment is as important as ever. New ideas and innovative strategies are needed in order to cope with worldwide ecological and economic challenges, with globalization and all its positive and negative consequences. Climate protection is one notable example. It remains one of the main challenges facing the world community, because it affects, or will affect almost every country. Consequently climate protection will be one of the central issues on the agenda of Germany's presidency of the EU Council and its chairmanship of the G-8 next year.

2005 was a year of climatic extremes. Long dry periods, heavy rainfall and destructive storms are evidence that climatic change has already occurred and that Germany is also affected. In the future we can expect long term changes in the atmosphere, with a negative impact on our ecosystems and on human health. In particular, agriculture and forestry, as well as drinking water supplies and biodiversity are seriously affected. Countermeasures must be introduced rapidly if we are to protect ourselves as best we can against these problems and preserve an environment that is worth living in for future generations. If we fail to do so the consequences will be costly, because ignoring the need for climate protection carries with it a heavy financial burden. Therefore we must act today to avoid having to repair the damage in the future. This is something that traditional environmental policy should have taught us. What needs to be done?

By 2050 the amount of greenhouse gases being produced around the world must be reduced to half the 1990 level, and efforts must be made to limit the rise in temperature to no more than two degrees centigrade compared with the middle of the 19th century. Therefore the Kyoto Protocol, which came into effect in February 2005 after negotiations lasting several years, must be developed further. Scenarios prepared by the Federal Environment Agency show that the instruments that have so far been agreed will not produce any appreciable reduction in emissions of greenhouse gases by 2030. Germany can only remain an international leader in this field by continuing to advance climate policy and its own exacting goals for reducing greenhouse gases. Climate protection is a challenge for the entire world and therefore the USA, currently the largest source of greenhouse gases, must be involved in this process, as must the leaders among the newly industrialising countries, including China, India and Brazil.

Photo: Bernd Vogel

An active climate protection policy also requires sustainable energy production, i.e. long-term, ecologically acceptable sources that ensure a reduction in the amounts of harmful carbon dioxide produced, as well as the other atmospheric pollutants resulting from the burning of the fossil fuels oil, gas and coal, and reduce our dependence on imported energy from politically unstable regions. Increased energy efficiency, the development of renewable energy, greater competition on the electricity market, new investments in more efficient power stations and successful emissions trading offer good prospects for attaining these objectives. The Federal Environment Agency believes that the action being taken to increase the use of renewable energy must be contin-

ued. By 2005 renewable energy already accounted for around 10 per cent of all electricity generated in Germany. This indicates that the wind, the sun, water and biomass are by no means insignificant sources of energy. By 2050 they could meet at least half of Germany's energy needs, which will be substantially reduced by then.
Therefore improved energy efficiency in the short- and medium-term is just as important as increasing the use of renewable energy. We must make more use of the energy that we already have as well as achieving savings wherever possible. There is enormous scope for improvement in buildings in particular. Almost one third of all energy consumed is used for heating rooms, and in private households it can be as much as 75 per cent of the total energy consumption, although only half of all renovation measures include economical improvements to thermal insulation. The German government has increased its annual expenditure on building renovation measures with the aim of reducing CO_2 emissions to 1.4 billion euros. This assistance is having a positive impact on climate protection, encouraging investment of some ten billion euros and leading to the creation of new jobs. Electrical appliances also offer the potential for conserving energy. Electrical equipment is being sold every day that consumes unnecessary amounts of electricity, even when it is not in use and is only on stand-by. We need an efficiency competition with specified efficiency standards for important electrical appliances, as well as compulsory labelling.
The intelligent use of energy on its own is not enough. We must also make better use of our resources. The increasing worldwide consumption of raw materials such as oil, gas, steel and other metals has serious implications for the economy and is a cause of growing environmental pollution connected with their extraction and processing. Merely substituting renewal resources for those of fossil and mineral origin without taking their environmental impact into consideration is not the answer, because it increases the pressure to devote even greater areas, such as the rain forests in Brazil and Indonesia, to the production of raw materials. An economic system that conserves natural resources, and an increase in raw material productivity will be the main issues confronting modern industrialised societies in the future. In order to attain an environmentally sound level of consumption globally those of us in the industrialised nations must substantially reduce our consumption.
Effective measures to protect human health and the environment are investments. They will protect the health of future generations and preserve the basis for human existence. Let us take chemical safety as an example. The objective of the EU Commission with its new chemical law REACH is to provide improved protection for humans and the environment against the potential risks associated with the use of chemicals. After all, we are in contact with them almost everywhere, at work or in our private lives, in construction materials, paints, cleaning products, as additives, solvents or softening agents. REACH is intended to introduce a modern and transparent chemicals management system, transferring responsibility to the manufacturers for assessing their products and for furnishing proof about their safety. Chemicals whose safety has been proven form an important basis for the protection of human health and the environment. The aim is to achieve integrated risk assessment, closely linking environmental and health aspects, and a sustainable chemicals industry that does not pollute the environment or present a hazard to human health, and which protects natural resources.
A second example is the protection against effects from fine dust. We now know that ultrafine dust, from a number of sources, can severely affect health. This has now been acknowledged by the European Union and the German government, who have reacted accordingly. For the first time they have set limits for the concentrations of fine dust, which have applied universally since 2005. Efforts to water down these air quality limits or to delay the much-needed reduction in emissions should be avoided in the interests of human health. Suitable measures should now be introduced to ensure that the limits are adhered to. The European Union has an obligation, for example, to prescribe substantially lower limits of diesel particulates for new vehicles.
In early May 2005 the Federal Environment Agency began its work at its new headquarters in Dessau. This new administrative building is not only striking in an aesthetic sense but also sets new standards for environmental and economical construction. The Agency has always emphasised the advantages of ecological construction and promotes environmentally friendly and healthy working and living areas. It was therefore also a question of its own credibility in seeking to meet these demands with its new building. The new headquarters in the home of the Bauhaus has now become an attraction in its own right. With its outstanding ecological, aesthetic and technical features it is an example of the successful implementation of the requirements of environmental protection.
I hope that you find this Annual Report 2005 both stimulating and informative.

Prof. Dr. Andreas Troge
President

ENVIRONMENTAL PROTECTION AS THE DRIVING FORCE BEHIND INNOVATION AND INFRASTRUCTURAL POLICY

The worldwide ecological and economic challenges require new ideas and innovative strategies, and this also applies to environmental policy. What would be the likely implications for the natural basis for life – in the more distant future too – if we were to neglect taking the urgent steps needed for its maintenance? This is the vital issue, and not just the question that is so often at the centre of public discussions: "What is the cost today of environmental protection?" – with the implicit suggestion "nice to have, but even without environmental protection things would stay much as they are". Environmental protection represents an investment. It ensures that, in the years to come, we will continue to be able to utilise nature's gifts, which we assume are available to us at no cost. Progressive environmental policy is also a source of innovation, leading to new technological solutions and revitalising the economy. As a rule environmental protection is an active process, an added value, and therefore a source of additional employment. This is a positive aspect, not only for those for whom it provides or maintains secure employment, but also as a means of ensuring timely and increased acceptance by the public of various environmental measures. Although this is certainly a pertinent and a useful argument, it should not be used to justify the pursuit of environmental protection. Expenditure on environmental measures remains a consequence of the over-exploitation of natural resources and our increased prosperity is due solely to this over-exploitation.

Numerous innovations such as multi-stage wastewater treatment, flue gas filters for furnaces, and products such as solvent-free paints and lacquers which are designed to protect health and the environment, have their origins in environmental protection and environmental policy regulations. They also have the potential to encourage the development of new technologies and innovations, emphasising the fact that environmental protection and economic development are not mutually exclusive but support one another. In the past it was often said that environmental protection is a luxury that is confined to countries that have already attained a certain level of affluence. Today we realise that pollution jeopardises economic development and one only needs to consider China to appreciate the truth of this statement. Although the economy there is growing by 10 per cent annually, the cost of the environmental damage being incurred is of similar proportions. In a global context there can be no economic development without a more economical and efficient use of natural resources.

The protection of essential natural resources and of health is an elementary factor in determining economic prosperity. In March 2005 the Council of Europe ratified the European Union's (EU) Lisbon Strategy for promoting growth and employment, with the aim of making Europe the most competitive and dynamic economic region in the world by 2010 [1]. At the same time the Council confirmed that environmental policy makes an important contribution to economic growth, employment, the quality of life and the sustainable use of resources. Environmental protection and environmental policy create outlets for sales and generate employment.

Environmental protection is already an important economic factor.

- In Germany in 2004 some 1.5 million people were employed in the environmental protection sector.
- With exports totalling 31 billion euros Germany led the world in sales of goods and products for environmental protection in 2003, and all the forecasts indicate that it will retain this dominant position in 2004.
- Germany also heads the field in Europe with the number of patent applications for innovative environmental technologies.
- In 2004 Germany manufactured products for environmental and climate protection with a value of 55 billion euros, accounting for 5.1 per cent of all industrial goods produced.

This shows that environmental protection is the driving force behind innovation and employment. Environmental protection may not be able

to achieve miracles in the employment sector but numerous synergies do exist between environmental objectives and innovation, and these should be utilised. What role can the protection of the environment and of natural resources play in promoting innovation and infrastructural development? In what areas of the innovation process can environmental policy have an impact? Where can synergies be observed and utilised? In the following pages the Federal Environment Agency (UBA) presents its answers to these questions as they apply to products, energy and the development of settlements.

Environmental protection encourages and shows the way for innovations

Innovations are per se a positive factor, and promoting innovation and infrastructural development of all kinds is a prerequisite for economic growth. The debate about innovation and infrastructural policies in the past can be summarised very succinctly. Innovation literally means "renewal", "change". However, the term does not give any indication of what kind of innovation is meant, the objectives that it pursues, under what kind of conditions it produces its results, or what these might be.

Climate protection presents global challenges and the need for a sustainable use of natural resources provides a worthwhile direction for innovative efforts. Other objectives which are closely linked with environmental protection involve a balance between the widely differing living conditions of people today and the need to maintain suitable living conditions for future generations. The sustainable use of natural resources must also help to safeguard prosperity and justice for future generations in a world with a constantly growing population. The National Sustainability Strategy launched by the German government in 2002 sets out clear objectives, which also apply to innovation and infrastructural policy [2]. These are:

- The doubling of energy and raw material productivity by 2020, compared with 1994 levels.
- A reduction in land consumption to a maximum of 30 hectares per day by 2020.

The policy, as affirmed in the coalition agreement between the ruling parties in November 2005, continues to pursue these objectives [3].

Environmental and raw material productivity as the driving force behind innovation and employment

Increasing worldwide consumption of raw materials such as oil, steel and ores has serious implications for the economy. Raw materials prices are rising, putting them further beyond the reach of poorer countries. At the same time, because deposits of raw materials have to be extracted from more inaccessible sites, the impact on the environment is becoming more severe. The rising prices of oil and gas, steel and copper in recent years underline the importance of improving raw material productivity. Clearly there is a need for innovative solutions.

An economic system that protects resources is essential if Europe is to reinforce its position as a viable place in which to live and conduct business. The EU Commission has responded to this situation with a Thematic Strategy on the sustainable use of natural resources (EU Resource Strategy). Its main purpose is to decouple the reliance on natural resources from economic growth [4].

The National Sustainability Strategy calls for a doubling of raw material productivity by 2020 compared with 1994, in other words a reduction in the amount of raw materials used in relation to the income derived from them. The UBA considers an absolute reduction in the amount of resources consumed as essential because, faced with rising incomes, a specific increase in efficiency can still lead to a rise in the consumption of raw materials in absolute terms (rebound effect). Around the world growing numbers of people are striving to achieve levels of prosperity comparable to those of the industrialised nations. However, since the availability of resources is limited, current and future consumption must be restricted and new solutions found.

In addition, as we explain in this report, taking the development of settlements as an example, a distinction must be drawn between various different raw materials. Focussing on materials, in Germany the indicator "raw material productivity" is dominated by the minerals used in construction, i.e. limestone, gypsum, slate, gravel, sand and clay, which account for three quarters of the total [5]. The German raw material indicator is substantially affected by building activity and the demand for materials that this implies. It is almost impossible to make any statement about the amounts of other raw materials which are consumed, such as metals. The UBA has therefore de-

veloped its own raw materials indicator, as a more effective way of making ecological statements about individual raw materials.

Integrated Product Policy as a programme for innovation

The Integrated Product Policy (IPP) is a fundamental component of an innovation-oriented environmental policy. The IPP is intended to achieve far-reaching reductions in the health risks and environmental hazards emanating from the manufacture, use and disposal of products. It focuses on supporting the processes and product innovations intended to protect health and the environment, in industry and in society. By impacting equally on innovative processes of a technical, organisational and a social nature the IPP helps to promote markets for environmentally acceptable, alternative products. The IPP creates new jobs, thereby safeguarding Germany's position as a centre for innovation and industry. It can help to develop the markets of the future and key technologies such as nano- and biotechnology (see also page 76). In so doing it is important to investigate the potential risks associated with these key technologies at an early stage during research and development and to take the necessary precautions wherever possible.

However, innovative products to protect health and the environment do not emerge unaided. They have been and still are affected by regulations, whereby prescribed limits result in the development of new products or improved production methods. But it may also be necessary to provide active encouragement for companies working to produce innovations. This can include information and the means to assist them in their decision-making, helping innovative products to become established or to improve their commercial position, either by providing financial assistance or by imposing financial disincentives to discourage the use of less ecologically acceptable alternatives.

Innovative products for protecting health and the environment

Globalization and the liberalization of markets, different and rapidly changing preferences on the part of buyers, an increased downward pressure on prices, shorter product life cycles and intensified competition for increasingly scarce natural resources are all factors that are accelerating the pace of innovation. Product innovation is an important organisational task for companies in every sector and, where high levels of energy and resources are required, the ability to exploit innovative potentials is vital for maintaining a competitive edge. In the case of innovations for promoting health or protecting the environment, surveys of small and medium-sized companies have revealed that innovative processes outnumber innovative products [6]. The basic problem is that entrepreneurial product innovation management has hardly impinged at all on so-called eco-design, which is intended to make products more environmentally friendly (see also Page 70). Small and medium-sized companies in particular face the challenge of ensuring that eco-design is firmly rooted in the areas of research, organisational and product development, advanced training and communication. This is essential in order to exploit the medium and long-term potential for the efficient management of resources and effective cost management, and to enable new markets to be developed.

Taking as an example the reduction in emissions from small furnaces, it is apparent that ecological product innovation is a strategic, long-term project. The past twenty years have seen a gradual improvement in environmentally related heating efficiency in Germany (see Table 1). The acquisition of skills and improved expertise have meant that the innovative capabilities of German manufacturers of small furnaces give them an advantage over their international competitors. German companies lead the field in the introduction of condensing boilers in particular. From the very beginning this process has been accompanied and supported by the Blue Angel eco-label, an important instrument of product policy. In the intervening years the value of the eco-label for small furnaces has been somewhat neglected.

Table 1: The reduction in emissions from small furnaces in selected product groups

Blue Angel eco-symbol	Product group	NO_x limit in mg/kWh	
Catalogue of criteria RAL-UZ 39	Special gas boiler	175	(1987–1991)
		100	(1992–1994)
		80	(1995–1997)
		70	(1997–2005)
Catalogue of criteria RAL-UZ 46	Oil-fired boiler units	150	(1987–1990)
		130	(1991–1994)
		120	(1995–1997)
		110	(1998–2005)

The criteria to be met for the Blue Angel eco-label [7]

Building products as an innovative field for protecting health and the environment

In addition to continuous improvements in the environmental properties of products, in the future there will be a greater emphasis on promoting innovations throughout entire product groups as an even more far-reaching means of relieving the pressure on the environment. Building products offer scope for such innovation. Different kinds of innovations help to create a new kind of overall system, a commercially viable structure that satisfies health and environmental demands.

The European Construction Products Directive (CPD) 89/106/EEC, which is basically intended to promote a free internal market for the trade in building products, presents possibilities for product innovations that protect health and the environment. Research institutes and authorities are developing measurement, testing and assessment methods which the European Committee for Standadization converts into standards. Access to the necessary readings gives manufacturers a greater familiarity with the health and environmental properties of their products and they are then better equipped to deal with the emissions produced by these products.

The Committee for the Health-related Evaluation of Building Products (AgBB) is composed of representatives of environmental, health and construction authorities at state and national level and its secretariat is located at the UBA. In 2003 it developed the so-called AgBB evaluation scheme, an assessment system for limiting the emissions of volatile organic compounds (VOC) produced by building products. The AgBB updated this system in 2004 and 2005 and it was first applied in the same year when the Deutsche Institut für Bautechnik (DIBt, German Construction Engineering Institute) issued its certification for building products [8]. Based on this assessment system the UBA has since developed new guidelines for the award of the Blue Angel eco-label, for example for flooring adhesives and elastic floor coverings. A report by the Deutsches Institut für Bautechnik that was commissioned by the UBA is intended to show manufacturers involved in the work of preparing standards how health and environmental aspects can be taken into consideration when drawing up standards for products, as a way of exploiting their potential for innovation [9].

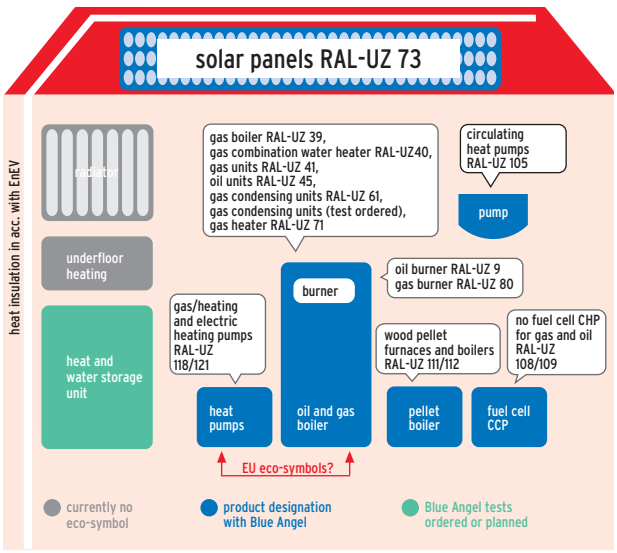
Another example of a systemic approach to the hygienic and environmental properties of products can be found in building heating systems

Photo: Freudenberg Bausysteme KG

Innovative and less polluting: Vulcanized rubber flooring that has been awarded the Blue Angel eco-label has been installed in the new UBA building in Dessau.

(see Fig. 1). Optimum heat generation requires a product with ideal hygienic and environmental properties, for example as characterised by the award of the Blue Angel eco-label. In the future products with these improved properties will enjoy certain competitive advantages. The approval of the European Union's Eco-Design Directive in the autumn of 2005 represents the implementation on a European-wide scale of the efforts by the EU Commission and the Environmental Council to initiate systematic eco-design requirements for energy-consuming products. The UBA, together with the manufacturers, is thus giving its back-

Figure 1: Innovative and environmentally compatible products for heating buildings, components bearing the Blue Angel eco-symbol



ing to the introduction of the most energy-efficient requirements and the highest health and environmental standards in Europe.

But this alone is not sufficient. The ecological product should also be combined with the energy supply system, ideal dimensions and controls, and regular maintenance in order to achieve the best possible, most energy-saving heat generation in buildings. Through a systemic approach to the means of providing energy and to product policy the UBA seeks to achieve a form of innovation that effectively protects health and the environment.

How the market is being transformed

Innovations that protect health and the environment extend the range of ecologically designed products. Environmental policy has at its disposal selective instruments for assisting companies when products are being launched and achieving initial market penetration. The programmes by Kreditanstalt für Wiederaufbau (KfW) for assisting the commercial introduction of products enable these product innovations to gradually become established on the market. Examples include investment credit for photovoltaic installations as part of the KfW assistance programme entitled “Solar Energy Generation”. Product innovations attract public attention and recognition through competitions and the award of prizes, such as the architectural competition „Photovoltaics in the Design of Buildings“ organised by the Federal Environment Ministry.

Private sector consumers as well as public sector and commercial buyers all play a vital role in helping innovative products to achieve market penetration. Publicity emphasising the environmental attributes of specific products helps companies to achieve a competitive edge. The UBA supports such public relations activities with product-related information systems such as the eco-label.

One example of an innovative product still in need of the support that demand from the automobile industry would bring is that of car air conditioning systems which use carbon dioxide as a coolant, which in this particular case is climate-neutral. This product assists the process of replacing the environmentally hazardous coolant HFKW-134a and is also more economical than standard mobile air conditioning units. However, the automobile industry has yet to incorporate this innovative development in its own products.

Innovations in the energy sector offer competitive advantages

The pollution and hazards affecting the environment are largely due to the generation of useful energy from the fossil energy sources, i.e. oil, gas and coal. The pollution caused by energy production ranges from the emission of greenhouse gases and classic examples of airborne pollution to the subsequent damage resulting from coal mining, spillages from oil tankers, gas explosions and the risks presented by nuclear energy. International obligations to achieve climate protection and a renunciation of nuclear power are changing the face of the energy system in Germany. The development of renewable energy systems such as those relying on wind, biomass and solar power requires substantial investments, and the changeover to the use of sustainable energy can only be economically viable if state supports the efficient use of energy with the same intensity as it supports the accelerated use of renewable energy.

Germany was one of the pioneers in the process of climate protection, helping to boost innovation by German industry and giving it a competitive advantage over other countries [10]. Consequently Germany has coped relatively well with the latest rise in energy prices, due in part to the fact that production does not consume energy at anything like the same rate as it did during the energy price hikes of the 1970s and 1980s. But so far only one quarter of the objectives formulated by the German sustainability strategy, of doubling energy productivity by 2020 compared with the base year of 1990, have been achieved. In order to meet this target the yearly increase in energy productivity for the period up to 2020 must on average be three times higher than it was between 1990 and 2004 – i.e. 2.9 per cent annually. Further efforts and measures to boost energy efficiency and savings will be needed. As energy prices continue to rise the investment in energy-efficient technologies becomes more economically viable.

The UBA believes that the action being taken to increase the use of renewable energy must be continued. By 2005 renewable energy already accounted for 10.2 per cent of all electricity generated in Germany, and wind, solar energy, water, biomass and geothermal sources could be supplying at least half of all Germany’s energy needs by 2050. There are few other industrial areas in which Germany occupies such a strong international position as it does with renewable energy. For example, it is the world leader in the con-

Renewable energy has become a best-seller.

struction of plants generating electricity from solar energy, and four of the world's ten most successful manufacturers of wind power installations are German companies.

Such an outstanding competitive position offers major opportunities for safeguarding and increasing employment, in view of the fact that experts predict very rapid growth in the world market for renewable energy over the next few decades. On the photovoltaic market annual growth rates of between 20 and 30 per cent are expected worldwide, with the result that the installed output will be three times the current level by 2010. Similarly promising prospects for growth exist for solar power, biomass and wind energy. It is estimated that output from new wind power installations will increase by some 55 per cent between 2006 and 2010 [11]. Renewable energy systems are already a major German export as well as a significant growth factor. In order to ensure that this expansion continues it is essential that Germany encourages further innovation in the field of renewable energy. According to a recent study, if this can be achieved, the number of jobs in the field of renewable energy in Germany could rise from the current figure of around 170,000 to at least 300,000 by 2020 [12].

However, innovations should not simply be considered in the context of products or components. Support should also be provided for innovative methods of financing too, such as the so-called contracting models, i.e. models for financing and implementing investments in energy conservation by specialist firms, who refinance their investments through savings achieved in the cost of energy. Also included are participation models, whereby interested members of the public can take a stake in installations utilising solar energy and receive a share of the profits. Participation and financing models actively involving municipal or regional administrations could also be applied to great effect in other countries.

In 2004 the Federal Environment Ministry organised a conference in Bonn under the title "renewables 2004" which approved an international programme of action to promote the use of renewable energy [13]. If the measures outlined at this meeting can be implemented they would lead to worldwide investments totaling some 320 billion US dollars. In this way, by 2015 around 1.2 billion tonnes of climate-threatening carbon dioxide emissions could be avoided annually [14], which would be equivalent to some five per cent of the world's current anthropogenic emissions of carbon dioxide.

During the conference "renewables 2004", governments, international organisations and representatives of civil society agreed to work together in a global policy network (Renewable Energy Policy Network – REN 21) with the aim of continuing the political dialogue about ways of promoting renewable energy. At the 14th session of the UN Commission for Sustainable Development (CSD 14) it presented a plan for examining the implementation of the International Plan of Action of the "renewables 2004" conference, with the participation of more than half of the governments and organisations that had submitted over 200 voluntary campaigns and commitments in Bonn. In response to enquiries it was reported that almost 80 per cent of the campaigns had already been initiated or fully implemented. Some countries have made the declared objectives nationally binding. China has now increased its target for expanding the use of renewable energy to 15 per cent by 2020, equally United Kingdom (15 per cent by 2015) and Germany (20 per cent by 2020). And all three countries have introduced selective policies to enable these objectives to be met.

Improved energy efficiency in the short- and medium-term is just as important as increasing the use of renewable energy, with enormous scope for improvement in buildings in particular. Some 30 per cent of Germany's energy requirements are used to heat rooms, while 75 per cent of the total energy consumption in private homes is accounted for in this way. And yet there is an enormous and so far unexploited potential for energy saving measures in buildings. The Ger-

man government has therefore substantially increased the financing of the KfW-CO_2 building renovation programme from 360 million to 1.4 billion euros annually for the period 2006 to 2009. This assistance is also having a positive impact on structural and employment policies. If the annual rate of renewal of older buildings could be increased to between two and three per cent from the current figure of around one per cent, on balance some 120,000 additional jobs could also be created by 2010 [13].

Innovations in the energy infrastructure

Most of the Germany's electricity is obtained from large power plants using nuclear energy, lignite, coal and natural gas. Because of the advanced age of many of the power plants, and as a result of the decision by the German government to renounce the use of nuclear power, substantial investments will be required by 2020 to replace the country's electricity generating facilities. By then German power suppliers will have to find replacements for installations with a total output of as much as 45 gigawatts. Clearly these essential investments must be accompanied by a reorganisation of the energy supply system in order to provide more sustainable supply structures and improve energy efficiency. Innovative approaches to demand side management must be adopted if energy consumption is to be reduced, with the power suppliers or public sector agencies assisting the customers for electricity and heating in their efforts to improve energy efficiency. Climate protection considerations have a vital role to play in the restructuring of power plants as part of a process of medium- and long-term investment. Decentralised combined heat and power (CHP) plants with an efficiency of 90 per cent, capable of simultaneously supplying electricity and heating, offer the best solution.

Photo: DVV Stadtwerke Dessau

The district heating plant in Dessau achieves energy utilisation in excess of 70%.

The investment period between now and 2020 should be used to improve the efficiency of the network of power plants and to achieve greater decentralisation as part of the effort to improve international climate protection. This is necessary because a more efficient and decentralised energy sector will not only enable Germany to attain its national climate protection objectives but also to set an example and to make a constructive contribution to the international debate about energy and climate protection, thereby helping to meet the exacting demands of global climate protection. In terms of climate protection policy the use of lignite and coal for generating electricity can only be justified if very high rates of efficiency can be achieved in the conversion process. The energy supply companies must therefore pursue an ambitious process of power station modernisation.

Restructuring of the energy system to protect the climate must also include the use of renewable energy for decentralised heat production. Most of Germany's heating needs are currently being met by using small boilers powered by oil or gas. A significant proportion is also obtained from district heating and other heating power plants, supplying heat locally and also over longer distances. Although renewable energy is making an increasing contribution, in 2005 it still only accounted for 5.3 per cent of the entire heating market [12]. In the future more heat should be obtained from renewable sources such as the sun, biomass and geothermal installations, while the development of combined heat and power will also take effect, replacing the inefficient production methods of current conventional heating plants. Innovation should therefore take the form of small and decentralised installations. CHP plants are only economic and environmentally acceptable if there are regional customers for the heat that they produce. Such CHP plants may be operated in the form of small, individual units or municipally, as part of a local district heating network.

The innovative development of settlements and infrastructure

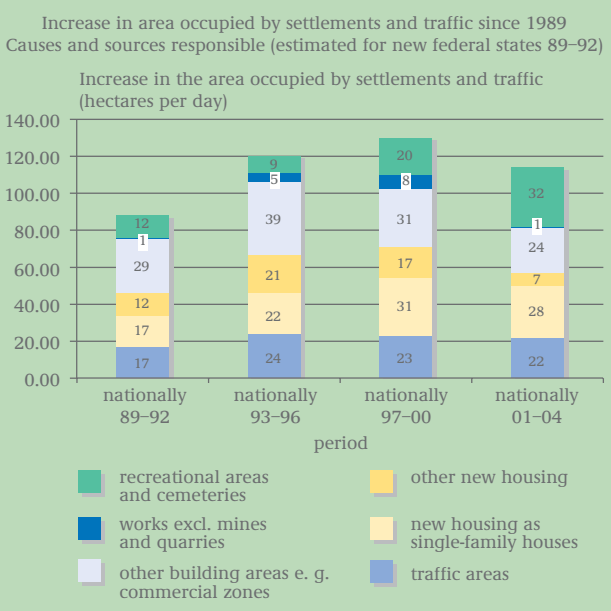
A third example of the sort of innovation that is needed if sustainability objectives are to be met can be found in the development of settlements and infrastructure. For decades the public as well as urban and regional planners have taken "cities

designed for the car" and "living in green suburbs" as their models, and as a result much of the available open space has been built over. In 2005 the Federal Statistical Office calculated that the area devoted to settlements and traffic increased by an average of 115 hectares per day between 2001 and 2004 (Fig. 2, see also Page 45).

According to the German Sustainability Strategy the land area being lost in this way should be reduced to 30 hectares per day by 2020 in order to retain the remaining undeveloped areas as a natural asset. In any case local authorities are no longer in a position to finance much more development of new building land. Especially in the eastern states of Germany high levels of investment have been deployed, in some cases with assistance from European Union budgets, for the development of land for housing and commercial use which, due to a lack of investors or buyers, is now lying unused [15]. The costly development of building land on greenfield sites has resulted in vacant plots in high density areas. Expensive development work in new construction areas contrasts with a lack of maintenance and renovation work in existing building stock, mainly in the heart of cities and in villages.

With a total of 40 hectares per day housing construction is still the main cause of urban sprawl and the sealing of new land. The construction sites themselves account for some 35 hectares daily of the land being swallowed up for housing,

Figure 2: Increase in the area occupied by settlements and traffic since 1989 (h/d)



Source: Federal Statistical Office

with the associated connecting roads occupying a further five hectares per day. Whereas settlements of single-family homes take up around 32 hectares of land each day (28 hectares for building, four hectares for the connecting roads), the construction of housing for two-family or multi-family occupancy requires approximately eight hectares each day. For many years the Federal Republic of Germany indirectly assisted this consumption of land by granting an allowance for owner-occupied housing and a lump sum to assist commuters. The decision to abolish the owner-occupied housing allowance and to reduce the assistance for commuters was therefore a far-sighted decision that will help to promote sustainable development.

The redevelopment of existing building stock does much to protect resources and safeguard employment in the craft trades. Moreover, in terms of the total energy and resources used and the necessary infrastructure, the energy-efficient renovation of old apartment buildings for multiple occupancy is more economical than a spacious, detached single family house on a greenfield site. A new systemic approach to infrastructural development is therefore also urgently needed, particularly in the case of transport infrastructure, which was responsible for sealing 22.5 hectares every day between 2001 and 2004.

Environmental considerations such as the protection of the soil and maintaining its fertility, the protection of uninterrupted open spaces, environmental protection and efforts to save fuel led to new ideas in the planning of settlements and infrastructure. From the economical point of view, the prerequisite for structures with long term viability is no longer to construct new buildings on greenfield sites but to maintain existing building stock in built-up areas. Moreover close proximity is essential for encouraging forms of living and lifestyles that are socially innovative and help to conserve resources. If this pattern were to become an established part of international discussions and could be adopted in the larger emerging countries in the long term it would do much to avoid the wrong sort of development.

There are considerable synergies to be gained in infrastructural planning between a sparing use of other limited resources such as energy and open areas and the consumption of minerals for building. On the subject of "Building and Homes" the UBA has shown that far-reaching implementation of the strategies for „Managing housing stock, modernising energy systems and urban renewal", accompanied by substantial improvements in the

services provided for residential areas, could reduce the demand on building materials by around a third by 2025 compared with the levels in 2000. The additional demand for space would be reduced by as much as 85 per cent, i.e. from 35 to around five hectares daily, while annual carbon dioxide emissions would decline by more than 50 per cent [16].

The revitalisation of inner-city areas also opens up possibilities for new and innovative services: facility management, new forms of joint ownership and shared responsibilities for the heating supply to buildings (contracting models) and modern utilisation concepts such as car sharing and rent-a-bike are more feasible in densely populated areas with effective social ties. Such models also create jobs in the service sector and in small businesses. For people who are moving home the service-oriented management of this task also enables requirements to be met with only minimal use of resources. This is a factor worth considering because all too often apartment swaps fail to materialize due to fears about the cost and effort involved in organisation, renovation and removal.

Photo: BMU / Brigitte Hiss

Bicycles for hire at Ernst-Reuter-Platz in Berlin.

Innovations and a sustainable infrastructural policy

Innovations do not only have to be of a technical nature. The UBA believes that they should encourage sustainable patterns of consumption and open up markets for environmentally friendly goods and new services. Therefore technical innovations should be accompanied by social innovations, including organisational changes. For example many goods could be replaced by innovative service arrangements (leasing). These are summarised by the UBA under the slogan of “Use instead of ownership”. The responsibility for leased products remains with the owner, who has an interest in ensuring that they are used as frequently as possible, then returned and exploited again. In future there can and must also be a more innovative approach to the interactions between the various responsibilities for ownership, financing and maintenance of product systems and infrastructures.

This wider interpretation of the concept of innovation still does not go far enough because the existing infrastructure affects much of our consumption of resources, irrespective of how thrifty some individuals may be. Consequently innovations to technical processes and products must be accompanied by innovations to the infrastructures themselves. In their present form our technical infrastructures cannot be maintained on a global scale without imposing unsustainable burdens on our natural resources, both as sources of supply and for subsequent disposal. That is why the infrastructure in its various forms must be modernised. This should take place initially in the industrialised nations, with the aim of reducing the amount of resources consumed. As an industrialised nation Germany has an opportunity to use this impending and urgently needed infrastructural renewal to achieve harmonisation between this infrastructure and a sustainable form of development, which would certainly be of interest to less developed countries [17].

Because the infrastructure has been in place for a long time and is the result of long term planning, and given the expected challenges such as those presented by an absolute reduction in the flows of energy and materials, wide-ranging innovations can conflict with accustomed ways of thinking and acting and with the established way in which such patterns are adminstered. Infrastructures in their current form emerged at a time when no one could have foreseen any limitations to the demands on the environment, or had any idea about zero growth or even declining population levels. The underlying force behind the development of infrastructures, which was focused on clearly definable regional problems, was the pressure resulting from these problems and a belief that economic growth was the answer to all problems. Now a long term view needs to be taken of infrastructural innovations, against the background of the conditions imposed by the world’s available natural resources. In Germany innovation is taking place in a situation characterised by reduced growth and a declining birth rate. That is why it is so important

that all those involved should recognise when the time is right for innovation and act together accordingly. For example, in the discussions about the Accelerated Planning Law legislators should carefully weigh the abolition of so-called mooting dates against the reduced possibilities for participation.

An innovation-based policy for health and environmental protection

Innovations require a concrete long-term objective. In a systemic context, the following definition was proposed some time ago: "In the future the principle aim of innovation should represent a departure away from the compulsion to constantly create new products, especially those designed to replace work, and towards non-material responses to social desires and requirements" [18]. In the future specific innovation policy will be concerned not only with the continued development of existing instruments (planning, regulatory and fiscal laws, incentives and support, and communication processes), but also with ensuring that such instruments interact to maximum effect. A sustainable innovation policy requires a supra-departmental approach in which a good idea can be introduced to suitable participants under ideal conditions and at the right time.

What can environmental policy do in order to encourage and utilise the potential for innovation in Germany? When political decisions are being made by the European Union or, in a wider context, by the World Trade Organisation (WTO), the perspective must extend beyond Germany without being condemned to inactivity at a national level. The UBA believes that the following points are of central importance for an innovation-based policy aimed at protecting health and the environment:

- Innovations require objectives. The German government's Sustainability Strategy prescribes important objectives for the environmental sector.
- Germany and Europe must not slacken their efforts to protect the environment, and should consider the protection of resources as their main area of action.
- Increased energy and material efficiency are essential as the basis for an innovation-based environmental policy, combined with an increased potential for improving competitiveness and employment.
- An innovation-based environmental policy must examine state and private sector innovation research to determine its environmental compatibility and sustainability.
- Innovations should not only be defined in technical terms but must also incorporate systemic and organisational innovations as well as cultural aspects.

Examples of the means and instruments required in order to initiate the described change of direction are also given in this article:

- New, ecologically improved products are needed, and in individual cases state support may assist with the commercial launch of a product.
- All those involved in the market should strive to improve the interaction between various instruments such as regulatory law, financial incentives, information and communication.
- In the case of heating, an efficient, decentralised heating supply is necessary, which should also include local heating systems.
- All those involved should endeavour to implement new examples of settlement development and infrastructural planning.
- More joint ventures and innovation networks should be set up between the state, industry and society.
- All the participants must be able to act when decisions with long term effects have to be made.
- Innovative new services capable of satisfying cultural requirements more effectively should be developed by all concerned.
- Direct and indirect subsidies that encourage the consumption of environmental resources should be dismantled.

The UBA intends to contribute in its own way, assisting the networks of policymakers, companies and associations to successfully develop and implement their ideas. All the participants should make reciprocal use of these networks, thereby enabling innovations to evolve as rapidly as possible for the benefit of mankind and the environment.

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Sources:

[1] Notification by the Commission to the Council dated 20.7.2005 can be downloaded from:
http://europa.eu.int/growthandjobs/pdf/COM2005_330_de.pdf
additional details at:
http://ec.europa.eu/index_de.htm

[2] Progress Report 2004 by the Federal Government "Perspektiven für Deutschland – unsere Strategie für eine nachhaltige Entwicklung" (Prospects for Germany – our strategy for sustainable development) can be downloaded from:
http://www.bundesregierung.de/nsc_true/Content/DE/__Anlagen/fortschrittsbericht-2004,templateId=raw,property=publicationFile.pdf/fortschrittsbericht-2004

[3] The Federal Government's Coalition Agreement dated 11.11.2005 can be downloaded from:
http://www.bmu.de/files/das/ministerium/application/pdf/koal_2005.pdf

[4] "Thematische Strategie für eine nachhaltige Nutzung natürlicher Ressourcen" (Thematic Strategy on a sustainable use of natural resources) can be downloaded from:
http://www.europa.eu.int/comm/environment/natres/pdf/com_natres_de.pdf and
http://www.umweltbundesamt.de/uba-info-daten/daten/ressourcenstrategie.htm

[5] see "Umweltnutzung und Wirtschaft" (Environmental use and the economy), Report on the overall environmental and economic accounts 2005, Federal Statistical Office, Wiesbaden 2005

[6] see findings of the dialogue "Nachhaltige Güter produzieren und vermarkten – Chancen für kleine, mittlere Unternehmen und Handwerk" (Producing and marketing sustainable goods – opportunities for small and medium-sized companies and craft trades), documentation can be downloaded from:
http://www.dialogprozess-konsum.de/images/stories/Fachdialoge/FD2/protokoll_fachdialog_kmu_deu.pdf

[7] see also the criteria for Blue Angel products on the internet:
www.Blauer-Engel.de

[8] see also the Annual Report for 2004 of the Federal Environment Agency, p. 29 ff., on the internet at:
http://www.umweltbundesamt.de/uba-info-medien/UBAJB2004klein.pdf

[9] The report "Gesundheits- und Umweltkriterien bei der Umsetzung der EG-Bauprodukten-Richtlinie" (UBA-TEXTE 06/05) – (Health and environmental criteria in the implementation of the EU directive on building products) can be downloaded from:
http://www.umweltdaten.de/publikationen/fpdf-l/2884.pdf

[10] see the climate protection concept of the Federal Environment Agency: "Die Zukunft in unseren Händen – 21 Thesen zur Klimaschutzpolitik des 21. Jahrhunderts und ihre Begründungen", (The future in our hands – 21 theses on climate protection policy in the 21st century and the reasons behind them) which can be downloaded from:
http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=2962

[11] see "Global Wind 2005 Report", Global Wind Energy Council, p. 3; the report can be downloaded from:
http://www.gwec.net/index.php?id=8

[12] The brochure “Erneuerbare Energien in Zahlen – nationale und internationale Entwicklung” (Renewable energy in figures – national and international development) from the Federal Environment Ministry can be downloaded from: http://www.erneuerbare-energien.de/inhalt/37422/

[13] The programme of action can be downloaded from the internet at: http://www.renewables2004.de/pdf/International_Action_Programme.pdf

[14] Federal Environment Ministry, Nature Conservation and Reactor Safety, 2005: “Content Analysis of the International Action Programme”, p. 5, available on the internet at: http://www.renewables2004.de/en/2004/outcome_actionprogramme.asp

[15] Henseling and Penn-Bressel: “Siedlungsentwicklung und Umweltinanspruchnahme“ (Development of settlements and environmental demands) in Loske and Schaeffer (publ.): Die Zukunft der Infrastrukturen, Metropolis-Verlag, Marburg 2005; ISBN 3-89518-502-7

[16] The report “Nachhaltiges Bauen und Wohnen in Deutschland, Stoffflussbezogene Bausteine für ein nationales Konzept der nachhaltigen Entwicklung – Verknüpfung des Bereiches Bauen und Wohnen mit dem komplementären Bereich Öffentliche Infrastruktur“ (Sustainable construction and housing in Germany....) – (UBA-TEXTE 01/2004) can be downloaded from: http://www.umweltbundesamt.de/uba-info-medien/dateien/2600.htm

[17] “Perspektiven für Deutschland – Unsere Strategie für eine nachhaltige Entwicklung“ (Perspectives for Germany – our strategy for sustainable development); publ. Press and Information Office of the Federal Government, April 2002

[18] Schmidt-Bleek: “Faktor 10 Manifest“ (Factor 10 Manifesto) in Fricke (publ.): Arbeit, Umwelt und Technik in der Wissensgesellschaft, Bonn 2000

FINE DUST PARTICLES: A CONTINUING CHALLENGE IN THE EFFORTS TO MANAGE AIR QUALITY

In several respects the term “dust” has acquired a different meaning since the 1960s and is also assessed differently, which is one result of several decades of successful environmental policy. In earlier decades the emphasis was on visible “dirt”, the coarse particles of dust that tended to obscure the problem of fine particles, where it already existed. The clean air policy of the 1970s and 1980s ensured that these coarse dust particles were increasingly eliminated from the air. While coarse dust only stays in the air for a short time before falling to the ground (settling), smaller dust particulates remain finely disperged in the air over longer periods in the form of aerosols. Because particulates in the environment are mainly irregular in shape their size cannot be accurately described by using a single parameter. Instead an equivalent diameter is used, as a rule the so-called aerodynamic or kinetic diameter. The aerodynamic diameter is an abstract term, defined as the diameter of a sphere with a standardised density of 1.00 g/cm^3, with the same settling rate as the particle itself.

According to their behaviour in dispersion, these suspended dust particles can be subdivided by size into the following size categories fractions, taking pragmatic aspects into account:

- Term PM10 refers to all those small particles with an aerodynamic diameter of less than 10 micrometes (µm = one millionth of a metre). The abbreviation PM stands for Particulate Matter.
- A proportion of the PM10 fraction consists of particles with an aerodynamic diameter of less than 2.5 µm. These are referred to as PM2.5.
- In a stricter sense, scientists consider coarse dust particles to have an aerodynamic diameter of more than 2.5 µm, while fine dust particles are below this size.

On average in the surrounding air nowadays some 80 per cent by mass of all suspended dust particles can be categorised as belonging to the PM10 fraction; approximately 60 to 80 per cent of the dust particulates classed as the PM10 fraction consist of the PM2.5 fraction. This means that only 20 to 40 per cent by mass of the measured PM10 values have particles in the range 2.5 to 10 µm. Nowadays airborne dust consists mainly of PM2.5 fine dust particles (fine particles in the stricter sense), which are imperceptible to the naked eye. An air mass carrying fine particles can be recognised indirectly by the effect of light scattering as a slight “blue haze”, without the restricted visibility caused by the presence of mist droplets, such as occurs with smog in the winter.


Photo: H.-G. Oed

However, there have not only been changes in the distribution of the dust according to its size. Over the years statutory requirements regarding air quality have also been adapted in response to new findings and pollution scenarios. The threshold limit of 150 micrograms of dust per cubic metre of air (µg/m^3) for all suspended dust particles that was introduced by the European Union in 1980 was much higher than the current level (see box, page 17).

From coarse to fine

Dust is a classic example of the ubiquitous pollutants that were largely responsible for so-called

Previous and current permitted pollution limits (threshold limits)

Up to 31 December 2004 the valid threshold limit for all kinds of air-disperged dust was 150 micrograms of total suspended dust particles per cubic metre of air (µg/m³), defined as annual mean. The new EU law (Directive 1999/30/EC, adopted in German right in the 22nd Ordinance to the Federal Air Pollution Control Act, 11 September 2002) prescribes an annual mean value of 40 µg/m³ for the PM10 fraction. In addition to this, a daily (24 hours) average of 50 µg/m³ may be exceeded on no more than 35 days in a year.

The previous threshold limits for total suspended particulate matter and the current ones for fine particles are not directly comparable because these fine particles only account for a certain proportion of total suspended dust particles. Another difference is that the previous limit was based on a larger area than the new figure. As a result of the Directive 1999/30/EC, the pollution limits in general were considerably tightened: by a factor of around five in the case of the new annual mean, and for the new 24-hours average by as much as six times.

winter smog until the 1990s. This type of smog – a combination of "smoke" and "fog" – consisted of airborne pollutants in the form of high concentrations of dust and gas (dust, sulphur oxides, carbon dioxide, nitrogen oxides). A catastrophic smog in London during the winter of 1952 led to more than 4,000 deaths. Until the 1980s winter smog was one of the main environmental problems in the larger cities of West Germany and in the heavy industrial regions of the rivers Ruhr and Saar, and in Central and Eastern Germany until 1992.

The emissions responsible for this winter smog were mainly the result of the combustion of various fuels, frequently of low grade materials: a low carbon content, resulting in a poor calorific value and a high proportion of ash, all contribute to produce a low thermal output at release of high levels of dust. In particular, burning the type of coal known as refuse or inerts, which has a high ash and sulphur content and was frequently distributed by the mining industry as payment in kind (allowance-in-kind-coal), generating high levels of sulphur dioxide and dust pollution. These built up when the atmospheric conditions hindered the air exchange that normally takes place replacing polluted stale air with fresh air. The combustion of vast stocks of lignite and its use by the chemical industry as well were the main cause of dust pollution.

Reducing emissions – clean air as the objective

As the result of a successful clean air policy – seventies' slogan "Blue sky over the Ruhr!" –, skies are in Germany nowadays everywhere bluer, and not just over the Ruhr. However, it has been a long process, accompanied by intensifying the energy conversion efficiency resulting in lower energy demand. The pollution limits specified by the First General Administrative Provision to the Federal Air Pollution and Immission Control Act – Technical Instructions on Air Pollution Prevention = "TA Luft") could still be met in the 1970 by building sufficiently high stacks, together with the right choice of fuel and low-performance filtering of exhaust gases. Ten years later this "tall chimney policy" proved to be inadequate, when it was realised that pollutants were being distributed over a wide area and causing extensive damage, for example leading to the acidification of lakes in Scandinavia. The Large Combustion Plant Ordinance (13th Ordinance for the Implementation of the Federal Air Pollution and Immission Control Act) and the "TA Luft" Instruction of 1986 introduced strict emission reduction levels for the particulate matter (PM) emitted by both new and old industrial plants and their installations. Since then the prescribed degree of efficiency of dust separators has been determined according to the latest – "best" – available tech-

Image of fly ash particle consisting of iron oxide with carbon black deposits, obtained with a scanning electron microscope.

nology (BAT). Whereas prior to the early 1980s dust precipitators or bottom-of-line electro-filters for collecting coarse dust were sufficient, nowadays scrubbers and fibrous filters, or multi-stage, highly efficient electro-filters are required in order to comply with the strict requirements of the "TA Luft 2002" and the 2004 Large Combustion Plants Directive. With the introduction of these new filtration systems the emphasis in the spectrum of particle sizes for dust emissions moved into the PM10 fraction range. As a result the limited quantities of residual dust still being emitted can definitely be classified as "fine particulate matter" or "fine dust".

The use of more efficient flue gas cleaning methods, combined with a reduction in the large-volume high-emitting production that created high levels of PM, for example in heavy industries, led to a significant reduction in PM emissions, but this was timely accompanied by a considerable increase in the emissions from road traffic. This shift of emphasis and the increase in the volume of traffic led the European Community to introduce stricter emission standards for all vehicles and arts of drive-train in a number of stages, beginning in 1985. These have to be complied with by all new vehicles registered after this regulation came into force. Compared with stationary installations such as power plants, vehicles do not have to be continually adapted in response to advances in technology. Given that the average vehicle has a life of more than ten years, it will take a considerable time before compliance with stricter limits can actually contribute to improved air quality. The period allowed by law for conversions or retro-fitting, around five years, is considerably shorter for those industrial installations subject to authorisation. At present traffic is responsible for around one third of all fine particles matter emissions, and 60 per cent of this derives from diesel exhaust gases. It is difficult to determine the remaining 40 per cent of the emissions caused by traffic (from the abrasion of brake pads and tyres and from resuspended dust stirred up in the streets). The assessment of these dust emission component levels is afflicted with a high level of uncertainty.

How dangerous are fine dust particles?

The harmful effects of dust, and especially that of fine particulate matter, on human health have been known since the middle of the 20th century. At that time attention focused on those relatively coarse particles which hinder the lungs functioning correctly. In high concentrations these forms of dust can produce high mortality rates. Unlike the coarser particulate matter, fine particles penetrate deeper into the lungs, where it can cause inflammation. Apart from diseases of the respiratory tract and impaired pulmonary functions, long-term exposure can also cause cardio-vascular diseases. There are also indications that it can have a carcinogenic effect. Even short-term exposure to high concentrations can be damaging to health.

There is no lower threshold for the harmful effects of fine particulate matter. In contrast to many other environmentally hazardous substances, it is not possible to specify any concentration levels that do not present a health risk. This means that even the smallest concentration of fine particles can shorten life expectancy. Although a working group from the World Health Organisation (WHO) [19] established that no life-shortening effects from PM2.5 have so far been observed at concentrations in the ambient air of 10 µg/m^3, it also pointed out that such effects could not be ruled out.

An important basis for assessing the potential carcinogenic effects of fine dust particles has been provided by the report prepared by the American Cancer Society (ACS), revealing that increased concentrations of PM2.5 lead to a greater risk of lung cancer [20]. However, caution should be exercised when interpreting this data because the increased risk cannot be proven in all social groups. An evaluation of this study revealed that, on a yearly average, an increased concentration of 10 µg/m^3 PM2.5 corresponds to a reduced life expectancy of 0.7 years in the general population. Therefore the annual mean concentration of up to 30 µg/m^3 PM2.5 currently being registered in inner cities would correspond to a statistical reduction in life expectancy by some two years.

By way of comparison, the Federal Statistical Office reported that some 800,000 Germans died at an average age of around 76 in 2004. They included around 5,600 road deaths (motorized and non-motorized road users) with an average age of around 44. Thus, the latter group died on average 32 years earlier than the others and accounted for 0.7 per cent of the overall total of 800,000 deaths. If the latter figure is equivalent to 100 per cent, the average reduction in life expectancy from road deaths is 32 x 0.7/100 years, i.e. about 3 months.

In addition to man-made emissions (anthropogenic emissions) from sources such as traffic, house fires and industry, the environment is also

subject to pollution by fine particulate matter from natural sources, but the amount in question differs within Germany and cannot be accurately quantified. At a rough estimate the average figure is 8 µg/m³ PM2.5. This means, in terms of the current specified limits for PM10, after deducting natural contamination, a reduction in life expectancy from anthropogenic sources by approximately one year. The latest report from the WHO [19] recommends that, in the long term, annual average concentrations should not exceed 10 µg/m³ PM2.5. In view of the short term effects the WHO advises that the daily average of 50 µg/m³ PM10 should never be exceeded.

Ultrafine particles and nanoparticles

Particles with a diameter of less than 0.1 µm (100 nanometres [nm]) are referred to as ultrafine dust. Fine particulate matter of less than 100 nm in diameter are referred to colloquially as nano particles. Nanotechnology is the name given to a promising technology of attracting and increasing interest, and refers to the manufacture, examination and application of functional structures measuring less than 100 nm. Normal measurement methods are inadequate for determining the very small mass of these particles in the air, and consequently they are characterised in terms of their quantity per cubic metre air (l/m³). Ultrafine dust particles can find their way into the smallest branches of the lungs and even into the blood stream. Toxicological studies have pointed out the potential health hazard presented by ultrafine dust particles. As yet there is insufficient epidemiological data in order to be able to deduce any quantitative relationship between cause and effect.

Little is known about the effects of nanoparticles on health. Investigations into cell cultures conducted in vitro (i.e. carried out on cells in a test tube) indicate that ultrafine particles induce inflammatory reactions or exacerbate existing inflammation. Similar effects have been demonstrated in experiments on animals, although there may be differences between one species of animal and another. It is difficult to generalise because of the variability of the chemical nature, surface properties and the size of the nanoparticles, as well as the possibilities for the adsorption of pollutants such as polycyclic aromatic hydrocarbons and dioxin-type compounds, and the various modes of assimilation and action with regard to living organisms or cells. To the opinion of the Federal Environment Agency the potential risks to human health presented by the continued development of nanotechnology are deserving of more attention.

Carcinogenic properties of substances contained in particulate matter

It has not been conclusively shown whether fine particulate matter (PM) itself can cause cancer or whether existing findings reveal that individual carcinogenic materials are contained in the dust particles. However, there is no disputing the fact that diesel exhaust particles (soot) is a potential carcinogen. So far no separate pollution limits for soot have been specified because the presence of carcinogenic properties in other substances contained in the diesel exhaust particles, especially those of a natural origin, cannot be scientifically excluded. In this respect measures to reduce PM pollution should not concentrate exclusively on diesel soot.

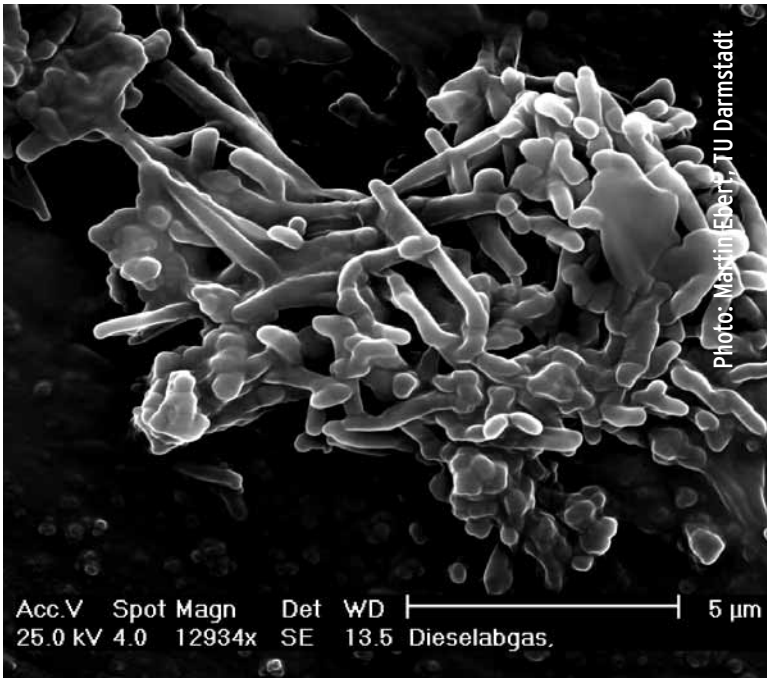


Image of a diesel exhaust particle taken by scanning electron microscope.

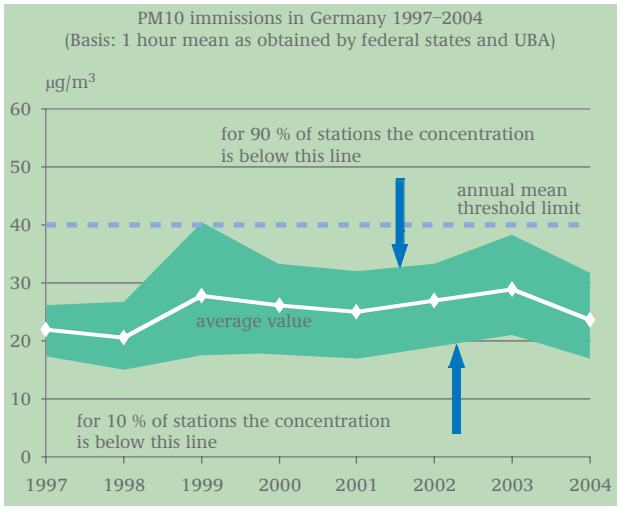
Dust, in our sense particulate matter, can also contain heavy metals and metalloids, some of them with carcinogenic potential. They not only enter the human body directly from the air but can also find their way into the soil and into rivers and lakes, and from there into the food chain. Therefore a reduction in the assimilation of pollutants via these routes forms the subject of the Maximum Doses' Ordinance and of other similar instruments (for commercial foodstuffs) such as the Drinking Water Ordinance and general recommendations regarding consumption,

especially nutrition. The consumer protection area is regulated separately. The amounts of some of these heavy metals and metalloids (arsenic, cadmium, nickel and mercury) and polycyclic aromatic hydrocarbons will in future also be restricted by the imposition of target levels under the terms of the 22nd Ordinance of the Federal Air Pollution and Immission Control Act; here the last European directive to air pollution control, i.e. the 4th Daughter Directive to the Framework one, is on the way to be adopted in German right.

Fine particulate matter – not only a German problem

Since the EU air quality standards came into force air pollution by fine particulate matter (PM10) in Germany has been the subject of widespread discussions, and for good reasons since, in many cities, the concentrations of fine particles have exceeded the permitted daily 24h-mean on more than 35 days (see Fig. 4). Looking beyond Germany it is apparent that this is a common problem elsewhere in Europe and in other countries of the northern hemisphere. The PM10 annual mean readings of around 20 µg/m³ in Germany, Europe, the USA and Japan, as obtained at all measuring stations, are at similar levels. Figure 3 is a graph showing an example from Germany. The annual threshold limit value of 40 µg/m³ is being maintained at 90 per cent of the measuring stations. This limit is being exceeded in several large cities and conurbations in Germany. Concentrations of between 40 and 50 µg/m³ occur in cities such as Berlin, Hanover, Munich and Stuttgart.

Figure 3: PM10 immissions in Germany (1997–2004)



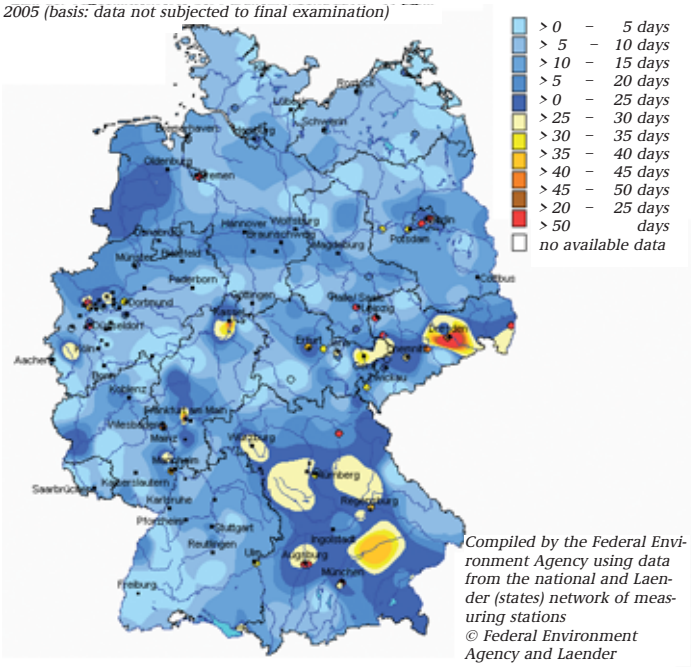
Pollution levels are significantly higher in southern European cities, for example in Athens and Rome, where average annual levels are far in excess of 50 µg/m³. Here too, as in Germany, local pollution is mainly due to the high volumes of traffic. Other factors include aridity, a lack of air movement and the transportation of dust particles (for example secondary ones and dust from deserts) from more distant regions. On occasion these factors increase the pollution levels substantially. This is borne out by the fact that the 24-h daily limit value of 50 µg/m³ is being exceeded on 100 days in the year in the cities of southern Europe. In a number of countries of eastern Europe, where power stations and industrial plants are in need of overhaul, they are responsible for a high level of pollution by fine dust particles, with annual mean values in excess of 50 µg/m³.

The PM10 situation is less critical in Northern Europe and the British Isles. Average annual levels of around and below 20 µg/m³ (Copenhagen 20 µg/m³, Stockholm and London 17 µg/m³) are typical to the region. Here as a rule there is a lower frequency of the PM10 daily limit exceedences, which is attributable to more favourable weather conditions – fewer temperature inversions, stronger winds and more frequent precipitation.

In Europe and the USA the provision of stricter emission standards for vehicles, mobile machin-

Figure 4: Cases in which the 24-h daily mean limit in Germany is exceeded (2005)

Number of 24-h daily mean readings of particulate matter concentrations > 50 µg/m³ 2005 (basis: data not subjected to final examination)



Compiled by the Federal Environment Agency using data from the national and Laender (states) network of measuring stations
© Federal Environment Agency and Laender

The maps and data about the current immissions situation as compiled by the Federal Environment Agency are intended to be of assistance to the public. As the study covers such a wide area it cannot be used for interpreting details about small areas.

ery and industrial plants, along with the development and introduction of fuels containing lower levels of components forming air pollutants, is the dominant feature of the measures already introduced and of those awaiting introduction. By planning their own measures many European countries also intend to reduce the volume of traffic by offering improved public transport facilities.

Achieving the threshold limits – but how?

At first glance there would appear to be a rather simple connection between the solid and gaseous pollutants (emissions of fine PM and its precursors) released into the air and the actual concentration of air pollutants that occurs (fine PM immissions): The more emissions, the higher immission levels. Fine PM is mainly produced by traffic, industry, domestic sources, trade and small business and agriculture as well, and the more they emit, the higher the concentrations of pollutants. If it is apparent that the concentrations of pollutants will exceed the permitted levels the authorities responsible, mainly the Laender and their administrative districts, with the involvement of towns and cities and the counties, are required to draw up plans or programmes to maintain air quality prescribed by law, which should, first of all, identify the main sources of air pollution. The responsible authorities must implement measures aimed at these polluter groups, in accordance with their share of the amount of pollution produced.

However, in practice, in the case of the pollutant PM10, local authorities find it difficult to ensure that the specified limits are adhered to by simply relying on the polluter pays principle, because the contribution from sources outside the region, including some a considerable distance away, can produce concentrations of fine dust more or less equivalent to what is emitted locally. This is due to the following factors:

- In the absence of rain or snow, fine PM can be suspended in the air for several days before falling to the ground. During this period the wind can carry the fine particles over distances of several hundred kilometres. Even in heavily polluted street canyons in large cities, lined by high buildings, sources located outside the city are responsible for half of the concentrations of PM10 [21, 22].

- Some exhaust gases, such as sulphur dioxide, nitrogen oxides and ammonia, react with one another in the air and are then transformed into secondary PM. At least half of the regional background pollution by PM10 is accounted for by this secondary PM [21, 22], with the result that, along with those responsible for emitting these precursor gases, an even greater number of sources are contributing to the pollution.

In such a complex situation dispersion models have to be used to identify the most effective abatement measures. These computer programs make it possible to calculate how airborne pollutants may dissipate and undergo chemical changes under typical meteorological conditions. The resulting reduction in PM10 concentration for each potential abatement can then be estimated.

Using dispersion models and, independently of them, through statistical evaluations of the measured chemical composition of the fine PM as well, in most air quality management plans it was possible to identify road traffic as the group causing the most pollution. Consequently the majority of measures to reduce emissions, such as transit ban for heavy duty lorries and setting up environmental protection “low emission” zones, are applied to this group of polluters [23, 24]. An analysis of the contributors to pollution along a street with heavy traffic in the centre of Berlin revealed that road traffic alone is responsible for half the concentration of the PM10 immission. And of this pollution half originates from the traffic in the street itself, with the remainder being attributable to traffic elsewhere in the city and in the surrounding region [21]. Road traffic is not only responsible for primary emissions of dust but, due to the nitrogen oxides emissions of vehicles, it also contributes substantially to forming of secondary PM. If in Berlin, for example, only vehicles with a particulate matter limit of 50 mg/km (EURO-3 passenger cars) were registered, on streets with heavy traffic the number of 24-h limit value exceedences could be reduced from 77 to about 20 [24]. To enable such local measures to be implemented, in May 2006 the German cabinet approved an ordinance for marking low-emission vehicles (35th Ordinance, October 10th, 2006).

On its own, a reduction in particulate matter emissions in vehicle exhaust gases would not be sufficient to achieve adherence to the PM10 limit values on heavily frequented downtown roads. As around half of the PM10 immissions caused by traffic on city roads will not be emitted from the exhaust pipe but originated from wear on tyres and brake pads, and from the way that dust in

Retroffiting a diesel-engined car: Particulate filters can be added afterwards

the street is resuspended. There are no known technical measures for effectively reducing such emissions. A number of field trials have been conducted but they failed to confirm that wet-cleaning of the roads would reduce the PM10 level [24]. A smoother traffic flow does achieve a minimal lowering of the emissions of resuspended particles, leading to a reduction of up to 1 µg/m³ in the concentrations of PM10 at the roadside [24], and where this is not sufficient a general reduction in the volume of traffic should be taken in account. Apart from additional local pollution in the streets it is also essential to achieve substantial reductions in the PM10 background pollution.

Regional background pollution consists in particular of fine particles from the fraction of PM2.5 [22]. Therefore, in order to minimise background PM pollution it is necessary to reduce primary PM2.5 emissions. These mainly derive from the combustion of diesel fuel in engines without particle filters and from wood and coal burnt in furnaces without particulate matter separators. Despite their relatively small numbers, wood-fired stoves in households and as used by small consumers (fireplaces, ovens, boilers) currently account for about 20 per cent of all German PM2.5 emissions, a level equivalent to that produced by the exhaust gases from road vehicles. In view of rising oil prices and the development of renewable energy for climate protection purposes we can expect to see a continued increase in the numbers of wood-fired furnaces. It is important to achieve substantial reductions in the emissions from small wood-fired furnaces because they produce fine particulate pollution, and this is the purpose of the amendment by the federal authorities to the ordinance on small and medium-sized furnaces.

To lower background pollution it is also necessary to reduce emissions of precursor gases that form secondary PM pollution across Europe, especially nitrogen oxides and ammonia. In Germany around half of all emissions of nitrogen oxide are produced by road traffic, while some 95 per cent of the ammonia emissions come from agriculture. Road traffic is not responsible for any ammonia emissions.

Once implementation takes place of the national and European measures which have already been passed, such as the amended “TA Luft” and the Ordinance on Large Combustion Plants (so-called Current Legislation or CLE Scenario), emissions of many airborne pollutants in Germany will steadily decline over the next 14 years (see Table 2). Based on the adoption of the CLE Scenario, the UBA calculated the expected PM pollution for the years 2010 and 2020 using a dispersion model [25]. Table 3 shows the range of PM10 and PM2.5 values. These calculation models only allow for limited spatial resolution. They reproduce the air pollution in general in larger areas, for example in conurbations, but not at local sites of concentrated pollution such as roads with high traffic densities.

According to the dispersion model, PM10 annual mean concentrations of around 30 µg/m³ in conurbations are still indicated for the year 2010, corresponding in an empirical context to the current permitted exceedences’ number of 35 occasions on which the 24-h daily mean limit value may be exceeded. However, because urban background pollution at local sites with high concentrations of pollution only accounts for between 40 and 60 per cent of the total pollution, it can be assumed that even by 2010 it will still not be possible to adhere everywhere to the permitted 35 exceedences. Ad-

Table 2: Changes in German emissions according to the CLE scenario
(in kilotonnes p.a.)

Year	NO_x	NMVOC	SO_2	NH_3	CO	PM2.5	PM10
2000	1657	1522	641	638	4768	167	255
2010	1182	1057	450	624	4245	133	219
2020	906	867	426	606	4000	117	204

Table 3: Concentration range for the annual mean readings for particulate matter in Germany, in accordance with the CLE scenario

(concentration ranges µg/m³)

Year	PM10	PM2.5
2000	12 – 35	7 – 25
2010	8 – 28	7 – 20
2020	8 – 25	5 – 18

ditional, nationwide measures would be needed to achieve this. In its communication Thematic Strategy on Air Pollution within the Clean Air for Europe Programme the European Commission calls for a further reduction in German emissions of primary PM and precursor gases as well by an average of 20 per cent compared with the CLE Scenario for 2020 in order to improve air quality sufficiently to enable the target to be met [26].

What about the future progress?

Because of the health hazards of PM2.5 the European Commission has proposed the introduction of air quality standards for particulate matter of this size [26, 27]. In addition to the limit values for PM10 it suggests stipulating an annual mean value of 25 µg/m³ for particles with a size of PM2.5 capable of entering the lungs. This figure corresponds to a PM10 concentration of 30 to 40 µg/m³, making it no stricter that the current limit for the PM10 fraction. It is therefore questionable whether adherence to such limits on emissions for PM2.5 is a suitable way of achieving further reductions in

What is being done elsewhere?

Limit values for the PM2.5 fraction have already been specified in the USA (see Table 4). These are currently undergoing scrutiny and this process should be completed by the autumn of 2006. The U.S. Environmental Protection Agency is planning even stricter limits on PM2.5 [28]. The current annual mean limit value is to be reduced from 15 µg/m³ to between 14 and 12 µg/m³, and the daily limit of 65 µg/m³ to between 40 and 35 µg/m³. In addition to stricter limits for PM2.5 the Environmental Protection Agency is planning to introduce an indicator for the coarser dust fractions, which are nevertheless still capable of entering the lungs. This is intended to express the concentration of the particulate matter fraction between 2.5 and 10 µm. For this indicator a limit of between 50 and 70 µg/m³ with reference to the daily average is under discussion.

Table 4: International limit values for particulate matter (PM)

Country	PM10 limit value	Limit value in relation to time
PM10 limit values internationally		
EU	40 µg/m³	Annual mean value
	50 µg/m³	24-h mean, max. 35 exceedences allowed
Switzerland	20 µg/m³	Annual mean value
	50 µg/m³	24-h mean period, 1 overrun allowed
USA	50 µg/m³	Annual mean value
	150 µg/m³	24-h mean, max. 1 overrun allowed in a year
California	20 µg/m³	Annual mean value
	50 µg/m³	24-h mean
Japan	100 µg/m³	24-h mean
	200 µg/m³	1-h mean
PM2.5 limit values (in international context)		
USA	15 µg/m³	Annual mean value
	65 µg/m³	24-hr average (98 % of value of daily average for one year, averaged out over 3 years)
California	12 µg/m³	Annual mean value
EU under discussion	25 µg/m³	Annual mean value

emissions, beyond what is already necessary. Because the PM2.5 faction is a component of the PM10, any measures that reduce PM10 emissions as a whole will also affect the smaller faction.

The European Commission has also proposed a 20 per cent reduction by 2020 in the current background PM2.5 concentration in those urban areas that are not seriously affected by emissions produced by traffic or industry. This would require not only measures at a local level but also a reduction in emissions of PM and its precursors over a wide area. The Environment Council of the European Community expressed majority approval for this proposal in June 2006.

In support of this objective both the European Commission and the United Nations Economic Commission for Europe (UN-ECE, members comprise the USA, Canada and all the countries of Europe), are considering limiting emissions of PM by their member countries through the imposition of national ceilings on emissions, which already exist for the main precursor substances of PM (sulphur dioxide, nitrogen oxides and ammonia). Substantial reductions in precursor substances must be achieved in order to meet pollution reduction targets in urban background areas as proposed by the European Commission. No concrete proposals on new maximum national emission levels for PM and its precursor substances can be expected before 2007. In this respect it is doubtful whether a decision can be reached at the present time on a 20 per cent reduction of urban background concentrations within the framework provided by legislation at a European level.

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Sources:

[19] World Health Organisation: WHO air quality guidelines global update 2005; the report can be downloaded from:
http://www.euro.who.int/Document/E87950.pdf

[20] Pope, C.A. et al.: Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. In: Journal of the American Medical Association, 287: 1132–1141 (2002)

[21] Senate Department for Urban Development Berlin: Luftreinhalte- und Aktionsplan für Berlin 2005 – 2010 (Plan for maintaining clean air and action plan for Berlin 2005 – 2010). Available on the internet at:
http://www.stadtentwicklung.berlin.de/umwelt/luftqualitaet/de/luftreinhalteplan/

[22 Stern, Rainer: Der Beitrag des Ferntransports zu den PM10- und den NO2-Konzentrationen in Deutschland unter besonderer Betrachtung der polnischen Emissionen: Eine Modellstudie. (The contribution by long distance transport to concentrations of PM10 and NO2 in Germany with particular emphasis on emissions from Poland. A model study). Final report of the UFOPLAN project FKZ 204 42 202/03. FU Berlin, Institute for Meteorology. Berlin 2006

[23] List of clean air plans on the internet:
http://www.uba.de/Luftreinhalteplaene (in German)

[24] Diegmann, Volker and others: Final report of the UFOPLAN project FKZ 204 42 222 “Maßnahmen zur Reduzierung von Feinstaub und Stickstoffdioxid“ (Measures for reducing fine dust and nitrogen oxide). IVU Umwelt GmbH, Sexau 2006 (in preparation)

[25] Stern, Rainer: Applications using the REMCALGRID model for predicting emissions 2010 and 2020 in Germany on the basis of high definition data on emissions. Report on the UFOPLAN project FKZ 202 43 270. Institute of Meteorology, FU Berlin, Institute of Meteorology, Berlin 2006 (in preparation)

[26] Commission of the European Community, proposal for a directive from the European Parliament and the Council on air quality and clean air for Europe (KOM(2005) 447 final), 21.09.2005:
http://europa.eu.int/eur-lex/lex/LexUriServ/site/de/com/2005/com2005_0447de01.pdf (in German)

[27] Commission of the European Community, notification by the Commission to the Council and the European Parliament, Thematic Strategy for Maintaining Air Purity (KOM(2005) 446 final), 21.09.2005:
http://eur-lex.europa.eu/LexUriServ/site/de/com/2005/com2005_0446de01.pdf (in German)

[28] Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper, U.S. Environmental Protection Agency 2005

BELIEVING, MEASURING, ASSESSING, ANTICIPATING: THE LONG ROAD TO CHEMICAL SAFETY

Chemicals are used in the manufacture of countless items, including furniture, toys, washing and cleaning products, cosmetics and rainwear. Such products are with us all our lives. Unfortunately some chemicals have undesirable effects, triggering allergies, or causing cancer, genetic damage or deformities in unborn children. Laws have therefore been passed stipulating that the effects of new chemicals on human beings and the environment must be investigated before they can be launched on the European market. These investigations are generally conducted by the manufacturers. The findings are then evaluated by regulatory bodies such as the Federal Environment Agency (UBA). These authorities may even go so far as to recommend to the government that certain applications of these products should be banned. The question arises: how can the complex assessment procedure be made clearer? And are there quicker and more efficient ways of ensuring that the thousands of chemicals that have not been tested to determine their risks actually represent a hazard and should be subject to controls?

Not only industry data is included in a chemical substance risk assessment. The UBA itself conducts measurements and investigates whether the approved substances are genuinely safe. The assessment of substances began more than 25 years ago, starting with industrial chemicals. Since then pesticides, medicines and biocides have also been included. What are the implications of these assessments for humans and the environment? Does it mean that fewer environmentally hazardous chemical substances and products will be developed in the future, or are new hazards emerging? For example, it appears that nanotechnology products will require their own form of assessment using a different set of criteria. There will also be changes in the way that environmental assessments are carried out. Integrated risk assessment in the form of the close interlinking of environmental and health aspects, and sustainable chemistry that protect resources and do not pollute the environment or represent a hazard to human health are no longer just empty words.

BELIEVING

According to current EU chemical legislation, when the authorities are assessing industrial chemicals proof must be shown of the risks they pose to the environment or to humans. Manufacturers and importers supply data about substance properties and exposure for the purposes of risk assessment. So far the registration procedure only applies to so-called new substances, those first introduced onto the European market since 1981, of which there have been some 3,700 so far. One of the main features of this registration process is that the applicant must submit to the authorities a standardised set of data about the safety, environmental and health properties of the substances. However, this does not represent a genuine pre-marketing control system, linking the commercial viability of the substances with their proven safety.

The information available about existing substances is very limited: there are some 100,000 existing chemicals on the market, of which 30,000 are of economic significance, and little is known about their effects and side effects. Although a programme has been established under the EU Existing Substance Regulation for the testing and assessment of existing substances, the results have been meagre. A total of 76 existing substances were “conclusively” assessed, and risk minimisation strategies were recommended for 11 of them.

This could not be allowed to continue. The European Union (EU) is therefore currently engaged in negotiations on a new chemicals legislation. The proposed regulation is entitled REACH, encompasses several hundred pages and includes 140 articles and 17 appendices. The acronym REACH (Registration, Evaluation and Authorisation of Chemicals) represents a paradigm change in European chemicals policy. REACH is intended to introduce a modern and transparent chemicals management system, transferring responsibility for the assessment and for furnishing proofs about the safety of their products onto the manufacturers [29].

The responsibility of manufacturers and users

At the heart of the new chemicals policy is a shift of the so-called burden of proof, which is referred to here as the Disclosure Obligation. In future it will not be the task of the authorities or consumers to prove the hazardous nature of products. Instead companies will be required to furnish evidence of the safety of the substances which they manufacture or import into the EU. In practice this means: when registrating a substance the manufacturers themselves have to prepare a registration dossier and carry out their own risk assessments. The onus is on them to provide proof that the measures they have undertaken are sufficient to protect human health and the environment.

Thus the new chemicals policy will in future be based on the responsibility of the industry itself, which will not, as is normally the case, have to deal with the full range of official control mechanisms. Companies obviously want to market their chemicals, but how can they be prevented from misinterpreting their data? And how can the industry safeguard the quality of its registration dossiers in a credible way? It is questionable whether all businesses have sufficient expert knowledge at their disposal to be able to conduct the prescribed risk assessment of their chemicals and, in special cases, of their products too.

The new European Chemicals Agency based in Helsinki will examine the registration dossiers to ensure that they are complete and plausible. Subsequently national agencies such as the UBA will conduct risk assessments for selected substances. The aim is not just to examine individual registration dossiers but also to establish an inherent control mechanism. This should enable companies to submit registration dossiers that are complete, can stand up to spot checks and above all are an adequate means of confirming and ensuring safe use of the substances. It remains to be seen whether these mechanisms will suffice or whether additional quality assurance systems are needed.

Photo: wvgw/BGW

Many chemical substances have been on the market for decades. Little is known about their effects and side effects.

Institut für Energie- und Umweltforschung Heidelberg GmbH (ifeu, the Heidelberg Institute for Energy and Environmental Research) was commissioned by the UBA to prepare a proposal for an institutionalised quality assurance system based on both internal and external quality assurance measures. The ifeu has accordingly proposed that companies should appoint a certified product safety officer to supervise all risk assessments. Moreover, to avoid any gaps in the data, rules should be drawn up to ensure the exchange of information in the supply chain of a product. A further proposal by ifeu is for the establishment of a commission of experts, comprising representatives of industry, authorities and science, to ensure that external quality controls are carried out, i.e. from outside the company. This commission would carry out spot checks on the dossiers to determine their quality, prior to evaluation by the authorities.

Imbalances in the self-assessment process

The importance of controls and systematic quality assurance can be demonstrated using the German Water Law as an example. Because the chemicals from industrial plants can find their way into lakes and watercourses, manufacturers and plant operators are required to examine and classify any substances in terms of the hazard they represent to water, if these are not subject to the administrative regulation on water-hazardous substances (VwVwS) in accordance with § 19g WHG. The UBA publishes the results of this classification on the internet. Plant operators must conform to safety regulations of varying degrees of strictness depending on the category of risk posed to water. Thus the transfer of responsibility to industry that is envisaged by REACH already exists, on the basis of German Water Law. In the past substances were classified by a body known as the Assessment Committee for Water-Endangering Substances (KBwS), which came within the scope of the Federal Environment Ministry. Since 1999 industry has been able to assume responsibility for this task itself.

Already much of the documentation submitted with the applications does not satisfy the UBA and its requirements concerning the identity of the substances and the consistency of the applications for classification. The examinations of self-assessments also reveal that extensive quality assurance is needed in order to eliminate any doubts about the self-assessment.

MEASURING

Experience has shown that trust is good but that an examination of the reasoning underpinning this trust is also important. The UBA has its own measuring facilities, enabling it to conduct selective investigations into the data about substances in the environment and in humans, and to undertake new examinations. This may take place, for example, if scientific investigations query the environmental safety and threats to human health of a substance that has already been introduced commercially.

The Artifical Pond and Stream System (FSA) is one of the main laboratories available to the UBA and can reproduce the behaviour of various substances in streams, rivers and lakes, along with the biotic communities that inhabit them [30]. These investigations of substances are much more thorough than conventional laboratory studies, enabling the FSA to examine the problems in close detail.

The federal authorities' German Environmental Specimen Bank (ESB) and the Environmental Survey provide useful information about increasing or decreasing concentrations of substances in the environment and in human tissues. The ESB is invaluable because of its function as an archive. For over twenty years representative samples of typical eco-systems (for example from the soil, sediment, the living environment) and human samples (such as blood and urine) have been collected, examined to determine the extent of their contamination with pollutants, and stored in the archive. New findings and modern methods also enable pollution from previous years and decades to be studied, thereby enabling the compilation of time series showing the development of the pollution.

Since the mid-1980s the UBA has been carrying out nationwide environmental surveys at intervals of several years. These studies investigate the contamination of the population with pollutants in a representative way using human samples and samples from the immediate vicinity of the participants in the study (for example drinking water and the air in enclosed spaces). In this way the pattern of contamination can be followed over an extended period and, if required, politically necessary, restrictive measures can be prepared.

Irgarol in surface waters

Irgarol is an antifouling agent in the paint used on boats and has been used increasingly as a substitute for tributyltin compound (TBT) since the mid-1980s. Its presence can be detected in par-

A giant open-air laboratory: external view of the Artifical Pond and Stream System. The effects of chemicals on the environment are simulated using troughs and ponds.

ticular in marine environments and not only is it extremely toxic to algae but it is also suspected of interfering with the hormonal system of various organisms in the environment. Here, as in so many other cases, the question arises: is a substitute that is supposed to offer an improvement not just as much of a problem as the substance it is intended to replace.

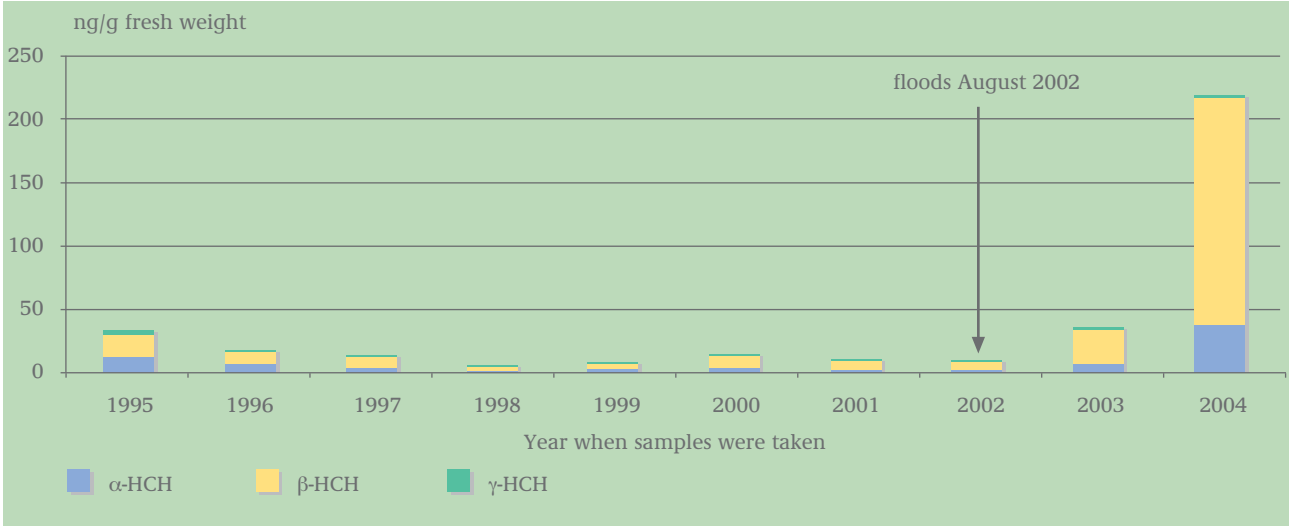
UBA researchers have analysed the environmental risks posed by irgarol. Firstly they investigated whether lakes and watercourses in Berlin, Brandenburg and Mecklenburg-Vorpommern contained traces of this biocide agent in the water or the sediment. Samples were mainly obtained from yacht marinas and landing stages. At all these locations UBA experts found residues of irgarol and products resulting from its decomposition, which are also toxic to algae.

The considerable risks to the environment posed by irgarol were confirmed by investigations carried out in the research ponds of the Artificial Stream and Pond System, where a single dose of irgarol was shown to have a serious and harmful impact on plant life. For the first time, in experiments using the freshwater pulmonate mollusc *Radix balthica*, UBA scientists, together with colleagues from the University of Frankfurt am Main and the LimnoMar Institute in Hamburg, were able to demonstrate that irgarol may affect oestrogen levels: their experiments revealed that male snails were feminised. The revelation by the UBA that this hormone-like effect occurs in surfacewater in such concentrations provides a clear warning against the use of irgarol as an anti-fouling agent on commercial vessels and leisure craft. One particular problem revealed by the sample is that leaching of irgarol from boats' hulls suggests that the resulting pollution may be permanent. In 2006 the EU will commence a risk assessment of this biocidal agent, incorporating the findings obtained from research by the UBA.

Inherited from the GDR – hexachlorcyclohexane (HCH) in fish from the Elbe

Since 1995 the national Environmental Specimen Bank (ESB) operated by the UBA has been catching bream in late summer in the River Elbe and its tributaries, the Saale and Mulde, in order to store samples and conduct analyses of pollutants. Samples taken in recent years reveal a significant decline in the amount of heavy metals and chlorinated hydrocarbons (see Fig. below). This is mainly a consequence of the reduction in the amount of pollutants being released into these rivers, of restoration work and of the closing of factories.

In past years flooding in the Elbe catchment area also led to increased contamination in the fish, but this generally reverted to pre-flood levels within a year. It therefore came as no surprise that the contaminating residues in the fish samples rose again quite significantly following the Elbe floods of August 2002. However, not all the chlorinated hydrocarbon levels in the samples subsequently declined. For example, levels of α-HCH and β-HCH by-products from the production of the insecticide lindane, did not decline, in fact they continued to increase, to levels that have never before been registered in freshwater fish in Germany. Why was this? In the mid-1970s there was wide-scale use by the German Democratic Republic (GDR) of lindane as an insecticide. Lindane was manufactured in the area around Bitterfeld and waste products from this production process were deposited in the immediate



Source: Federal Environment Agency

vicinity, in some cases in the soil alongside rivers. The flooding in 2002 caused the pollutants to find their way into the eco-systems of the Elbe and Mulde, and researchers later found them in the fish stored at the Environmental Specimen Bank.

The West's burden – perfluorooctane sulphonate (PFOS)

Whereas the negative effects of lindane have been known for a long time, increased public discussion of modern perfluorinated chemicals is a recent development, and these chemicals can also be found in the environment. They are in everyday use on account of their excellent impregnating properties or as dirt- and water-resistant coatings: in textiles, carpets, upholstery and packaging. In its May 2005 issue the magazine "Ökotest" reported on perfluoro-octanoic acid (PFOA) residues in Gore-tex® jackets and impregnating sprays.

The UBA examined human blood samples from the Environmental Specimen Bank for the presence of perfluorinated compounds, with worrying results: there can be no doubt that these chemicals have found their way into humans. Small concentrations of the compounds perfluoro-octane sulphonate (PFOS) and perfluoro-octanoic acid (PFOA) were found in each of the samples examined. No definitive answer has yet been found as to whether this constitutes grounds for concern and whether these concentrations could represent a health hazard. As a precautionary measure, in the case of such long-lived substances as the fluoro-compounds, care should be taken to restrict their distribution because long term effects cannot be ruled out.

PFOS is persistent, accumulates in the environment (bio-accumulative) and is also toxic. Responding to the concerns expressed by many Member States (including Germany) the European Commission has submitted a proposed directive that largely prohibits the marketing and use of PFOS, with only a few exceptions. Furthermore, in view of the global distribution of PFOS, it is planned to include it in the list of Persistent Organic Pollutants (POPs) in the Stockholm Convention. The Review Committee of the Stockholm Convention is currently investigating whether PFOS is one of the substances possessing the properties of a POP. In its investigation the UBA pointed out that not only PFOS but also PFOA represented a substantial hazard to humans and the environment.

Phthalates in humans – where are the sources?

Phthalates (phthalic acid esters) are colourless liquids that are almost odorless, not easily volatilized and insoluble in water. Due to their many different uses phthalates can be found almost everywhere. The best-known phthalate, di(2-ethylhexyl)phthalate (DEHP), is mainly used as a softening agent in PVC products, and very soft PVC products contain up to 40 per cent DEHP. Phthalates can also be found in dispersion paints, lacquers, paints, cosmetics and many other items. Because DEHP and other softening agents are not permanently bonded into plastics humans inevitably absorb them through food or the air that they breathe. For a long time house dust was regarded as the main source of this contamination, due to the fact that children frequently absorb dust, earth and other particulates containing pollutants through hand-to-mouth contact. However, recently the German Environmental Survey of Children (GerES IV) conducted by the UBA demonstrated that no such connection existed. The amount of DEHP taken in daily is, however, disturbingly high: up to ten per cent of the children examined are receiving more DEHP each day than is toxicologically safe.

Effective measures must be introduced in order to identify the sources. The UBA is therefore conducting a study into the food consumed daily by children to determine its DEHP content and at the same time to identify the effect this substance has on the bodies of these children. In the past small children's plastic toys were also a major source of DEHP. In the interests of child health the EU has prohibited the use of certain phthalates (including DEHP) as softeners in toys and items for babies. This ban takes effect on 16 January 2007.

Quality assurance in the laboratory

Internationally agreed test and assessment methods form the basis for effective enforcement against the background of global economic operations and the EU Chemicals Law. Since the end of 2004 the UBA's laboratory for examining substances that are hazardous to water has been applying the internationally valid quality standards of Good Laboratory Practice (GLP). This quality assurance system ensures that all investigations are of a consistently high quality and enables the findings to be retraced. Other advantages include the legal practicality and international acceptance of

the findings obtained under GLP. The number of experiments conducted on animals can also be reduced as a result of GLP standards. In companies operating multi-nationally, where the parallel registration of chemicals takes place in various countries, the number of experiments on animals is reduced by 70 per cent. In September 2005 the GLP system was introduced in a binding form by the UBA Ecotoxicological Laboratory, which now has a practical quality-assurance tool for examining the results of investigations.

Alternatives to experiments on animals

The development and legal recognition of alternatives to animal experimentation represent a major component of modern risk assessment of substances and products. These alternative methods are intended to limit or replace established tests on vertebrates. At present few alternative tests are available. However, researchers have developed a number of methods using fewer animals or none at all which do provide sufficient information for determining the hazardous nature of a substance. For example the UBA has played a decisive part in the development of a new and more humane test method using the roe of the Zebra fish *(Danio rerio)*, replacing the previously used method of testing sewage using orfes.

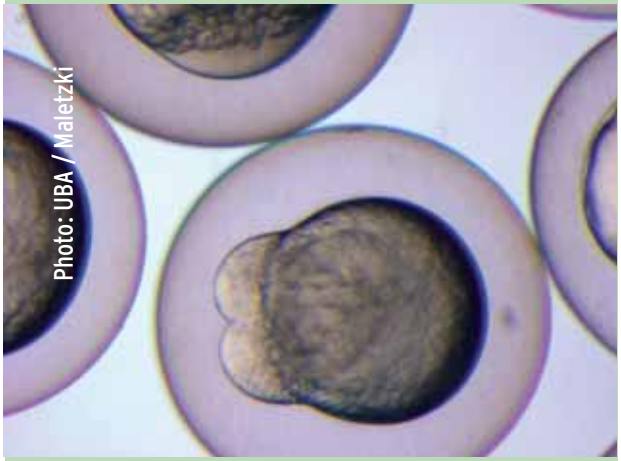


Photo: UBA / Maletzki

A process that does not harm animals: the fish roe test replaces experiments conducted with mature fish.

The fish roe test is now available as a DIN standard and is one example of the way in which alternative methods can help to reduce the number of tests conducted on animals. The authorities have been using the test since 2006 to determine the toxicity of sewage and the amount of the sewage levy in Germany. Previously the practice was to routinely carry out these tests on mature fish. Is this fish roe test also a suitable substitute for fish in tests on individual chemicals, biocides or pesticides? Because internationally harmonised test guidelines were a prerequisite, in 2005 Germany took the initiative and submitted a slightly modified proposal for testing to the OECD Secretariat. The test guideline in question is one that is used to determine acute toxicity to fish using fish embryos. There are encouraging signs that approval will be granted soon.

ASSESSING

In the early 1980s the Chemicals legislation, with its registration procedure for newly marketed chemicals, referred to as new substances, represented the first systematic assessment of the chemical risks to humans and the environment. The UBA was actively involved in developing and establishing the basic methodology for assessing environmental risks. Firstly this contributed towards the development of models for the emission of substances into the environment and for the way in which they degraded and were distributed in the environment. In this way it is possible to estimate the exposure of living organisms to these substances. Secondly UBA also continued to develop a method of assessing the eco-toxicological effect on the basis of laboratory data [31].

Adapting assessment methods to meet requirements

The assessment of environmental risks has now become a regular part of nearly all the chemical legislation enforcement processes. In addition to old and new substances the UBA also assesses the environmental risks posed by pesticides and biocides. In a long-drawn out explanatory process in which the UBA also played its part, the EU has now introduced assessments of the environmental risks for medicines too. Rules which have been harmonised on a European-wide scale, as described in the Technical Guidance Document (TGD) for the regulatory assessment of substances, and in other guidelines, are indispensable. The TGD is amended as new findings become available: one new element, derived originally from the requirements for the protection of the oceans, is that of PBT assessment, i.e. the assessment of persistent, bio-accumulative and toxic substances. The usual risk assessment methodology, comprising a comparison between the expected exposure and effect, is inapplicable here be-

cause it cannot be used to deduce a concentration threshold for substances with high levels of persistence and accumulation in the environment that excludes long-term harmful effects. To guard against any possible harm to the environment the EU has developed PBT assessment as a separate test set-up (for criteria, see Table 5). The special attention given to such substances was also adopted, for example, in the guidelines for the environmental assessment of human medicines with particular reference to the TGD for chemicals, that recently received EU approval.

Successes in the assessment of chemicals

Since 1981 manufacturers throughout the EU have registered over 3,700 new substances with the relevant authorities. What have these numerous assessments of individual substances contributed to environmental protection? In many cases it has been the reassuring realisation that, apart from the precautions that would in any case be required, no additional measures are necessary. Nevertheless, the obligation to submit additional information for more effective risk limitation, or the threat of imminent restriction, has led some manufacturers to withdraw their applications.

Such cases also help to reduce risks, provided that these substances or the application are not replaced by equally risky or even more hazardous existing substances. In the case of new substances the instruments offered by the risk reduction measures employed so far range from voluntary restrictions, for example in the case of the antifungal substance fungitex, which is only used in closed cycles in textile processing plants, to complete prohibitions on manufacture and use. Consequently the PCB substitutes ugilec 121 and DBBT have been banned since the 1980s.

Failure as an opportunity: REACH and existing substances

There are still some 100,000 substances which have not yet been tested to determine their safety for consumers and the environment. The EU has agreed on four lists, containing the names of 141 existing substances to be dealt with as a matter of priority. Just how complicated and time-consuming the assessment work is can be seen from the experience obtained over the past 13 years with the EU Existing Substances Regulation. Community risk assessment and harmonisation of the conclusions are extremely difficult and time-consuming, especially in view of the considerable economic importance of certain substances. It is also evident that the affected branch of industry only supplies effective information if its own substance comes "under suspicion". Accordingly community risk assessment of specific substances has to start anew each time instead of coming to a rapid conclusion. As a consequence only just under 80 assessment procedures have so far been concluded. REACH is an attempt to dispense with this tedious and time-consuming procedure. It is, after all, not the assessment per se that is the objective of the regulation of chemicals but clarification as to whether the substances represent an unacceptable risk to the environment and health, and whether risk reduction measures are necessary.

Deregulation should not lead to a reduction in safety levels

A prime example of a successful method of preventing environmental damage is offered by those pesticides for which approval has not been granted, the UBA having withheld its agreement due to their negative impact on the balance of nature. This includes substances with such well-known ac-

Table 5: Criteria for identifying PBT and vPvB substances in accordance with TGD

Criterion	PBT	vPvB
Persistence	Half-life sea water > 60 days – fresh water> 40 days – marine sediment: 180 days – limnic sediment: > 120 days	Half-life water > 60 days – sediment: > 180 days
Bioaccumulation	BCF > 2000	BCF > 5000
Toxicity	$NOEC_{aquat.\ Organisms}$ < 0.01 mg/l CMR (carcinogenic, mutagenic, toxic to reproductive system) endocrine effects	not required

tive ingredients as lindane, endosulfane, aldicarb, azinphos-methyl, enthion, parathion and vinclozolin. The UBA is involved in the licensing decision by means of an assessment arrangement.

Such decisions could not be reached without a well-founded risk assessment. With plant protection the assessment methodology is applied not only to decide on the suitability of a pesticide, taking environmental aspects into account, but also to link the approval with suitable risk minimisation measures if necessary. One common example is that of the minimum distances between the agricultural area to which these substances are applied and any adjoining areas of water. In this way the environmental risk is reduced to an acceptable level. In such cases the results of the examination of the substance leads directly to a concrete rule of action for agricultural users of pesticides.

In view of the increasing demands (both qualitative and quantitative) on the manufacturers of pesticides and on the authorities carrying out the assessment, the authorities' many years of experience of substance assessment and research into pesticides should be used to create easily manageable measures and simplified assessment concepts. As an immediate and feasible measure, the law being planned by the German government to ease the burdens on small and medium-sized companies should include a provision intended to simplify and standardise the conditions pertaining to the distances to be maintained when applying pesticides, and to update these conditions to reflect new technological developments. However, deregulation should not signify a reduction in safety levels: the UBA has helped to develop answers to the emerging new requirements of the law on pesticides by using geo-referenced, probabilistic assessment concepts (see also page 87).

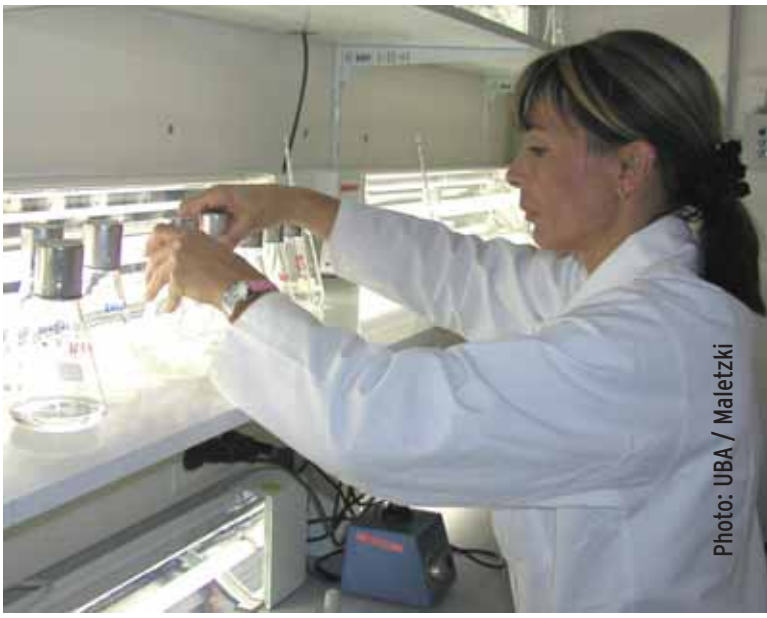
Assessing chemicals – responsibility leads to knowledge

A long tradition underlies the assessment of chemicals. Because the new chemical legislation REACH transfers the work of risk assessment to the manufacturers and importers, often the knowledge and practical experience of assessment methods that has been obtained over many years by the relevant authorities will initially be lacking. In an effort to assist those now assuming these responsibilities the authorities intend to draw on their experience and make use of the chemical assessment concept in order to combine practical and safe modules that can be used by businesses. This is taking place in many projects being conducted by the EU Commission, the so-called "REACH Implementation Process", in which the UBA, as one of the co-founders of the process of chemical assessment, is also being consulted.

Biocides – the conflicting objectives of health and environmental protection

Biocides are used to eradicate or restrict the numbers of so-called pest organisms. They are frequently deployed in close proximity to humans. Even assuming that the relevant regulations have been complied with, biocides can still find their way into the environment, presenting a health risk to humans, animals and nature as a whole. The European Biocidal Directive of 1998 introduced a strict approval procedure for these products. The declared objective of this directive, now incorporated in German chemical law through the biocide law, is to improve protection for the environment and for health. Like every other approval procedure, the one that regulates biocides is likely to have far-reaching implications for the market: forecasts by industrial associations of the likely trends indicate that, of the 15,000 biocide products being marketed in 2000, probably only half will still be in existence by 2010.

The explanation for this reduction is that a number of products will not pass the approval process or that the manufacturers, for economic reasons, will not register them for a process which is too expensive, given their anticipated sales. Although failure to grant approval on the grounds of health or environmental protection is both reasonable and necessary, under certain circum-



Laboratory testing: Chemicals under scrutiny.

stances the removal of biocide products from the market for economic reasons may have negative consequences, because some of them are indispensable and do have a beneficial effect on health. Many pests transmit diseases and effective ways have to be found to combat them in order to keep new or known epidemics and their animal vectors under control.

The UBA is not only responsible for carrying out environmental tests for the approval of biocides but also, under the terms of the Infectious Diseases Prevention Act, for testing and determining the efficacy and applicatbility of pesticides that may be used in pest control operations by the authorities. With these combined capabilities the agency is in a position to prepare and submit selective solutions, thus helping to avoid any gaps in the range of biocides for dealing with special carriers of disease or pests. The first step in this direction was a specialist conference organised by the UBA in March 2006 on the impact of the new biocide regulations for disease prevention in Germany, identifying expected problems and suggesting possible solutions [32].

ANTICIPATING

One of the main tasks of the UBA is to assess and reduce the risks that substances present to humans and the environment. Such assessments are always based on best available scientific and technical knowledge. This means that the UBA not only considers known environmental pollution but also measures new pollutants, investigates new kinds of effects, and examines and introduces new assessment methods. One example is provided by the testing and assessment of chemicals with a hormonal effect. The UBA makes a significant contribution to the development of harmonised test and assessment procedures. Anticipating also means understanding the scope of future environmental problems.

Focus on protecting children

Environmental influences have an important impact on health, especially of children. Recent investigations have revealed that pollution and chemicals affect children differently to the way that they impact on adults. The potential harm to children can only be determined using a special risk assessment method developed specially for this age group. The UBA is only too aware of the importance of protecting children's health. The ongoing German Environmental Survey (GerES) is therefore devoted exclusively to children for the first time and will provide findings about the pollution to which they are exposed [33].

Children react with greater sensitivity to environmental influences.

In numerous projects over the past ten years the UBA has been conducting an in-depth examination of the effects of substances that could affect the hormonal systems of animals and humans. This group of substances affects developing organisms in particular and the damage caused during this phase of life is irreversible. Experts are debating whether substances with a hormonal effect could also be responsible for defects in human reproduction, deformities of the sexual organs and the increase in certain types of cancer, as well as for reduced sperm quality in European men. According to this hypothesis, substances that affect the organism prior to birth cause damage which cannot be detected until puberty. In order to investigate these connections it is necessary to document the pollutants affecting the developing human being prior to or shortly after birth. Therefore, in 2005 the UBA commissioned the University Clinic Münster to collect samples of placenta, blood from the umbilical cord and human milk at the time of birth. Analyses of these samples from the perinatal archive enable conclusions to be drawn about the chemicals to which children are exposed prior to and shortly after birth.

Nanoparticles – new ecological opportunities and risks

Nanotechnology products represent a completely new group of substances. Nanoparticles are less than a millionth of a meter in size. Because of their minute size, their special surface properties and biologically important dimensions, nanoparti-

cles have particular chemical, optical, mechanical, electrical, magnetic and biological capabilities, which distinguish them from larger solid bodies and endow them with different properties. As a result nanoparticles have many varied uses and we can expect to see them being introduced in many applications around the world. For example, nanomaterials could be used to adsorb and transport contamination such as heavy metals or organic substances on their large, active surfaces. These and other properties make nanoparticles of interest for new applications, but they also contain unknown risks to health and the environment. Over the coming decades nanotechnology is expected to gradually but fundamentally change the face of industry in all the main sectors (auto industry, mechanical engineering, chemicals, textiles, medicine, biotechnology and environmental technology). However, this will also be accompanied by many new applications that will ease the burdens on the environment:

- Surfaces protected by a delicate coating made from a nanomaterial are resistant to scratches and repel dirt;
- Nano-catalysers permit more environmentally friendly production methods at low temperatures;
- "Nano" anti-reflection coatings on solar panels improve the energy yield.

However, nanotechnology can also harbour environmental risks. For instance, nanoparticles with special properties, when used in household products, cosmetics, food and medicines, could also produce unwanted effects outside their intended field. Medicines can be transported in spherical molecules, for example, and laboratory experiments have shown that these hollow spheres can penetrate the brains of fish, where they can cause damage. One important question to be answered concerns the life cycle of these nanomaterials. Until now no suitable methods have existed for a carrying out a comprehensive risk analysis. The UBA will be launching research projects to assess the hazards to the environment and health presented by nanoparticles and to give a timely indication of the risks and measures that could be taken to protect health and the environment (see also Page 76).

Integrated risk assessment – a combined view of health and the environment

REACH requires an official regulatory authorisation for those chemicals which are particularly hazardous to human health and the environment, to enable them to be substituted if possible. These consist primarily of substances which

- may cause cancer (carcinogenic substances);
- may cause genetic changes (mutagenic substances);
- may adversely affect the reproductive system (reproduction-toxic substances);
- are persistent, accumulate in the environment and possess toxic properties (PBT substances);
- may influence the hormonal system (endocrine disruptors);
- and some long-lasting (persistent) polar substances.

All of these substances have a wide range, in terms of time (persistence), spatially distribution (uncontrolled, extensive distribution) or effect (irreversible effects). In most cases they present a danger both to human health and the environment. Once they have found their way into the environment persistent substances may adversely impact on humans and the environment. An endocrine effect may, for example, have implications for human and animal populations in the environment. What could be more pertinent, therefore, than the exchange of information between the players in the environmental and health sectors, for each to make use of findings from the other area, and to prepare common assessments in order to be able to identify long term damage at the earliest possible stage? Until now there has been insufficient joint consideration of the risks to humans and the environment to enable a balanced, overall assessment to be made.

There are many reasons for the lack of a fully integrated view of health and the environment. The main obstacles to a combined approach have been the different types of training, qualifications and traditions in risk assessment in the health and environmental sectors, and the varied ways in which the effects and methods have been studied in toxicology and ecotoxicology. A common view is also made more difficult because of the fragmented organisation of the different authorities. In Germany the work of chemical legislation enforcement is generally shared between three authorities from three different departments.

The European "Plan of Action for the Environment and Health 2004–2010" encourages the de-

velopment of uniform assessment standards which take into account both environmental and health aspects. To achieve this aim closer networks should be established between participants from science, the authorities and non-governmental organisations in the fields of the environment and health, and in research. The EU is responding to the initiative proposed by the World Health Organisation (WHO) which, for example, in a report in 2001 clearly showed the benefits of a combined approach for human health and the environment [34].

The UBA is pursuing the objective of linking assessments of health and the environment more effectively within the scope of its own operations in order to create and strengthen a shared view of human health and the environment. It is also stepping up its cooperation with other authorities that are active in the fields of health and the environment. This is being supported by the work carried out jointly on the Action Programme Environment and Health (APUG).

Sustainability is more than just a matter of safety: a sustainable chemical industry

Today one single idea links not only the various authorities but is becoming more firmly established in the public eye and in industry too: that of a sustainable chemical industry. There is widespread agreement that high levels of protection for human health and the environment are a desirable objective. The application of innovative industrial technology and management concepts can lead to the creation of a competitive and innovative, science-based economy.

The common aim is the production of chemicals which, before they are launched onto the market, avoid polluting water, the soil and the atmosphere, as well as helping to conserve resources and energy. A sustainable chemical industry would change chemicals throughout their entire life, i.e. not only the manufacture of the primary chemical raw materials but also the processing, use and subsequent disposal of these products. The chemical industry, one of the most important and innovative sectors in Europe, should be transformed so that it conserves resources and reduces its energy consumption, substituting hazardous substances with other chemicals or processes which are safer for the environment and users, without the need for expensive risk-minimisation measures. If the authorities, the public and the chemical industry make proper use of this opportunity, the production, reprocessing and use of chemicals would present less of a threat to the environment and human health and the environment would no longer be overstretched as both a source of materials and a dumping ground.

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Sources:

[29] Additional information about REACH:
http://www.reach-info.de/05_dokumente/01_dokumente.htm

[30] Additional information about the Artificial Stream und Pond System:
http://www.umweltbundesamt.de/fsa/htm_en/fsa.htm

[31] Additional information about chemical policy and pollutants:
http://www.umweltbundesamt.de/chemikalien/index.htm

[32] A summary of the findings of the conference is available on the internet as a PDF file:
http://www.umweltbundesamt.de/biozide/index.htm

[33] Additional information about the survey:
http://www.umweltbundesamt.de/survey/index.htm

[34] The WHO report “Integrated Risk Assessment” can be downloaded from:
http://www.who.int/ipcs/publications/new_issues/ira/en/index.html

AN EXAMPLE OF ECOLOGICAL CONSTRUCTION WITH

As a model project for ecological and innovative construction the new UBA administrative building in Dessau compares very favourably with the Gropius buildings in the vicinity. (photo: dbb)

Offices curving like a snake: the serpentine facade gives an added dynamic to the building structure; the coloured areas provide rhythm. (photo: dbb)

Ideal conditions: The folds in the glass roof allow light into the long atrium. (photo: dbb)

OUTSTANDING EXAMPLES OF ECOLOGICAL CONSTRUCTION WITH

As a model project for ecological and innovative construction the new UBA administrative building in Dessau compares very favourably with the Gropius buildings in the vicinity. (photo: dbb)

Offices curving like a snake: the serpentine facade gives an added dynamic to the building structure; the coloured areas provide rhythm. (photo: dbb)

Ideal conditions: The folds in the glass roof allow light into the long atrium. (photo: dbb)

Enforcement and other tasks of the Federal Environment Agency

Involvement as the assessment authority in the enforcement of the Leaded Petrol Act (BzBlG).

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 wind farms in the sea.

Involvement in the approval process for water recovery treatment plants.

Membership of the Joint National Coastal Monitoring Committee (GAK).

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.

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

- German contact point (coordinating German involvement)
- German contact point for the areas of water quality, atmospheric emissions, inland waters, marine and coastal environment, soil, agriculture, climate change, chemicals, the environment and health, information systems, noise, spatial analyses and ground cover data, transport, waste and energy.
- Climate change sub-group of the European Thematic Centre for Air and Climate Change.

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

Involvement as an approval authority in the enforcement of 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.

National quality assurance agency for analytical marine data.

WHO cooperating centre for drinking water hygiene.

World Health Organisation (WHO) cooperating centre for monitoring air quality and combating atmospheric pollution.

National reference laboratory for the EU for monitoring atmospheric impurities.

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

Advisory board for soil investigations for the development and standardisation of methods.

Action Programme Environment and Health, office at the UBA.

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

Office of the Committee for for Health-related Evolution of Building Products (AgBB). Involvement in the enforcement of the Law on Protection against Infection: development of concepts for preventing, identifying and preventing the spread of water-borne diseases – § 40 IfSG.

Contact office for the Basel Convention. Approval authority for the transit of waste.

Body responsible for legal and technical supervision of the foundation Stiftung Elektro-Altgeräte Register (EAR) in accordance with § 18 Section 1 of the Act on Electrical and Electronic Equipment (ElektroG).

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 for the “Programme for promoting investment with a demonstrative character for reducing environmental pollution” in association with the KfW Förderbank (German Development Bank).

Support for the German Laender and German applicants for assistance under the European assistance programme LIFE-Environment (L´Instrument Financier pour l´Environnement) in accordance with a decision by the Conference of Ministers of the Environment.

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

Preparation of proposals for state of the art development in the implementation of European and international agreements (especially EU, UN, UN-ECE, HELCOM, OSPAR).

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 Existing Chemicals.

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

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

Receiving and assessing information about detergents and cleaning products in accordance with the Law on Detergents and Cleansing Agents.

Office for 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 environmental testing and testing of insecticides and disinfectants to determine their effectiveness in accordance with §18 of the Law on Epidemic Control.

Office of the Commission for Assessing Disinfestation Products and Procedures in accordance with § 18 of the Law on Epidemic Control 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 combined federal/state pool of data on materials (GSBL).

Enforcement authority in accordance with the Greenhouse Gas Emission Allowance Trading Law (TEHG) of 15 July 2004 and in accordance with the Act on Project-based Mechanisms under the Kyoto Protocol to the United Nations Framework Convention on Climate Change of 11 December 1997 (Project Mechanisms Act, ProMechG) of 30.09.2005.

Office of the Permanent Committee for Environmental Information Systems (StA UIS) of the Federal/State Working Group on Sustainable Development (BLAG NE)

DIVISION I "ENVIRONMENTAL PLANNING AND SUSTAINABLE STRATEGIES"

Shaping sustainable development – in Germany and internationally – is the common theme of this division and its four departments. This involves linking up environmental strategies and integrating them with other policy areas as sustainable development cannot succeed without a change in those sectors which are essential for the protection of people and the environment – for example, energy and climate protection, traffic and noise abatement, international environmental issues and regional planning. Division I formulates proposals for concepts and instruments in order to achieve the environmental quality targets which have been suggested by the Federal Environment Agency (UBA) and specified by policymakers. The effectiveness of the instruments is examined and developed with the help of, among other things, different scenarios. Ultimately, sustainable development can only be realised in cooperation with the global community of states. That is why coordination of the Federal Environment Agency's international cooperation comes within the division's remit.

The division's varied services can only be provided using a trans- and multidisciplinary working method involving the social and natural sciences, jurisprudence and engineering science – together with intensive in-house cooperation and the inclusion of external national and international partners. Product planning and the resulting research planning for the entire agency are based here. The implementation of any sustainability strategy depends very much on the acceptance of the goals and measures by society. The statutory duty of "Informing the Public about Environmental Issues" is another focal point. Public relations work is aimed at the general public as well as the experts.

For additional details about the division: http://www.umweltbundesamt.de/uba-info-e/e-fach1.htm

Department I 1 "Sustainability Strategies and Information"

Environmental information and environmental indicators – pointing the way for sustainable development

A policy for sustainable, i.e. lasting ecological, development in Germany was approved by the Federal Government in April 2002 and is aimed at achieving the fairest possible balance between the needs of those alive today and the prospects for future generations. The basic premise is to ensure that such a policy is environmentally, economically and socially viable and lasting. In other words: sustainable development means that we preserve a world for ourselves and for future generations which is worth living in, with greater equality between the poor and rich regions of this world.

It is clear that there are limits to the amounts of precious environmental and natural resources that can be consumed; they cannot be stretched without consequential damage to the environment. Nature imposes limits upon us. The Federal Environmental Agency's concept of sustainability is best portrayed by the image of a ship sailing in a channel marked by buoys. These buoys mark the limits of economic and social development which the ship may not cross if the natural basis for life for future generations is to be preserved.

Requirements for action can only be indicated, and an awareness of developments by social groups can only be achieved through the supply of regular, comprehensive and specific information to the public. With its environmental information, UBA contributes to an awareness of environmental problems and to a strengthening of environmental awareness in society, in order to encourage public commitment to the work of achieving sustainable development in Germany, in Europe and worldwide. Environmental information is one way of monitoring the success of sustainability policies, without which the various players in the public arena (in politics, the economy and in science) would have no voice and

would be unable to act. Providing information therefore has the same status as scientific work at the UBA.

Division I 1 “Sustainability Strategies and Information” passes on details about the UBA’s many scientific findings to the appropriate media. One example is the UBA’s internet service at www.umweltbundesamt.de. Since 2005, almost all of the agency’s scientific publications have been available free of charge, either in printed form or as electronic downloads. To enable unrestricted availability of environmental information for all users, the accessibility requirements, guaranteeing that people with disabilities also have access to the full range of information, have been observed and extended to all the agency’s websites since 2005. The department meets the agency’s statutory requirement to educate the public about the environment by publishing brochures, leaflets and posters and by presenting topical environmental themes at domestic and foreign trade fairs; in 2005 at the Environment in Abu Dhabi, at ENERTEC in Leipzig, at the Hanover Energy Trade Fair, at IFAT in Munich and at GTS in Bangkok. Moreover, the UBA’s Central Answering Service responds to questions on all kinds of environmental themes, from all sections of the population. There were 100,000 such queries in 2005.

The UBA assists the projects of NGOs (non-governmental organisations) which are active across Germany. In this way the agency supports extra-parliamentary environmental policy, helps to disseminate information about the environment and so improves the basis for environmentally relevant behaviour, as well as improving communication and cooperation between those involved in the protection of the environment. Funded by 3.2 million euros from the environmental budget, in 2005 the UBA supported 33 newly registered projects and 27 projects launched in previous years by environmental associations and other NGOs [35]. Assistance was provided for projects dealing with the new European chemicals policy (REACH) and fine dust, and for measures to strengthen “Local Agenda 21” processes.

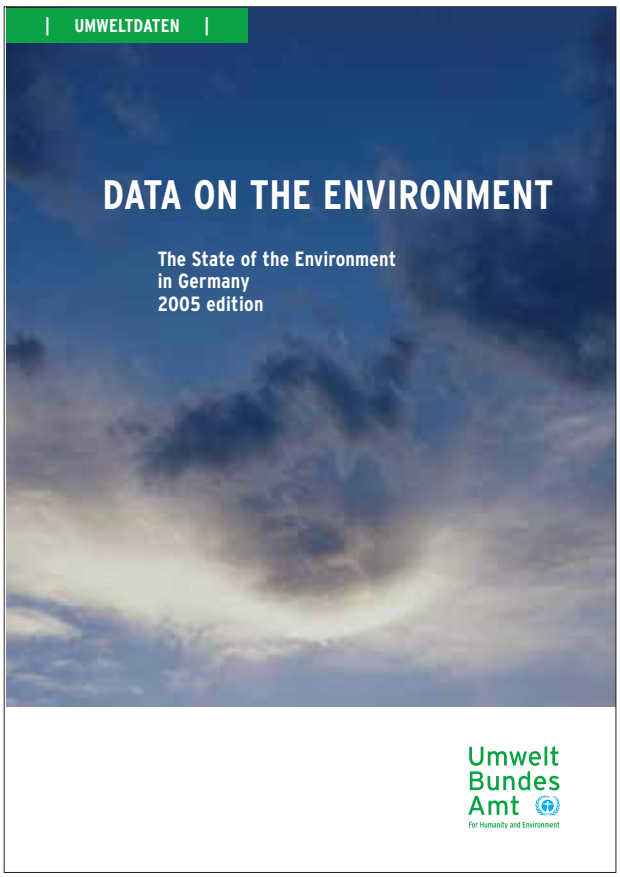
Photo: UBA

Represented at IFAT 2005 in Munich, the International Trade Fair for the Environment and Waste Disposal.

Environmental information at a glance

Environmental reporting pursuant to the EU Directive on Information 2003/4/EU and articles §§ 10, 11 of the Environmental Information Act are directed at the public and also at political decision-makers. It uses data from environmental monitoring and other statistics to record changes in the environment. The main threats to humans and the environment, as well as the role of major contributors to pollution, are backed up by data. This provides a close-up of the environmental situation and identifies in detail where action needs to be taken. The comprehensive reports include “Data on the Environment”, on the condition of the environment, which is published every four years, and the regular internet update ”Umweltdaten Deutschland Online” (Environmental Data Germany Online) (www.env-it.de/umweltdaten/). In particular the series of reports “Daten zur Umwelt” (Data on the Environment) pursues a policy of integrative reporting. The relationship is shown between the possible influences of social activities on changes in the condition of the environment and society’s reaction to risks to the environment, either by the introduction of measures or changes in habits.

Environmental indicators are highly aggregated identifying data which follow trends in important areas of environmental protection activity. They are a simple and transparent means of communication – most of all for environmental policy decision-makers, who have to identify and react to current situations. Examples of such indicators are the growth of primary energy consumption in Germany and the trends in carbon dioxide emissions over the last ten years. Indicators are at the centre of the German Sustainability Strategy, helping to monitor the success of political and social measures in pursuit of sustainable development in Germany. These indicators also present a picture of the developments in relevant areas of activity for the benefit of interested members of the public, to equip them for participation in environmental decision-making.



With the development of systems of indicators and the cultivation of important environmental indicators the UBA makes a substantial contribution to the effectiveness of these instruments for monitoring the German sustainability strategy. Environmentally relevant sustainability indicators are regularly published as an "environmental barometer" on the internet (www.umwelt-barometer.de). The "German Environmental Index" (DUX) aggregates the state of environmental political target acquisition and makes a statement about the trend as a time series. The "Umwelt-Kernindikatorensystem Deutschland" (System of Environmental Core Indicators in Germany) has extended the environmentally related part of the comprehensive approach to sustainability by introducing some 50 environmental indicators. These can be used by environmental policy decision-makers in order to closely follow whether Germany has made sufficient progress in environmental policy or whether increased efforts or a change of course are necessary. The System of Environmental Core Indicators reflects the four main themes of the sixth environmental activity programme of the European Community, which records all the resources to be protected, and which has made a substantial contribution to determining environmental policies in this decade:

- climate change,
- biodiversity, balance of nature and landscape,
- environment, health and quality of life as well as
- resource use and waste management.

These overriding issues are subdivided into 16 themes according to cause and effect – from the "Greenhouse Effect" to "Land Resources". The indicators have been chosen strictly according to Germany's environmental policy priorities and their compatibility with EU environmental indicators. As far as possible development trends are evaluated by comparing them with quantified environmental targets, for example, the percentage of renewable energy in primary energy consumption compared with the national target of a 4.2 per cent share by 2010. The targets described in German sustainability policies take precedence over other targets determined nationally or internationally.

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[35] For more information about assistance with projects: http://www.umweltbundesamt.de/projektfoerderungen/index.htm

Department I 2 "Environmental Protection Instruments"

Strategies for the economical development of settlements and infrastructure

Germany is rather liberal in its use of land, and many people consider this unwise. In December 2005 the Federal Statistical Office presented new figures for the increase in the areas used for settlements and traffic: from 2001 until 2004 this amounted to 115 hectares per day, mostly at the expense of arable land. The goal of the National Sustainability Strategy is to reduce Germany's consumption of land by 2020 to 30 hectares per day. To conserve land, protect the soil and limit the sealing and fragmentation of the landscape the UBA, in this case the Department I 2 "Environmental Protection Instruments", develops and implements a range of strategies, measures and

instruments. About half of all the land being used for settlements and traffic has been sealed. However, the consumption of land means more than just sealing it over. A vicious circle is created, consisting of urban sprawl, infrastructural development, traffic, environmental problems, the exodus from the cities and more settlements. In fact, in the final count, more land is sealed and traffic generated than with the compaction of existing building areas. Further consequences of urban sprawl are:

- landscape fragmentation and loss of biological diversity,
- impairment of the mesoclimate and of the water balance,
- the encouragement of production methods and lifestyles that make intensive use of transport, materials and energy.

Economic, social and urban development aspects of land consumption

Conserving land is imperative not only because of the need to protect the environment. It is also advisable for economic and social reasons: the loss of agricultural areas diminishes the options available for practical uses such as the production of biomass. In the case of urban sprawl, higher fixed costs per person for infrastructure, such as supply lines and transport, are incurred. Long distances disadvantage those people who cannot or do not want to use a private car. In the city short distances make it easier to reconcile the needs of the family with those of work.

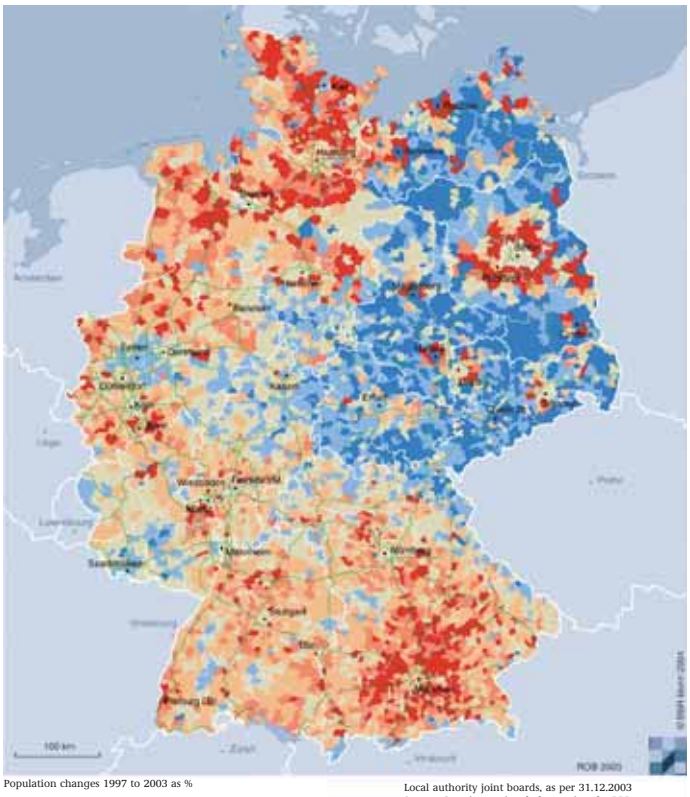
Competition between towns and municipalities for tax revenues can result in vacant lots and empty buildings, referred to sometimes rather ironically as “urban pastures”. Expulsion to the country does mean cheap building land and the ensuing increase in the demand for building land on greenfields makes it harder to develop urban centres. Land consumption also has social implications: the exodus of affluent households from towns to surrounding areas means that social segregation is very advanced in some urban areas, leading in particular to a weakening of the inner cities.

Demographic change: the impact on settlements and infrastructure

Germany is facing a difficult demographic situation. The proportion of older people is increasing, accompanied by a population decline in many regions, presenting regional planners with a number of new challenges. Apart from unoccupied buildings there are capacitive problems for the environmentally relevant infrastructure: water, energy and waste disposal, local public transport and local amenities. With fewer people, the demand for water and bus travel declines. As a consequence, in order to cut costs bus services are reduced or even withdrawn altogether. Those without cars are the ones who suffer. On the other hand, the water pipelines and sewage treatment plants still exist and have to be maintained. The operating and maintenance costs are shared by a diminishing number of users and water becomes more expensive.

A research project has been commissioned by the UBA to analyse the effects of demographic change on the quality of infrastructure, costs and the environment, and to develop recommenda-

Figure 5: Current population changes 1997 to 2003



Population changes 1997 to 2003 as %

less than -5.0	
-5.0 to less than -1.5	
-1.5 to less than 1.5	
1.5 to less than 5.0	
5.0 to less than 7.5	
7.5 and above	

Local authority joint boards, as per 31.12.2003
Source: Ongoing regional observations by BBR
Basis for data: Changing state of the population at federal and state level.
Note:
For improved comparability the data is showed at the level of local authorities and local authority joint boards (referred to as “Ämter” in Schleswig-Holstein, “Samtgemeinden in Lower Saxony, “Verbandsgemeinden” in Rheinland-Pfalz, “Verwaltungsgemeinschaften” in Baden-Württemberg). The term used here is “Verbandsgemeinden”

Source: BBR (2005): Regional Planning Report 2005, Reports Vol. 21; Bonn; p. 31

tions for action. The results are expected at the end of 2006 [36].

Costs and benefits of settlement development and new approaches to the recycling of derelict land

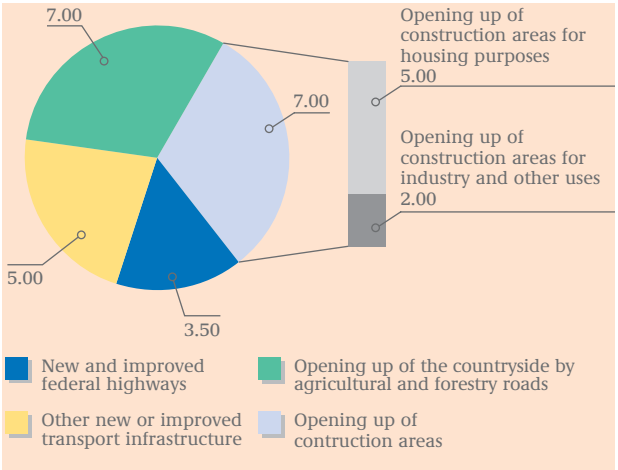
One approach to limiting the sealing of new land is to return brownfields or other derelict sites, for example, former military or railway land, to the economic cycle. Besides its own assessments of the relevant publications the UBA has commissioned research projects to examine why municipalities, private households and investors favour new out-of-town plots despite the very high subsequent costs, and what the obstacles are to inner-city development. In cooperation with Deutsche Bahn AG, a more in-depth analysis will be made of selected regional property markets. The goal is to optimise strategies, measures and instruments for inner-city development. Particular attention is given to the economic incentives for those concerned, with municipal financing playing an important role. The initial results will be presented in autumn 2006 [37, 38, 39].

Assistance for regional economic structures

The aim of "structural assistance" is to strengthen economic growth in economically weak regions. Assistance programmes tend to concentrate on investment in construction and generally do not devote enough attention to environmental aspects. Furthermore, assistance for new industrial zones or supra-regional transport infrastructure leads to high levels of land consumption and additional environmental pollution.

Taking the federal/state cooperative scheme "Improving the Regional Economic Structure" as an example, the UBA has commissioned research into how German regional policies can incorporate environmental protection criteria in the future. The study identifies approaches for reforms which, in the future, will give more weight to environmental requirements. Environmentally relevant criteria will be applied as a condition for granting the highest rate of financial support, in particular in relation to land consumption, the purpose being to provide economic incentives for the utilisation of industrial zones which do not use much land or which make use of derelict settlement areas. The UBA believes that regional economic assistance should rather increase the subsidies for regional innovation, for example, with educational programmes, instead of promoting building infrastructure [40].

Figure 6: Area newly occupied by transport infrastructure 2001–2004 (hectares per day)



Source: Federal Statistics Office, 2005

Integrated management of coastal zones

Economic and settlement activities as well as infrastructural measures on land and at sea, for example wind farms, extensions to harbours or tourism, could endanger the coastal environment. Therefore, with the help of regional management, the protection and development of natural resources and natural landscapes are to be harmonised with social and economic requirements.

The basis for coordinated action, including cross-border activity, is provided by the recommendation of the European Parliament and Council of 31 May 2002, for Integrated Coastal Zone Management (ICZM). The Member States are required to present the results of a survey, develop steps for a national strategy and report on their implementation. Under the direction of the Federal Environment Ministry a strategy for ICZM in Germany was drawn up, which the UBA successfully prepared in the form of a research project.

For additional information: www.ikzm-strategie.de

Strategic environmental assessment and spatial planning legislation

Since 2004, when specific plans and programmes are being drawn up, their foreseeable effects must be described in a strategic environmental assessment, in the form of an environmental report. This has been specified by German legislation in accordance with the Directive 2001/42/EU of the European Union. If a plan or programme includes several projects, their effects on the environment are to be considered within the overall context, for example, with regard to landscape fragmentation. In collaboration with the Federal Agency for Nature Conservation, the UBA is preparing indicators to evaluate landscape fragmentation by traffic routes, as well as targets and actions intended to limit such fragmentation.

In addition, with the stricter regulations on soil protection in the regulations on town planning, the federal legislation tries to enforce inner development. The UBA is currently researching additional approaches intended to strengthen the legal framework of planning. It would make sense to re-adjust planning considerations, placing a greater emphasis on environmental requirements, giving priority to inner development as well as assigning more powers to supra-local planning authorities and regional policy and to the provisions for intervening under the terms of the nature conservation legislation [41].

Economic instruments

Research projects commissioned by the UBA are also examining the potential of selected economic instruments in order to conserve land, which are currently being discussed by experts. Model calculations show that levies on the sealing on new areas could contribute effectively to land conservation. In the case of new building land, the levies to be paid would be determined according to the newly sealed or settled areas. As an alternative to a real estate transfer tax they would not impose additional burdens on the national economy [42].

Another innovative instrument would be a binding ceiling on the annual consumption of land in Germany, and on trading in land quotas – similar to emissions trading for greenhouse gases. The main partners in the trade in land quotas would be the municipalities. Such a system can effectively limit urban sprawl because development takes place where it creates the most benefits. A study commissioned by the UBA developed the basis for a Germany-wide trading model, taking into consideration the economic, social and environmental conditions as well as its compatibility with our legal system [43].

Additional activities

The conservation of land for agriculture is essential for sustainable development. The UBA has collaborated with the Federal Agency for Nature Conservation, environmental and nature conservation associations, as well as the German Farmers' Association, on a policy paper with recommendations for the conservation of agricultural land [44]. Additionally, a research project commissioned by the UBA will examine what potential agricultural land there is available for the cultivation of biomass serving as raw materials for industrial production and how this can be used in a sustainable way [45].

The UBA is closely involved in the research programme of the Federal Ministry of Education and Research (BMBF), which focuses on "Reducing the pressures on land and the sustainable management of land", known by the acronym (REFINA). The UBA evaluates the results in terms of their value as practical examples, measure and instruments which can be applied throughout the country.

Additional information about REFINA:
http://www.bmbf.de/foerderungen/3162.php

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Sources:

[36] F+E-Vorhaben Nr. 205 16 100 „Soziodemographischer Wandel in Städten und Regionen – Entwicklungsstrategien aus Umweltsicht“ (R+D Projects No. 205 16 100 “Socio-demographic Change in Cities and Regions – Development Strategies from the Environmental Aspect”)

[37] F+E-Vorhaben Nr. 293 16 123/02 „Von der Außen- zur Innenentwicklung von Städten und Gemeinden“ (R+D Projects No. 293 16 123/02 “From the Greenfield to Inner-city Development of Cities and Communities”)

[38] F+E-Vorhaben Nr. 205 77 252 „Nachhaltiges regionales Flächenressourcenmanagement am Beispiel von Brachflächen der Deutschen Bahn AG – Integration von Flächen in den Wirtschaftskreislauf“ (R+D Projects No. 205 77 252 “Sustainable Regional Land Resource Management Using Derelict Deutsche Bahn AG Land as an Example – Integration of Land in the Economic Cycle”)

[39] Evaluation by the Federal Environment Agency of Publications “Wirtschaftlichkeit kommunaler Wohn- und Gewerbegebiets-erschließungen“ (Economic Efficiency of Municipal Provision of Infrastructure for Housing and Industrial Areas“), Berlin 2006

[40] F+E-Vorhaben Nr. 203 11 109 „Förderung nachhaltigen Wirtschaftens durch ökonomische Instrumente – Kurzfristige Reformmöglichkeiten im bestehenden Rahmen der Gemeinschaftsaufgabe (GA) des Bundes und der Länder ‚Verbesserung der regionalen Wirtschaftsstruktur unter Flächenaspekten‘“ (R+D Projects No. 203 11 109 “Assistance for Sustainable Management by means of Economic Instruments – Short-term Possibilities for Reform with the Framework of the Common Task of the Federation and the States ’Improving the Regional Economic Structure Taking Land Aspects into Consideration’”)

[41] F+E-Vorhaben Nr. 293 16 123/01 „Rechtliche Analyse der Defizite des raumbezogenen Planungsrechts“ (R+D Projects No. 293 16 123/01 “Legal Analysis of the Deficits in Spatially-Oriented Planning Law”)

[42] F+E-Vorhaben Nr. 203 11 109 „Förderung nachhaltigen Wirtschaftens durch ökonomische Instrumente – Nachhaltigkeitspotenziale einer Steuer auf Neuversiegelung/-besiedelung“ (R+D Projects No. 203 11 109 “Assistance for Sustainable Management by Means of Economic Instruments – Sustainability Potential of Taxes on Newly Sealed Land/New Settlements”)

[43] F+E-Vorhaben Nr. 293 16 123/03 „Gestaltung eines Modells handelbarer Flächenausweisungskontingente unter Berücksichtigung ökologischer, ökonomischer rechtlicher und sozialer Aspekte“ (R+D Projects No. 293 16 123/03 “Structure of a Model for Negotiable Land Expansion Quotas Taking Ecological, Economic, Legal and Social Aspects into Consideration”)

[44] Position Paper on the Reduction in the Land Area Required for Settlements and Traffic “Entsiegelung bei Neuversiegelung – Eingriffsregelung optimiert anwenden: Gemeinsame Forderungen aus Landwirtschaft und Naturschutz“ (De-sealing in the Course of Sealing of New Land – Optimised Application of Intervention Rules: Shared Requirements of Agriculture and Nature Conservation), is available at: http://www.bauernverband.de/media/Positionspapier_Flaechenverbrauch.pdf

[45] F+E-Vorhaben Nr. 205 93 153 „Optionen einer nachhaltigen Flächennutzung und Ressourcenschutzstrategien unter besonderer Berücksichtigung der nachhaltigen Versorgung mit nachwachsenden Rohstoffen“ (R+D Projects No. 205 93 153 “Options for Sustainable Land Use and Strategies for Protecting Resources Taking into Particular Account the Sustainable Supply of Renewable Raw Materials”)

Department I 3 "Transport, Noise"

Sustainable Mobility

Although mobility and traffic are often used synonymously, they do in fact indicate two different things. Mobility is an important characteristic of the quality of life and of a functioning economy. Spatial mobility is the ability to move people or products for a certain purpose from one place to another. Mobility is a complex process, dependent on many factors, for example, the purpose of the mobility, what the destination can offer (shopping and leisure amenities), the choice of the form of transport and the route.

Mobility cannot therefore be equated with traffic because the same mobility can entail varying amounts of traffic: urban dwellers can reach many destinations with a minimum of transport. If you have regional customers for your products, there is no need to transport the products very far. Those who use a car for short journeys, instead of going on foot, create motorised traffic. The relationship between mobility and traffic is, to a large extent, dependent on the conditions which we create in everyday life and production, and on our ability to satisfy the need for mobility with a minimum of traffic and environmental pollution.

Road traffic is increasing and with it the amount of land that is being used up.

What is sustainable mobility?

In 1996, the Organisation for Economic Cooperation and Development (OECD) defined the term sustainable mobility as follows: "Sustainable mobility satisfies the need for social contacts and communication and makes access to goods and services possible without endangering the health of human beings or threatening the ecosystem. Renewable resources should not be consumed faster than they can be regenerated, and non-renewable resources should not be consumed faster than the rate at which substitute renewable sources can be exploited. The work of Department I 3 "Transport, Noise" of the Federal Environment Agency is orientated on this definition.

Maintaining mobility, reducing traffic

Sustainable mobility means harmonising economic performance and social safety with the long-term preservation of the natural basis for life. The most pressing goals of the strategy are:

- decoupling the growth of traffic from economic expansion and, as far as possible, avoiding certain traffic services;
- using and networking environmentally friendly and efficient transportation services and assisting the change to environmentally friendly means of transport;
- using technology to optimise the environmental friendliness and efficient exploitation of the resources of a transport service, and operating such a service in a way that causes the minimum environmental pollution;
- operating transport systems within a framework of fair competition, which also means factoring in the real costs (including environmental costs).

In these respects the multiple activities of the "Transport, Noise" Department are directed at today's society and the prospects for the lives of future generations. The following paragraphs include some examples.

Reducing the need for traffic

What generates traffic? The UBA looked into this before it developed traffic reduction measures. In past decades the expansion of settlement areas,

the increase in interlinked trade networks, changing lifestyles and the development of the transport infrastructure have considerably influenced the increase in traffic. Thus, measures which will have an effect on these determinants can influence the extent of the need for traffic. Limiting new settlement areas, for example, giving preference to building on existing sites in towns, instead of on greenfield sites, can result in shorter journeys to work or for shopping. Towns combining a mix of work places, restaurants, culture and sporting amenities provide good conditions for keeping journeys to a minimum.

Attractive possibilities for holidays in Germany and Europe could to some extent counteract the trend for travelling to ever more distant destinations. The possibilities of modern logistics have by no means been fully exploited for goods traffic, due to some extent to the low cost of transport. In individual cases, product-based management of industrial areas should enable the long distances between the various production stages to be eliminated.

The expansion of routes also contributes to the growth of traffic. This reduces goods transport costs, whereas savings in passenger transport times often result in the creation of more traffic. Experience shows that in many cases the hoped for increase in economic performance as a result of infrastructural expansion fails to materialise [46].

Encouraging less environmentally damaging forms of transport

Local public transport by bus and train in Germany takes the strain off the environment and is essential for our culture of mobility and daily life. Mobility in all sections of society depends on more efficient public transport, which also adds to the quality of urban life. It makes a considerable difference to a townscape and contributes to the identity of a municipality. Attractive local passenger services are the lifelines of a metropolis.

The UBA has prepared recommendations for action which can be put into practice in municipalities, giving the responsible municipal authorities and transport companies the concrete means of preparing for regulated competition in a liberalised European transport market. Strict environmental and quality standards will play an important role in ensuring and expanding the environmental benefits of local passenger services. The

Usually the quickest way of getting around town – the bicycle.

recommended action includes the legal framework, the way in which the bodies responsible for these tasks are organised, local traffic planning, the invitation of tenders and the award and form of the contracts, environmental standards and quality management as well as the relevant standards [47].

Walking and cycling are particularly eco-friendly and healthy. Model projects show how towns and local authorities can improve pedestrian and bicycle traffic. Lingen in Emsland, Plauen in Saxony and Luther's home town of Wittenberg in Saxony-Anhalt are excellent examples of how this can be done. As part of the project "Pedestrian- and Bicycle-Friendly Towns" these three urban models have developed simple and economical concepts enabling the successful establishment of pedestrian and bicycle traffic. Five points are decisive for encouraging pedestrian and bicycle traffic in these three urban models:

- the continuous flow of information between the parties concerned,
- the direct involvement of the public as well as social groups on advisory boards,
- cross-departmental cooperation between the responsible administrative bodies,
- accompanying quality management as well as
- continuous press and public relations work [48].

Improving the efficiency of transport services

The traffic sector accounted for 32 per cent of the total energy consumption of the Member States of the European Union in 2003 and the EU has predicted further growth in the coming years. Transport must be made more energy-efficient if it is to counteract the continuous increase in the amount of energy consumed by traffic, and the environmentally harmful carbon dioxide (CO_2) emissions. It is against this background that the ancillary working group of the "Joint Expert Group on Transport and the Environment" of the European Commission, under the auspices of the UBA, has produced a report on the theme "Reduction of Energy Consumption in Traffic". This report

- shows the potential of various measures for reducing the energy consumed by traffic,
- evaluates the savings produced by measures which have already been implemented,
- identifies the synergy effects between the reduction of energy consumption and other policy areas (for example, health, finance etc.),
- names examples of best practice,
- identifies the best possibilities for action at the EU level and
- suggests courses of action [49].

The establishment of international directives, including specific limits on the emissions from aircraft engines, are essential if technical improvements are to be introduced to increase energy efficiency in aviation. The environmental unit of the International Civil Aviation Organisation (ICAO), and the Committee on Aviation Environmental Protection (CAEP) in which the UBA has participated for years, are the responsible bodies. Their work focuses on the technical aspects of reducing emissions as well as the effects and the costs involved. The UBA has commissioned several studies into the structure of limiting values and emissions trading in air traffic and these findings have also been included in the debate [50].

Noise is another frequently underestimated effect of traffic on the environment. In fact road traffic is the greatest source of noise in Germany and its effects are manifold, leading to an increased risk of heart attack as well as disturbing sleep, communication and relaxation.

Surveys show that more than half the population feels stressed by road traffic noise. Noise-Noise road surfaces are ideal for reducing noise because they can be used almost everywhere, tackling noise exposure at its source. A considerable reduction in noise levels can be achieved with the new generation of double-layered, open-pored asphalt surfaces.

The effects of this significant noise reduction were recorded in analyses carried out on a federal highway in a built-up area, and the local residents were also involved. The findings: a reduction in the levels of noise to which the residents were exposed, an improvement in the conditions for communication and less interrupted sleep at night [51].

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Sources:

[46] The report "Determinanten der Verkehrsentstehung" (Determining Factors in the Formation of Traffic) (UBA-TEXTE 26/05) can be downloaded from:
http://www.umweltdaten.de/publikationen/fpdf-l/2967.pdf (German version) and from
http://www.umweltdaten.de/publikationen/fpdf-l/2990.pdf (English version)

[47] A handbook "Handlungsempfehlungen für einen umweltfreundlichen, attraktiven und leistungsfähigen ÖPNV" (Recommendations for environmentally friendly, attractive and efficient public transport) can be downloaded from:

http://www.umweltbundesamt.de/verkehr/index.htm

[48] The report "Fussgänger- und fahrradfreundliche Stadt. Chancen des Fuß- und Radverkehrs als Beitrag zur Umweltentlastung" (Pedestrian- and bicycle-friendly cities. Opportunities for pedestrians and cyclists to help reduce environmental pollution) (UBA-TEXTE 28/05) can be downloaded from: http://www.umweltbundesamt.de/fufs/modell.htm

[49] The final report "Working Group on the Reduction of Energy Use in Transport" can be downloaded from: http://www.umweltbundesamt.de/verkehr/downloads/reduction-energy-use-transport.pdf

[50] The latest studies can be downloaded from: http://www.umweltbundesamt.de/verkehr/index.htm

[51] The study "Lärmwirkungen von Straßenverkehrsgeräuschen. Auswirkungen eines lärmarmen Fahrbahnbelags" (The effects of noise produced by traffic. Effects of a low-noise road surface) can be downloaded from: http://www.umweltdaten.de/publikationen/fpdf-l/3047.pdf

Department I 4 "Climate Protection, Environment and Energy "

The Kyoto Protocol – how is the UBA working on its implementation?

An important international agreement on climate protection has entered into force in February 2005. The Kyoto Protocol, named after the Japanese city in which it was passed, came into effect after years of negotiation and ratification processes. It commits Germany to the demanding goal of reducing emissions of gases which damage the climate, known as greenhouse gases, by 21 per cent between 2008 and 2012, in comparison to the base year levels.

When the international agreement formally took effect it initiated wide-ranging activities at the UBA and most of all in Department I 4 "Climate Protection, Environment and Energy", which produces statistics, compares data from various years and, equally importantly, suggestes how Germany could achieve its climate protection goals.

What is a greenhouse gas inventory?

The Kyoto Protocol requires its signatory states to demonstrate their progress in reducing emissions of the six Kyoto greenhouse gases. For this purpose the UBA compiles the German Greenhouse Gas Inventory each year and reports it back to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and the European Commission [52].

National greenhouse gas inventories must meet certain quality requirements and criteria, for example, they must be internationally comparable. States should, to a large extent, achieve pollution control by means of domestic measures in order to show how climate protection is possible in a modern economy. Beyond that the Kyoto Protocol offers possibilities for using so-called flexibility mechanisms in order to reduce emissions. The flexibility mechanisms provided under the Kyoto Protocol take the form of emissions trading, Joint Implementation Projects between industrial states, which will lead to a reduction in greenhouse gas emissions, and the Clean Development Mechanism. The latter credits projects between industrialised and developing or threshold countries to reduce greenhouse gases, and apart from the environment they also consider sustainable development aspects. The quality of the greenhouse gas inventory is one of the most important factors that determine whether a country is permitted to apply these flexible mechanisms, which often lead to a cost efficient-reduction in greenhouse gases. For this reason, in recent years, the UBA has worked intensively to improve and safeguard the quality of the inventory.

What are the "assigned amounts"?

The year 2006 is significant for the implementation of the Kyoto Protocol. The countries involved, and the UNFCCC Secretariat, have stipulated the reduction in tonnes of CO_2 equivalents during the period 2008 to 2012 in comparison with the base year in order to fulfil the commitment to reduce the specified percentage of emissions. The UBA has already calculated these assigned amounts for Germany and has presented them to the United Nations for scrutiny. Once they have been reviewed and defined, the assigned amounts may not be changed and are valid for the entire commitment period.

If the UNFCCC Secretariat has doubts about any of the details given by any country it can adjust them and substantiate them with factors. If the

Important terms used in the Kyoto Protocol

Greenhouse gas emissions: Emissions are pollutant levels in the atmosphere which are caused by human activity (anthropogenic) and which result from, for example, combustion processes. The Kyoto Protocol identifies the gases carbon dioxide (CO_2), methane, nitrous oxide and the so-called F-gases (HFC, PFC, SF_6), which all have a damaging effect on the climate.

Carbon dioxide (CO_2) **equivalents**: Not all greenhouse gases have an equally strong effect. For example, one tonne of emitted methane increases the greenhouse effect 21 times more than an equivalent amount of carbon dioxide. The latter, however, is the greenhouse gas with the highest emission levels. In order to standardise the assessment of Global Warming Potential (GWP) the greenhouse effect of greenhouse gases is converted to that of CO_2 (GWP of CO_2 = 1) and termed a CO_2 equivalent.

The **base year** of the Kyoto Protocol is the reference point from which pollution control is to be implemented. For CO_2, methane, and nitrous oxide it is 1990 and for the F-gases Germany chose to use 1995.

Measured against the base year, the signatory states must cut their emissions by the end of the **commitment period**, i.e. between 2008 and 2012, at the latest.

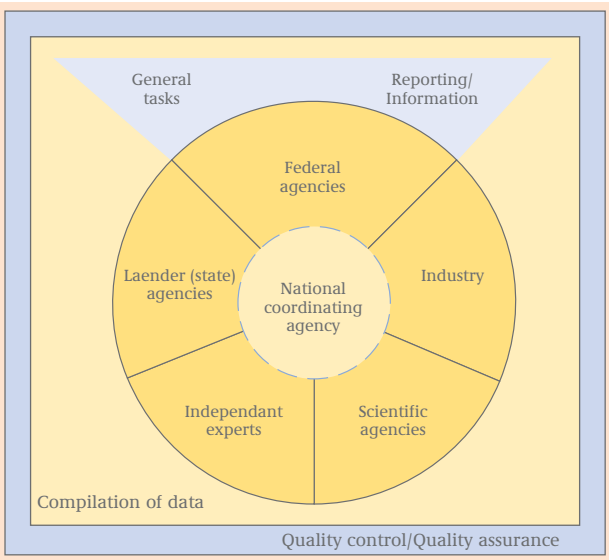
The scenarios use model calculations to analyse the future development of emissions under different framework conditions. These include the various climate protection policy measures which have already been implemented, as well as changes in the prices of energy and other raw materials. Such calculations can help the German government to identify the need to implement additional measures and to choose between different possible measures in order to attain the Kyoto targets.

details about the emissions from industrial processes do not meet the requirements, the Climate Secretariat can adjust them and offset them against pollutant-specific factors. Thus such a factor for methane for the base year would reduce the adjusted methane emissions in industrial processes by 73 per cent. For this reason the UBA takes particularly care in its investigation of base year data, taking into account that, because of the unification of Germany, the data situation for the year 1990 is complicated and not always complete.

What is the National Greenhouse Gas Inventories System?

The Kyoto Protocol requires that all its signatories establish a so-called national system by the end of 2006. The national system (see diagram) should provide all the necessary institutional and procedural arrangements for reporting on emissions. The UBA began setting up a national system in 2003. Its core is the Single National Entity at the UBA. It collects and checks the data submitted by the agency's other departments, other authorities and institutions as well as related organisations, adding them to the greenhouse gas inventory and the inventory report. The Federal Environment Ministry, together with the UBA and contracted researchers, has drawn up a climate protection statistics law. This law shall provide the necessary legal and institutional framework of conditions for the national system and contains regulations which will ensure long-term access to data, quality of data, punctuality in submitting data as well as data confindentiality. Linking up with the existing data flow should then enable any initial gaps in data to be filled. The draft law is currently undergoing approval at departmental level.

Figure 7: The national system – tasks and participating institutions



The national system

is intended to involve all agencies of the state in compiling the emissions inventories. This could make an substantial contribution in a technical sense to such an emissions inventory

How does the Federal Environment Agency register energy-induced CO_2 emissions?

Because they account for a high proportion, more than 80 per cent of all CO_2 emissions in Germany, those resulting from the conversion and use of energy are of particular importance. CO_2 produced by the combustion of the fossil fuels coal, gas and oil can be calculated according to the carbon content of the fuel in question. The so-called emission factor indicates how many grams of CO_2 result from the combustion of any specific quantity of fossil fuel used. The amount of the various fossil energy source materials consumed within a year, for example in power plants used to generate electricity or heat, in industry, as motor fuel in transport, or in households, is established by the UBA on the basis of various energy statistics such as those of the Energy Balance of Germany, which provides a comprehensive picture of energy consumption and flows of energy in Germany, statistics from the Federal Statistical Office, and the UBA's own calculations.

Figure 8 shows how energy-related emissions in Germany have developed over the past 15 years. Because of the economic changes which have taken place in the new Laender, resulting in the widespread closure of antiquated industrial and power plants, as well as a change in the primary fuel mix, the UBA recorded a sharp fall in the emissions by the energy and industrial sectors, particularly in the early 'nineties. Renewable energy, in particular water, wind and biomass, also make a very important contribution to pollution control.

What is the situation today?

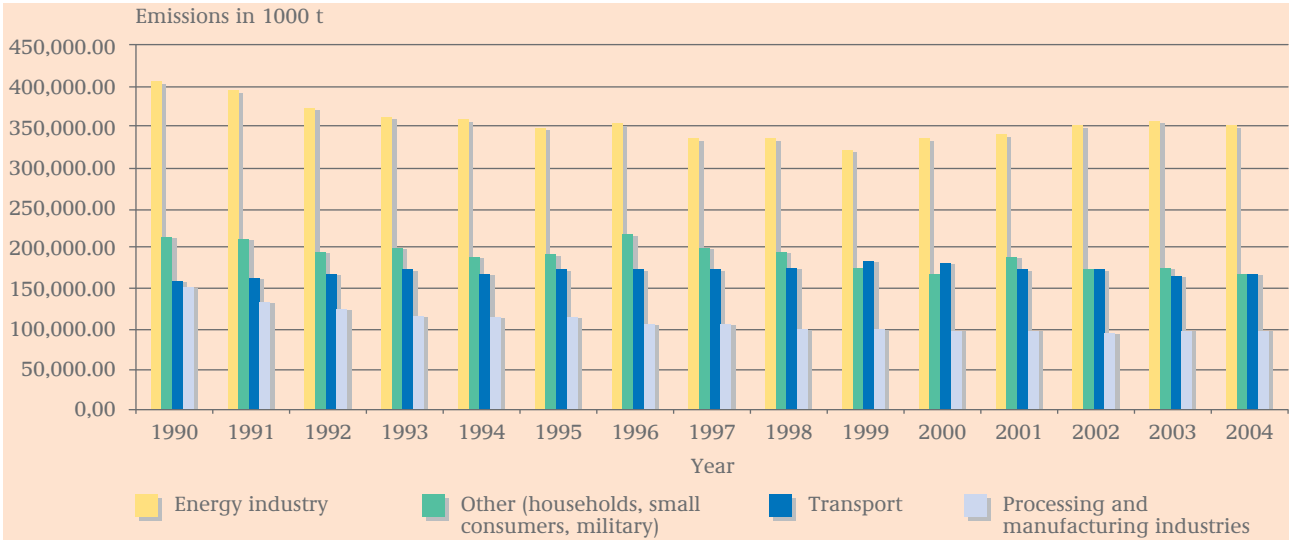
For 2004, the UBA calculated an emission of around 1,015 million tonnes of CO_2 equivalents, 17.4 per cent less than in 1990. In order to achieve the Kyoto target of a 21 per cent reduction in emissions by 2008–2012 compared with 1990, there must be further reductions in Germany, requiring additional action on climate protection. The information from the greenhouse gas inventory is an important basis for assessing the effectiveness of measures which have already been implemented as well as for considering the introduction of further measures.

Thinking ahead post-2012

The Kyoto Protocol requires that we consider the future beyond the regulated period up to 2012. At regular intervals the signatory countries must estimate how their emission levels may develop in the future. UBA scenarios show that, based on policies and measures which have currently been agreed, emissions will not decline any further between now and 2030. Only a consistent and continued development of climate policy will enable Germany to retain its international position as a pioneer in climate protection.

At the 11th session of the Conference of Parties to the UN Framework Convention on Climate Change in Montreal in December 2005, additional negotiations about further commitments post-2012, within the framework of the Kyoto Protocol, were initiated, as well as a more comprehensive dialogue about further action under the Framework Convention on Climate Change. Fur-

Figure 8: Development of CO_2 emissions resulting from energy production



Source: Federal Environment Agency, 2006

ther development of the international climate regime will depend greatly on the leading role of the European Union (EU) and Germany. The UBA is intensively involved in the EU through several expert groups, and is represented on the German negotiating team. For post-2012 the UBA has produced studies on the possible evolution of international climate policy agreements, as a contribution to the development of the German and the European position. The success of the negotiations is, in the opinion of the UBA, dependent on the extent to which economically advanced countries, including the USA as the largest source of greenhouse gas emissions and some developing countries, can be persuaded to reduce or control their output of these gases. How carbon sequestration in forests and in the soil, so-called sinks and limits to deforestation, especially in developing countries, are addressed in the future, are other important topics.

What are the objectives of the UBA's environmental activities for protecting the climate?

With its "21 Climate Policy Statements for the 21st Century" the UBA proposes a number of national and international goals in pursuit of environmental quality and for environmental action [53]. The objective of limiting the rise in global temperatures to two degrees Celsius by the end of the 21st century is intended to serve as a guideline for climate protection. To achieve this, worldwide greenhouse gas emissions must be roughly halved by mid-century. Germany's greenhouse gas emissions – like those of other industrialised countries – must be reduced by a minimum of 80 per cent by 2050, compared with 1990, to allow developing countries sufficient leeway for their own economic development.

How Germany can achieve the proposed objective for environmental action – reducing greenhouse gas emissions by 80 per cent by 2050 – is also described in "21 Climate ...". The necessary policies and measures cover such areas as energy conservation, transport and the development of renewable energy. The target for reducing emissions is set very high but it is achievable, without adversely affecting economic development. In contrast, the costs of neglecting climate protection are much higher than those of timely prevention and action.

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Sources:

[52] Additional information about the National Greenhouse Gases Inventory and the report "Deutsches Treibhausgasinventar und Nationaler Inventarbericht zum Deutschen Treibhausgasinventar 1990–2004" (German Greenhouse Gas Inventory and the National Inventory Report for the German Greenhouse Gas Inventory 1990–2004) can be downloaded from:
http://www.umweltbundesamt.de/emissionen/publikationen.htm

[53] Abridged and full versions of the climate protection concept "Die Zukunft in unseren Händen – 21 Thesen zur Klimaschutzpolitik des 21. Jahrhunderts und ihre Begründungen" (The Future in our Hands – 21 Climate Policy Statements for the 21st Century and the reasons for them) and other details about climate protection can be downloaded from:
http://www.umweltbundesamt.de/klimaschutz/index.htm

DIVISION II "ENVIRONMENTAL HEALTH AND PROTECTION OF ECOSYSTEMS"

This division develops concepts for environmental and health protection. In keeping with the agency's motto "For people and the environment", specialists in the five departments determine the extent of pollution in water, soil, air, drinking water and humans. They identify environmental influences on human health as well as changes in the ecosystem and in regional biodiversity. To protect human beings, plants and animals, the division assesses the hazards and develops quality goals and classification methods, which provide the basis for assessing the state of the environment. This involves not only identifying whether legally binding limit values are being adhered to in Germany but also the identification of new hazards and trends. Only in this way can environmental policy measures be developed before it is too late.

To assess the condition of the environment, the Federal Environment Agency (UBA) collects data itself (Air Pollution Monitoring Network, Environmental Specimen Bank). Other monitoring bodies provide additional data. The departments use these data to determine the actual condition of the ecosystem and to assess it in comparison with legally binding environmental targets. The agency reports the data and assessment results to political and scientific bodies and to the public at the national and international level.

The health aspects of environmental protection have increasingly come in public focus in recent years. Within the UBA and in cooperation with other institutions, such as those grouped in the Environment and Health Action Programmes (APUG), the division is working to more effectively link the requirements for the protection of both, the environment and health, creating synergies by such integration. These activities include advising the Laender and municipalities, and publishing brochures for the general public on the field of "Environment and Health".

For additional information about the division: http://www.umweltbundesamt.de/uba-info-e/-fach2.htm

Department II 1 "Environmental Hygiene"

Fungal mould in buildings

The occurrence of mould in enclosed spaces has been a problem for a long time. Mould can cause allergies and asthma in sensitive people. In recent years there has been a steady increase in the number of enquiries received by the UBA on this matter from the public. However, it is unclear whether the number of dwellings affected by mould has increased or only the number of complaints.

In its first guide, published in 2002, the UBA gave detailed recommendations for identifying and assessing mould in indoor environments. The information brochure "Hilfe! Schimmel im Haus" (Help! There's mould in the house) is also specifically intended to inform consumers [54]. Controlling mould is also a main theme of the Environment and Health Action Programmes jointly run by the Federal Ministries of Health, the Environment and Consumer Protection. Several research projects help improve the basis for identifying and assessing mould. The results of these projects have facilitated a standardised assessment of mould [55]. With its "Housing and Health" pro-

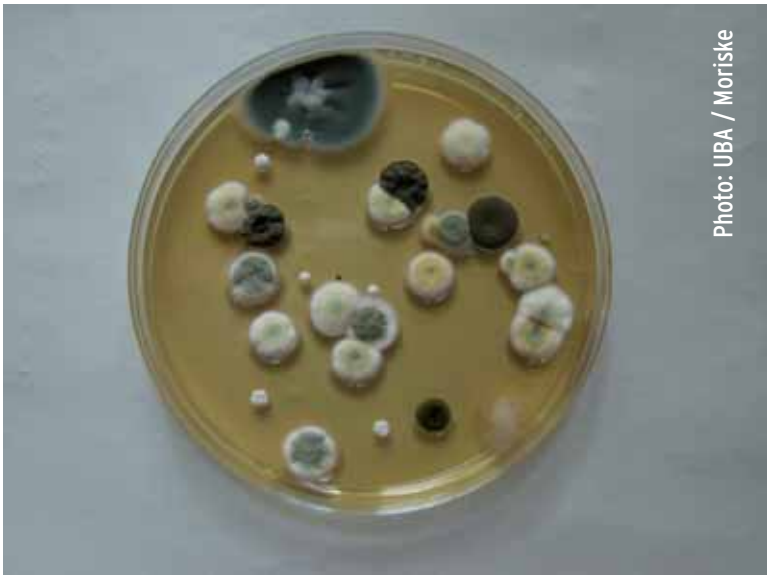

Photo: UBA / Moriske

Fungal mould prefers high levels of humidity in the air and in materials.

gramme the World Health Organisation (WHO) also regards mould as an important problem in indoor environments [56].

Humidity is the problem

Mould can grow in any damp place. An increase in humidity in an apartment can be the result of burst pipes, construction defects such as leaks, thermal bridges or a lack of horizontal barriers, and water vapour, e.g. from kitchen. Repairing construction defects in buildings and removing humidity for the indoor space are important prerequisites for preventing the mould growth. Correct heating and ventilation are also important. Ways of preventing and avoiding the damage caused by moisture were discussed by experts from academia and practice at the "Workshop on Humidity in Housing" jointly held by the University of Jena and the UBA in December 2005.

In principle ventilation by opening windows is sufficient to prevent an increase in humidity and any resulting mould. Opening one or more windows wide for five to ten minutes to achieve a rapid exchange of air is the preferred method of removing water vapour from the home. Present-day lifestyles and frequent work-induced absences mean that ventilation via open windows is not always carried out as it should be. Built-in ventilation systems can therefore offer an effective solution, especially for buildings constructed in an air tight way to conserve energy.

However such systems require regular maintenance and checks to prevent the growth of microbial agents. In the course of the workshop it became clear that even among specialists there is insufficient information on the relationship between ventilation planning, humidity and mould growth. There is obviously a need for improving information in this area.

Mould control and removal– what should be done?

How to remediate was the central question of many of the enquiries about mould infestation which the UBA received in 2005. This question was also one of the main features of the 12th "WaBoLu-Innenraumtage" (Annual Conference on the Indoor Environment), which was held at the UBA in May 2005. Participants discussed correct ventilation methods and construction work intended to prevent mould, and presented cases and appropriate solutions based on practical experience [57]. The Guidelines for Remediation of Mould-affected Buildings are an ideal source of information for anyone affected by this problem. These guidelines were developed by the UBA's Indoor Air Hygiene Commission and published by the UBA in the autumn of 2005 [58]. The following recommendations apply:

1. The first thing to be done in the case of mould is to identify and eliminate the cause. In most cases this requires professional help. A permanent solution to the problem is not possible without eliminating the causes of the problem.

2. Mould should be removed from affected areas using methods which cause as little dust as possible to be produced. Merely destroying the spores is not enough, because dead spores can also have allergic effects.

3. If the mould-affected area is not larger than half a square metre with the mould obviously only at the surface the residents can act themselves to some extent. Affected areas should be wiped with a damp cloth, which should then be disposed via the domestic waste. If the affected area is likely to remain damp for a longer period it should be treated with ethyl alcohol (white spirit) in order to prevent renewed growth of the mould. An alcohol concentration of 70 to 80 per cent is necessary for this procedure – a rule of thumb being: two teacups of water to one litre of white spirit.

4. If the affected areas are greater than half a square metre and the contamination extends deeper into the material, a specialist should be consulted who will then carry out proper remediation. In such cases residents may also help to contain the spread of mould spores by, for example, removing affected wallpaper and isolating the area in question from the rest of the living-area. However, this is only an immediate measure and cannot replace proper remediation. A specialist is needed to identify whether, for example, the mould is growing on hidden surfaces such as cavity walls. Drying the area with a hot air blower may be necessary prior to remediation.

Outlook

Are moulds really the cause of complaints? Elevated dampness in indoor environments not only causes the growth of mould but also of certain bacteria, for example, actinomycetes. Recent re-

search indicates that these can have an adverse effect on health. For this reason the UBA has initiated a further research project to study the presence and significance of bacteria under damp conditions. The results are expected at the end of 2006 or in early 2007.

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Sources:

[54] Information sheets are free and available either in printed form or online through the UBA website:
"Leitfaden zur Vorbeugung, Untersuchung, Bewertung und Sanierung von Schimmelpilzwachstum in Innenräumen" (Guidelines on prevention, investigation, assessment and remediation of fungal mould inside buildings), Federal Environment Agency 2002:
www.umweltbundesamt.org/f/pdf-I/2199.pdf

"Hilfe! Schimmel im Haus" (Help: mould in the house!):
www.umweltbundesamt.org/f/pdf-I/2227.pdf

[55] Bundesgesundheitsblatt, Issue 1, Volume 48, 2005, p. 1–54

[56] For additional information:
http://www.euro.who.int/Housing?language=German

[57] The findings of the conference are documented in the Bundesgesundheitsblatt, Issue 11, Vol. 43, 2000, p.1296–1302

[58] "Leitfaden zur Ursachensuche und Sanierung bei Schimmelpilzwachstum in Innenräumen", Umweltbundesamt 2005, (Guidelines on searching for the causes of fungal mould inside buildings and remediation), Federal Environment Agency 2005: is free and available either in printed form or online through the UBA website:
www.umweltbundesamt.org/f/pdf-I/2951.pdf

For additional details about the Commission for Indoor Air Hygiene: http://www.umweltbundesamt.de/uba-info-daten/daten/irk.htm

Department II 2 "Water"

The Water Framework Directive – programme of measures and cost efficiency

With the introduction of the EU Water Framework Directive (WFD, Directive 2000/60/EU) over five years ago a harmonised European law for the protection of all waters came into effect. Compared with previous legislation the WFD includes three fundamentally new aspects:

- detailed guidelines for transparent action in the management of water by river basins;
- increased importance of economic criteria such as cost efficient measures, water prices that cover the real cost as well as the consideration of environmental and resource costs into consideration;
- timely involvement of the public in all decisions.

Clean rivers provide a habitat for animals and plants.

In 2005 the German Laender presented a report which analyzed the state of water pollution in the river basins. This was in fact an opening balance sheet for the management of water. The subsequent monitoring of the condition of the water bodies will be used to clarify any remaining uncertainties in the risk assessment [59]. The management plans and programmes of measures for river basins that are required by the WFD from 2009 onwards must be prepared by the responsible regional authorities well in advance. The preliminary conceptual work for them was one main focus of the 'Water' Department of the Federal Environment Agency (UBA).

The WFD defines various units of differing size in which the management and assessment takes place. The smallest unit is the 'water body', which is the element to be monitored for its 'good condition', to determine whether the objectives have been reached. The most important management coordination takes place in the most extensive unit, 'the river basin district'. For reasons of practicability the river basin districts are divided into smaller units, frequently named sub-basins, in which less wide-ranging management strategies are coordinated and carried out. Authorities were appointed with responsibility for the various units.

Economic elements – cost efficiency

What lies behind the keyword 'cost efficiency', which the WFD insists must be applied to all programmes of measures? Put simply, the authorities concerned must look for the most cost-efficient measures for effectively attaining the demanding objectives of the WFD by 2015. Because the programmes must be drawn up by the end of 2009 (Art. 11 Sec. 7 WFD) and both public participation (as part of the management plan – Art. 14 WFD) and the Strategic Environmental Assessment (SEA) are to be included prior to this, any missing data or methodological shortcomings must be identified and rectified as soon as possible.

The cost efficiency of the measures at all management levels is to be clarified (river basin districts, water bodies). In order to develop measures, it is possible to begin from the river basin district (top-down) or from the water body (bottom-up). By 2004 the UBA had already authorised a handbook providing the basis for a selection of measures according to the bottom-up-process [60]. This handbook is currently being tested in various German river basins as well as throughout Europe by authorities and stakeholders. According to this handbook the following steps are necessary for each body of water:

1. Determining missing data for important parameters by an evaluation of the 2004 analysis and other information (especially from monitoring and from the baseline scenario) for every body of water, as well as determining causes (structured according to range of pollution, range of polluters/type of pollution and the respective deficit parameters).

2. Testing potentially effective measures with regard to their technical feasibility and the degree of objective achievement as well as eliminating those measures that are technically unviable or that do not lead to the desired objectives. This testing also includes so-called supplementary instruments, which can be applied at a local level, such as cooperative solutions between water suppliers and agriculture, information campaigns.

3. Selecting and clearly defining measures (including the supplementary instruments); i.e. calculating design parameters dependent on the degree of objective achievement and determining the economic costs of the measures.

4. If no prioritization of the direct costs of the measures is possible, the costs to the national economy (including environmental and resource costs) should be estimated in case significant economic costs are expected for at least one of the favoured combinations of measures.

5. A grouping of measures in order to achieve 100 per cent implementation of the objectives and to reduce costs.

Because the time and effort required for such a procedure can be considerable, a preliminary study is recommended (top-down), which would shorten the procedure and considerably reduce the work involved at the water body level. The preliminary study should clarify whether, on the basis of the overall situation in the river basin, a clear statement can be made with regard to the selection of measures. This would, for example, be possible in the case of typical pollution situations extending across the entire area (such as nitrogen emissions from agriculture) or in the case of a set of obvious upstream-downstream configurations (for example: when a large proportion of the contaminant is being introduced upstream). This would simplify the selection of measures. In

all cases international pollution in particular should be taken into consideration.

For the complete plan of measures, agreement must be arrived at between the responsible authorities regarding the conditions to be achieved in the river basin, the areas of the river basin in which the measures are to be carried out, and the time span involved. Cost efficiency in this case means initially carrying out measures in those areas of the river basin – particularly for international pollution – where the required reduction in pollution can be achieved at the least expense.

Where pollution extends across the entire area of a river basin, each of the German Laender or each member state must declare the extent of its own contribution to the river basin district, making an internal decision about the most efficient place on its own territory for implementing the measures.

Corrective measures

The measures required by the WFD to improve or to preserve the ecology of waters are of particular importance for waterways. In addition to the further development of maintenance methods in harmony with nature, hydro-morphological amelioration measures (for example: connection of ancillary waters and oxbows, reorganising and dismantling of technical structures, re-shaping banks) are to be developed by the federal authorities and the Laender. These measures should go beyond the maintenance needed for shipping but without restricting use of the waterway for transport.

The current UBA research project "Ecological Reorientation of the Management of the Federal Waterways" shows the marked declines in habitats and groups of species in the natural inland waterways of Germany – with reference to the quality criteria of the WFD and also the EU Fauna-Flora-Habitat Directive, and the Wild Birds Directive. It also describes suitable measures which could produce an effective improvement in the ecological condition, based on current quality criteria. The results of the research project can be used when compiling basic ecological maintenance principles in the future, as well as providing a guideline for water maintenance in harmony with nature. The results of this research are expected in November 2006.

Pollutants – measures to reduce their levels

The WFD review has identified nitrate and pesticide emissions from agriculture as the main causes of ground water pollution. The following measures should be considered to reduce these levels:

- Planting all year round (undersowing, cover crops, mulch tillage),
- Reduced tillage (in particular, no autumn tillage),
- Livestock production according to the land available, so that the amount of semi-liquid and solid manure produced is less than the nutritional requirements of the plants in question (management of farmyard manure),
- Use of pesticides by qualified personnel (obligation to use specialist firms),
- Cleaning of machinery and tools after pesticide use to take place only in the fields and not in the farmyard,
- Compliance with instructions for use of pesticide products (maintaining specified distances, mulch tillage).

Photo: UBA / Claussen

Algal bloom as an indicator of eutrophication on the beach of the East Frisian island of Spiekeroog.

Many of these measures can only be successful if there is intensive consultation and close cooperation with farmers. For this reason, economic instruments in the form of payments or levies should be considered in order to promote these measures.

The inventory and monitoring of surface waters have shown that heavy metals are one the pollutants causing frequent problems. The balance sheet for emissions into surface waters reveals a change in the input paths. In the mid-eighties, industrial waste water was the main source of emissions. However, these emissions as well as the substantial amounts from municipal waste water treatment plants, have been successfully reduced over the last decade. Of the remaining emissions the largest proportion derives from urban areas. Up to 40 per cent of all heavy metal entering surface waters comes from rainwater run-off from sealed urban areas.

Therefore, measures to deal with surface (diffuse) sources are of particular importance in achieving the necessary further reductions in heavy metal emissions. A UBA research project has investigated the origin of heavy metals in rainwater as well as possible measures for their avoidance and minimisation [62]. The results show that especially in the transportation and construction areas effective measures can be implemented. A handbook was developed to give builders and architects a practical tool to prevent or reduce emissions [63].

Another important approach to reduce heavy metal emissions is to avoid and/or treat rainwater run-off, irrespective of whether combined or separated systems (shared or separate sewers for domestic waste water and rainwater) are used. Suitable technical measures consist of selective, localised rainwater infiltration, the construction of rainwater treatment plants or additional storage capacity in urban combined sewer systems (retention volume) as a means of avoiding the discharge of untreated urban waste water through rainwater overflows. Finally, strategies to minimise soil erosion (furrows diagonal to slope, year-round plantings, reduced tillage) can contribute significantly to reducing the pollution of surface waters, not only by reducing heavy metal emissions but also nutrient emissions to surface waters as well as.

Photo: UBA / Rechenberg

Most of the precipitation falling on urban areas is removed by sewers.

It should be borne in mind that all of these measures may arise not only as a result of quality requirements in the immediate catchment area but also due to requirements further downstream, especially in the sea and in coastal areas. This means that, even if quality objectives are complied with in the upper reaches of a river, certain measures may still be needed there if the objectives cannot be met downstream due to the nutrient and pollutant loads from upstream.

Establishing a measuring network and monitoring programmes for waters

In 2007 the German Laender will clarify any remaining uncertainties in the assessment of the condition of waters with the help of selective monitoring programmes. They will be working on a structure for the monitoring programmes until the end of 2006 in accordance with guidelines issued by the Länderarbeitsgemeinschaft Wasser (LAWA-framework concept), including the establishment of the monitoring network. They will report to the EU Commission by March 2007. When the results of the monitoring work become available in 2008 the water management authorities in the river basins will then decide on the measures or combination of measures to be undertaken.

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Sources:

[59] The publications “Die Wasserrahmenrichtlinie – Neues Fundament für den Gewässerschutz“ (The Water Framework Directive – new basis for protecting waters) and “Die Wasserrahmenrichtlinie – Ergebnisse der Bestandsaufnahme“ (The Water Framework Directive – results of the river basin district analysis 2004 in Germany) can be downloaded from the internet at:
http://www.umweltbundesamt.de/wasser/veroeffentlich/kostenlos.htm

[60] The handbook “Basic principles for selecting the most cost-effective combinations of measures for inclusion in the programme of measures as described in Article 11 of the Water Framework Directive” (UBA-TEXTE 24/04) is available as a PDF document and can be downloaded from the internet at:
http://www.umweltdaten.de/publikationen/fpdf-l/2743.pdf

[61] See “Bericht der Bundesrepublik Deutschland zur Durchführung der Richtlinie 76/464/EWG und der Tochterrichtlinien“ (Report by the Federal Republic of Germany on implementation of the directive 76/464/EEC), for the period 2002–2004:
http://www.wasserblick.net/ servlet/is/34520/

[62] The report “Einträge von Kupfer, Zink und Blei in Gewässer und Böden – Analyse der Emissionspfade und möglicher Emissionsminderungsmaßnahmen” (Emissions of copper, zinc and lead in waters and the soil – analysis of emission paths and possible measures to reduce emissions) (UBA-TEXTE 14/2005) can be downloaded from the internet at:
http://www.umweltbundesamt.de/uba-info-medien/dateien/2936.htm

[63] ”Leitfaden für das Bauwesen – Reduktion von Schwermetalleinträgen aus dem Bauwesen in die Umwelt“ (Guidelines for the construction industry – reducing heavy metal emissions in the environment) (UBA-TEXTE 17/2005) can be downloaded from the internet at:
http://www.umweltbundesamt.de/uba-info-medien/dateien/2938.htm

[64] A PDF document from LAWA “Rahmenkonzeption zur Aufstellung von Monitoringprogrammen und zur Bewertung des Zustandes von Oberflächengewässern” (Framework concept for setting up monitoring programmes and for assessing the state of surface waters) can be downloaded from the internet at:
http://cdl.niedersachsen.de/blob/images/C11308341_L20.pdf

Department II 3 “Drinking and Swimming Pool Hygiene”

Hygiene problems in domestic drinking water systems

The new German Drinking Water Ordinance (TrinkwV 2001), in effect since 1 January 2003, includes domestic plumbing systems as so-called independent water supply installations. The operator of domestic plumbing systems, usually the owner, is thus the water provider and is consequently obliged to ensure that the water available to the user at the taps is “water fit for human consumption”. This water must meet the requirements of the Drinking Water Ordinance and, without causing any risks to health, must be suitable for drinking and for other domestic applications such as the preparation of food and physical hygiene.

The quality of the drinking water supplied by waterworks may be adversely affected upon entering the domestic supply system due to technical conditions within the building (for example, branching in pipes, stagnation of water, irregular use of the hot water system, unsuitable materials or fittings, inappropriate operation of the system). This can be assessed by comparing samples of the water where it enters the domestic system (as a rule, at the water meter) with samples taken from peripheral locations.

To avoid exceeding the specified limits at the tap, operators of systems within a building should have such tests carried out in order to ensure that they meet their obligations as defined in the Drinking Water Ordinance 2001 and under the occupier’s duty to ensure the safety of premises for persons or vehicles. Above all, in installations supplying water for public consumption in hospitals, nursing homes or facilities for children, public health departments are required to carry out tests on parameters in the system, or arrange for them to be carried out, particularly where adverse changes may have occurred. For this pur-

pose the local public health department sets up a monitoring programme with random sampling (§ 18 to § 20 TrinkwV 2001). In Appendix 2, Part II, to § 6 Section 2 TrinkwV 2001) chemical parameters are only listed if their concentration in the supply line could increase.

Microorganisms in the pipes

The concentration of microbiological parameters can change adversely when water enters the domestic system. The increase in pathogenic or potentially pathogenic microorganisms can cause health risks particularly to people with a weak immune system.

Legionella is one example of a pathogenic microorganism. These bacteria can reproduce rapidly if a hot water system is not operated properly. The inhalation of legionella aerosols, minute suspended liquid particles, from tapwater can lead to serious cases of pneumonia which, if untreated, may be fatal. Care should be taken with cold water too. For example, in hospitals in particular the bacteria *pseudomonas aeruginosa* should be considered a potential pathogen and is regarded as the most serious cause of infections such as pneumonia, wound infections and urinary infections from pathogens found in drinking water.

A scientific study demonstrated that *pseudomonas aeruginosa* infections among in-patients could be traced to a contaminated water supply, mainly from taps [65]. These and other scientific studies demonstrate that domestic water installations can be a potential source of infections from other microorganisms too. Therefore the monitoring of micro-biological parameters should be the responsibility of local public health departments.

The Drinking Water Commission of the German Federal Ministry for Health, located at the Federal Environment Agency (UBA), has addressed this problem area and has developed two recommendations [66, 67]. These contain guidelines for microbiological hygiene in domestic installations and provide local public health departments with expert advice on monitoring in accordance with § 18 to § 20 TrinkwV 2001. These recommendations include the selection of parameters and sampling sites, processes for sampling, testing procedures, frequency of monitoring and inspection, including an assessment of the findings. Another publication contains the results of an official hearing by experts on the subject of domestic installations as potential reservoirs of infectious pathogens [68]. It primarily addresses technical issues concerning the prevention, monitoring and decontamination of domestic installations.

Contamination by microorganisms can be avoided if domestic installations are constructed and operated according to generally acknowledged technical rules. Decontamination of affected systems is often protracted and costly, particularly if the microorganisms are found in so-called biofilms (slimy film in pipes and fittings). This undesirable bio-film develops when micro-organisms in the domestic installation grow on organic substance which can, for example, originate from material inadequate for use in drinking water systems.

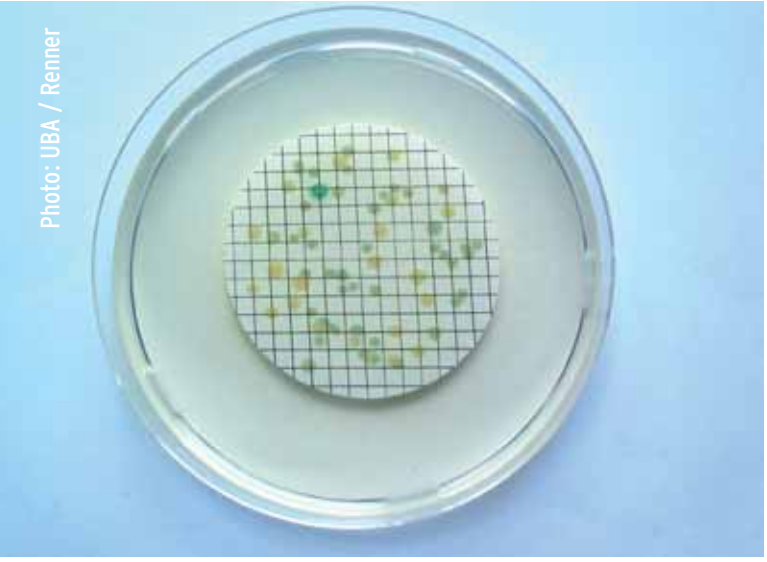

Photo: UBA / Renner

Mixed culture with *pseudomonas aeruginosa* (green colonies).

Photo: U. Szewzyk / TU Berlin

Growth of bacteria (formation of bio-film) on rubber used in drinking water systems.

Materials in contact with drinking water

To avoid chemical contamination or changes in taste or smell resulting from the material in the pipes, the use of synthetic materials in drinking water systems is limited to those listed in the KTW recommendations (KTW: the German initials of the "Working Group on Synthetic Materials in Contact with Drinking Water" of the former Federal Department of Health) [69]. These have been tested since 1 January 2006 in accordance with the regulations of the Federal Environment Agency [70, 71, 72, 73].

Certification by the German Technical and Scientific Association for Gas and Water (DVGW) is available for components. This certification requires proof that components made of synthetic materials have been tested for their hygienic suitability following the DVGW work sheet W 270 and KTW recommendations or the guidelines laid down by the Federal Environment Agency. The components then receive a DVGW test label confirming that they comply with the requirements of the German water regulations TrinkwV 2001 § 17 Section 1 and AVBWasserV § 12 Section 4.

Where metal components are used this may not lead to exceedance of the limit values for their concentrations as given in appendix 2, part II TrinkwV 2001. Here the parameters copper, nickel and lead are of particular importance and their concentrations should be monitored in a "mean weekly average sample". Because of the strong influence of the retention time of water in domestic installations (stagnation), concentrations may differ widely, depending on the quantity and frequency of sampling. Therefore, the UBA has published its own "Sampling Recommendations" on how weekly mean samples should be taken [74].

For new construction and the maintenance of domestic installations only metal components suitable for that particular water quality may be used. The requirements for the composition of the metallic materials and the water parameters which must be met for their use can be found in the technical standard DIN 509030, Part 6.

The EU Commission is currently developing evaluation methods for the various materials in contact with drinking water (EAS – European Acceptance Scheme). The UBA is participating in this process in order to maintain the existing quality standards in Germany and to achieve continuous improvements to preventive health protection. In domestic installations this includes planning and production as well as the selection of materials compatible with the characteristics of the drinking water at a particular location.

The prerequisites for preventive health protection in this area can be met by observing generally recognised technical regulations such as the DVGW worksheets, DIN standards and VDI (German Association of Engineers) guidelines, and through the certification of products (for example, by the DVGW).

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Sources:

[65] Reuter, S., Sigge, A., Wiedeck, H., Trautmann, M. (2002): Analysis of transmission pathways of Pseudomonas aeruginosa between patients and tap water outlets. Crit. Care Med. 10, 2222–2228

[66] Recommendations by the Federal Environment Agency following a hearing of the Commission on Drinking Water of the Federal Ministry of Health: Hygienic microbiological study of cold water in water supply systems pursuant to § 3 No. 2 letter c TrinkwV 2001, used to supply water for consumption by the public as defined by § 18 Section 1 TrinkwV 2001, Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Protecting Health), 49, Issue No. 7 (2006), p. 693–696

[67] Recommendations by the Federal Environment Agency following a hearing of the Commission on Drinking Water of the Federal Ministry for Health: Periodic studies of Legionella in central heating systems in domestic installations pursuant to § 3 No. 2 letter c TrinkwV 2001, from which water for public use is obtained, Bundesgesundheitsblatt- Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Protecting Health), 49, Issue No. 7 (2006), p. 697–700

[68] Results of a hearing by experts on 31.03.2004 at the University Clinic Bonn: Domestic installa-

tions, supplying water for consumption by the public, as a potential reservoir of infection, with particular emphasis on medical care facilities; Current knowledge, prevention and monitoring Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Protecting Health), 49, Issue No. 7 (2006), p. 681–686

[69] Health related assessment of synthetic and other non-metal materials for use with water within the framework of the Law on Food and Utensils – 1st announcement in Bundesgesundheitsblatt (Federal Health Gazette) 20 (1977), p. 10–13.

[70] Federal Environment Agency (2005), "Leitlinie zur veränderten Durchführung der KTW-Prüfungen bis zur Gültigkeit des Europäischen Akzeptanzsystems für Bauprodukte im Kontakt mit Trinkwasser (EAS)" (Guidelines for the implementation of the altered plastics and drinking water tests until the European Acceptance System for components in contact with drinking water (EAS) takes effect), Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Health Protection 48 (2005), p. 1409–1415

[71] Federal Environment Agency (2003),"Leitlinie zur hygienischen Beurteilung von Epoxidharzbeschichtungen im Kontakt mit Trinkwasser" (Guidelines for the hygienic assessment of epoxy resin coatings in contact with drinking water), Bundesgesundheitsblatt- Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Health Protection 46 (2003), p. 797–817; updated version 14.10.2005

[72] Federal Environment Agency (2004), "Leitlinie zur hygienischen Beurteilung von organischen Beschichtungen im Kontakt mit Trinkwasser" (Guidelines for the hygienic assessment of organic coatings in contact with drinking water), updated version 14.10.2005 available on the internet at:
http://www.umweltbundesamt.de/uba-info-daten/daten/materialien-trinkwasser.htm

[73] Federal Environment Agency (2003), "Leitlinie zur hygienischen Beurteilung von Schmierstoffen im Kontakt mit Trinkwasser (Sanitärschmierstoffe)" (Guidelines for the hygienic assessment of lubricants in contact with drinking water [sanitary lubricants]"), Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Health Protection 46 (2003), p. 818–824

[74] Federal Environment Agency (2004), "Beurteilung der Trinkwasserqualität hinsichtlich der Parameter Blei, Kupfer und Nickel" (Assessment of drinking water quality in relation to the parameters lead, copper and nickel), Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Health Protection 47 (2004), p. 296–300

Department II 4 "Soil"

Soil protection in the course of utilising organic waste

The agricultural tradition of using organic waste or sewage to enrich the soil goes back a long way, but discussions about the environmental compatibility of such methods are much more recent. Since the beginning of the industrial revolution the use and variety of materials used for production and consumption purposes has increased considerably and this can be seen to a greater or lesser degree in waste and in waste water. The consequences of the careless use of sewage during the last century can be seen in former irrigation fields: for decades domestic sewage from conurbations was allowed to percolate untreated into the soil. This led to accumulations of heavy metals, which even today prevent the use of this soil for food production.

Today's treatment methods ensure that water can, to a large extent, be re-circulated without risk into the environment. What remains is sewage sludge, which is used in agriculture as a fertiliser. Since the pollutant potential of sewage sludge has become known the risks associated with its use have been widely debated. Stimulated by the discussion about the recycling of sewage sludge, in 2001 the Joint Conference of the Ministers of the Environment and Agriculture of the Laender passed a resolution stipulating that, because of the importance of arable land for the production of healthy human food and livestock foodstuffs, as a precaution it is vital to ensure that farm management practices, and above all the spreading of sewage sludge, liquid manure and compost, do not lead to an accumulation of pollutants in the soil.

Following this resolution, the Federal Environment Ministry (BMU) and the Federal Ministry of Agriculture (BMELV) presented a joint concept for the standardised assessment of heavy metals in organic fertilisers (Concept for Fertilisers) on 28 August 2002. The starting point was the policy

paper “Gute Qualität und sichere Erträge” (Good Quality and Safe Yields) produced by the two ministries and based on research by the UBA. This paper, published on 3 June 2002, provided technical corroboration of the aforementioned resolution by the Conference of Ministers. This paper defined the maximum permitted heavy metal content for various organic fertilisers to ensure that the application of organic materials to the soil does not cause pollutants to accumulate above permitted levels. This resulted in a paradigm change in the approach to assessments. Whereas previously the decisive factor when granting approval for use as a fertiliser was whether the resulting accumulation of pollutants in the soil over the next 100 years exceeds the limiting values for soil, now the emphasis has shifted to the environmental quality requirements of the soil as a resource in need of protection. Meeting these conditions ensures that the organic fertiliser used will not lead to accumulations above the tolerated limits. The technical starting point for the necessary calculations is provided by the specific precautionary values for various types of soil as laid down in the national waste materials and soil protection regulations, thereby providing a yardstick for determining good soil quality.

Photo: UBA / Hüllenkrämer

The soil as a resource – careful management of the land will retain this finite resource for the benefit of future generations.

For the UBA and BMU this approach to the organic fertilisers to be applied to the land, emphasising the importance of land as a resource, provides guidelines for the continued development of appropriate statutory regulations in Germany and the European Union. The original approach has undergone further development and various technical aspects have also been included [76].

Heavy metals in fertilisers

The UBA research project “Limiting the introduction of contaminants in agricultural methods involving the application of fertilisers and the utilisation of waste” uses current datasets to document the pollution caused by contaminants in the fertilisers used by agriculture. The project clearly shows what the practical consequences would be of applying specific limiting values for each kind of fertiliser.

Composts: Waste from gardens and parks, and the garden or green waste compost produced from such waste, separately collected municipal waste and the organic bin compost produced from this waste all reflect the background situation at specific locations. In general these composts are not affected by the various calculation scenarios because the separate collection system for organic waste and the quality assurance for compost within the framework of the national scheme “Bundesgütegemeinschaft Kompost e.V.” contribute substantially to the high quality of compost, which contains only minimal quantities of organic and inorganic pollutants [77]. The UBA has commissioned research to identify the cause of the current increase in the copper content of composts as well as to develop effective limitation strategies. The findings are expected shortly.

Fermentation residues: These are a result of the production of bio-gas, which is obtained by allowing the fermentation of organic waste, renewable raw materials, and mixtures of organic waste and liquid manure. In terms of their environmental impact, solid fermentation products are similar in value to organic waste compost. However, a large amount of the liquid manure from the plants that were studied revealed excessive amounts of copper and zinc. This is due to the use of poor quality primary material such as liquid manure from pig farms.

Manure: Liquid manure and farmyard manure which were examined in the research project often exceeded the recommended levels of copper and zinc proposed by the fertiliser assessment

concept, and this is particularly true with regard to pig manure and liquid pig manure. It was, however, possible to reduce the fodder-related high levels of copper and zinc without seriously affecting the animals' health, thereby enabling the recommended quality standards to be adhered to [78].

In assessing copper and zinc it should also be borne in mind that, although they can have harmful effects, if used in the right quantities, including in micro-nutrients, they are necessary for plant growth. Although the fertiliser assessment concept in question considers the heavy metal characteristics of plant yields and thus the average amounts of heavy metals required by plants, it does not take into account locations with deficiencies and field crops with high copper and zinc requirements. Additional regulations could be introduced regionally, allowing higher yields without harmful effects. Investigations by the UBA also show that the production methods of the organic farms investigated lead to fertiliser of superior quality in terms of its heavy metal content, and this is particularly the case with pig farming on the basis of solid manure, but also with manure and liquid manure from cattle.

Turning to **sewage sludge**, the UBA research project identified levels exceeding the recommendations of the Fertiliser Assessment Concept, especially for copper and zinc. Alongside heavy metals, a critical view of organic pollutants should be taken when sewage sludge is used in agriculture and landscaping. Moreover, sewage sludge does not always meet the hygiene requirements of the regulations which have so far been applied to biowaste but not to sewage sludge. This should be taken into account when the sewage sludge regulations are revised.

Organic pollutants in fertilisers

As revealed by the findings of a comprehensive programme of investigations into organic pollutants in the sewage sludge produced by waste water treatment in North Rhine-Westphalia, sewage sludge contains a diversified inventory of allochthonous substances, i.e. which are alien to the soil, depending on their origins, and the routes by which they find their way into municipal sewage [79]. These pollutants include substances which, because of their harmful impact on health or the environment, in some cases represent a serious potential hazard to the vital resources of soil and water. Precaution must be taken to ensure that these pollutants do not accumulate in the soil and subsequently enter the food chain through water or useful plants [80].

One characteristic pollutant composition, a so-called pollutant "fingerprint", was frequently found in studies carried out over several years by the Environmental Protection Agency of the Land of Baden-Württemberg into arable land fertilised with sewage sludge. It includes organo-zinc compounds, polycyclic musk compounds, dioxins, polychlorinated biphenyls and polycyclic aromatic hydrocarbons along with the heavy metals copper and zinc [81]. Similar results were obtained from the aforementioned research projects by the UBA which examined land on which sewage sludge had been spread. Sewage sludge composts were also investigated in the project, and these revealed high levels of persistent organic pollutants in particular.

As a consequence the fertiliser assessment concept submitted by the UBA would largely result in a ban on the spreading of sewage sludge in its present composition, especially if the necessary specified amounts of organic pollutants and hygienic requirements were to be applied as well. The UBA favours the increased use of pollutant-free and hygienically safe fertiliser salts to replace sewage sludge containing plant nutrients obtained from waste water (phosphorus and nitrogen) [82]. These fertiliser salts can be extracted directly from waste water during the treatment process. The residues from waste water treatment should then be incinerated. The UBA is overseeing a working group that also involves the Federal Ministry of Education and Research and the Federal Environment Ministry, which is investigating the recovery of phosphorus from sewage sludge and waste water.

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Sources:

[75] Bannick, C. G.; Hahn, J. and Penning, J., Umweltbundesamt (2002): Zur einheitlichen Ableitung von Schwermetallgrenzwerten bei Düngemitteln. (The uniform derivation of limits on heavy metals in fertilisers). Müll und Abfall 8/2002, p. 424–430

[76] Bannick; Franzius; Hahn; Kessler; Markard; Penning, Vogel (2006): Zum Stand der fachlichen Weiterentwicklung des Konzeptes “Gute Qualität und sichere Erträge” (The current state of the technical development of the concept of “Good quality and reliable yields”). Müll und Abfall 3(38), p. 134–140

[77] Reinhold, J. (2004): Neubewertung von Kompostqualitäten. (Re-assessment of compost quality), UBA-TEXTE 15/04

[78] Schultheiss, U. et al. (2005): Schwermetalle und Tierarzneimittel in Wirtschaftsdüngern. (Heavy metals and veterinary medicinal products in fertilisers), KTLB-Schrift 435

[79] Ministry of the Environment and Nature Conservation, Agriculture and Consumer Protection of the Land of North Rhine-Westphalia (2004): Abfälle aus Kläranlagen in Nordrhein-Westfalen – Teil D: Organische Schadstoffe in Klärschlämmen aus der kommunalen Abwasserbehandlung (Waste from sewage treatment plants in NRW – Pt. D: Organic pollutants in sewage sludge from municipal sewage treatment)

[80] Friedrich, H. et al. (2005): Abfälle aus Kläranlagen (Waste from sewage treatment plants). Müllmagazin 2/2005, p. 8–25

[81] Regional Environmental Protection Agency Baden-Würtemberg (2003): Schadstoffe in klärschlammgedüngten Ackerböden Baden-Württembergs (Pollutants in arable land in Baden-Württemberg fertilised with sewage sludge). Bodenschutz 15

[82] Hahn, J. (2004): Neukonzeption der Abwasserverordnung gemäß § 7 a WHG. (A revised Waste Water Ordinance in accordance with § 7 a WHG). WLB, Wasser, Luft und Boden, p. 14 ff, May 2004

Department II 5 “Air”

The Federal Environment Agency’s air monitoring network

The contamination caused by air pollutants is not confined to their place of origin. Airstreams can carry them several hundreds of kilometres or even spread them around the entire globe. Through a number of international conventions Germany therefore cooperates with many other countries to combat transboundary air pollution and its effects:

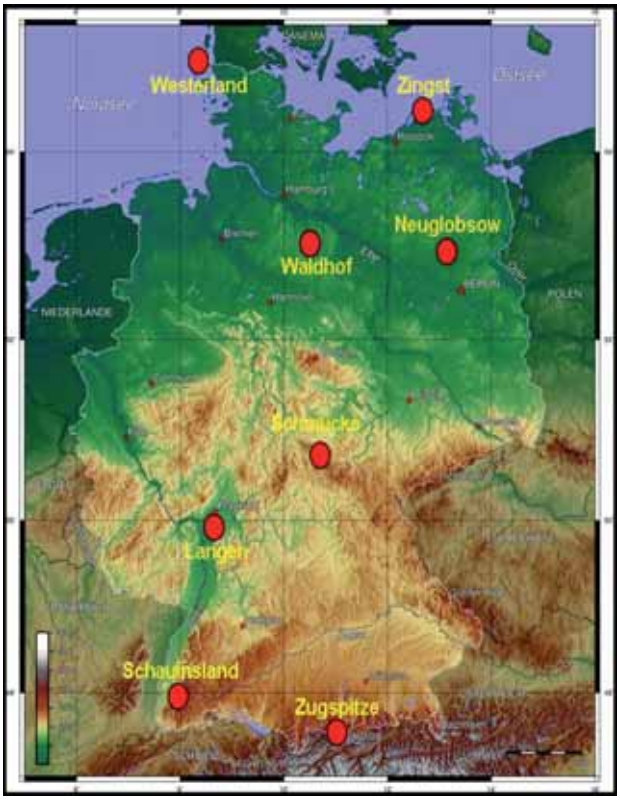
- in the field of “traditional” airborne contaminants: Convention on Long-range Transboundary Air Pollution (www.unece.org/env/lrtap/welcome.html);
- in the area of greenhouse gases and climate-forcing parameters: Global Atmosphere Watch Programme (GAW), (www.wmo.ch/web/arep/gaw/gaw_home.html);
- for protecting the marine environment of the Northeast Atlantic: OSPAR Convention (www.ospar.org/eng/html/welcome.html) and
- for protecting the marine environment of the Baltic region: Helsinki Convention (www.helcom.fi/).

In addition Germany has obligations under European Union (EU) legislation to monitor the air quality at background sites in order to determine the concentrations of heavy metals (arsenic, cadmium, mercury, nickel), polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC) in air.

In order to comply with international conventions, protocols and clean air strategies and to implement the EU law the participating countries monitor, in accordance with standard operation procedures, the concentrations of pollutants in transboundary air masses and in precipitation. The international instrument that is applied in accordance with the Convention on Long-range Transboundary Air Pollution (see Federal Environment Agency Annual Report 2004, p. 20) is known as EMEP (European Monitoring and Evaluation Programme, www.emep.int/). As part of this programme over 100 stations in 25 countries monitor transboundary air pollution in Europe. The immission and precipitation readings are recorded by international data centres, where they are fed into computer models, together with meteorological and emission data. In this way the origin, distribution, amounts transported, location and possible effects of atmospheric pollution can be calculated and assessed.

Germany has entered into international obligations to provide these readings, which are carried out by the Federal Environment Agency (UBA), using seven monitoring stations, staffed by specialists and distributed around Germany. They are located as far as possible away from local sources of pollutants to ensure that only longe-range and transboundary air masses are recorded. Conurbations with high levels of traffic, concentrations of

Figure 9: Map of the monitoring stations belonging to the UBA air monitoring network and its control centre at Langen



industry and many heating units are avoided as these would influence the readings.

The UBA air pollution monitoring network is one of a number of different international monitoring networks and its tasks and location differ substantially from the air monitoring networks maintained by the German federal states, the Laender. Monitoring strategies, methods and parameters are constantly being expanded under the international programmes, and the UBA air pollution monitoring network is actively involved in this process.

In addition to the regular work of the monitoring stations, such as taking samples, changing filters and carrying out maintenance work, they also conduct extensive analyses, calibration and development of monitoring and sampling procedures. The stations that make up the UBA monitoring network and their role in the international monitoring programmes are listed below:

- Neuglobsow monitoring station: EMEP, GAW (regional station), integrated monitoring,
- Schauinsland monitoring station: EMEP, GAW (regional station),
- Schmücke monitoring station: EMEP,
- Waldhof monitoring station: EMEP,
- Westerland monitoring station: EMEP, OSPAR,
- Zingst monitoring station: EMEP, HELCOM,
- Zugspitze GAW station: GAW (global station) and the
- network management centre at Langen: technical and administrative management, analysis centre, data centre.

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The findings obtained by the UBA air monitoring network for a number of measurement parameters of current significance are given below.

Sulphur hexafluoride

Together with carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), sulphur hexafluoride (SF_6) is a major greenhouse gas with a greenhouse potency 22,000 times higher than that of CO_2. This airborne pollutant can remain in the atmosphere for some 3,000 years. Since the first readings were taken at the Schauinsland monitoring station in 2001 and at Zugspitze in 2002 the average monthly levels of sulphur hexafluoride have risen from around five parts per trillion (ppt) to just under 6.5 ppt (30 per cent in five years). SF_6 is mainly used in electrical operating equipment, in particular in the switches and insulators for high voltage installations.

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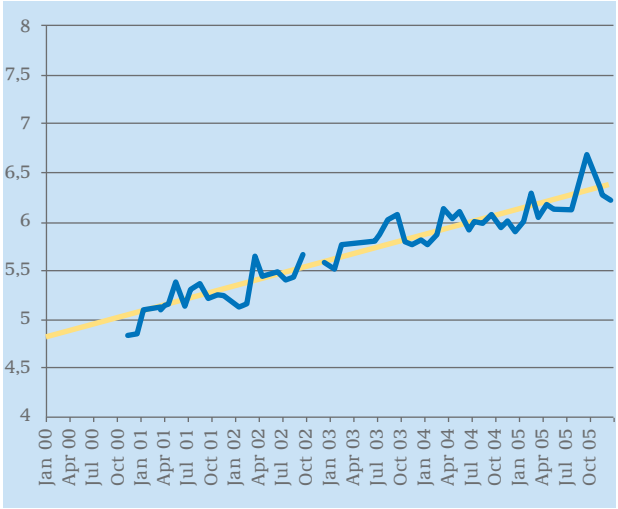
Figure 10: Development of concentrations of SF_6 at the Schauinsland monitoring station since 2000



No change in the CO_2 situation

As part of the GAW programme a number of stations in the UBA monitoring network are being used to determine the levels of carbon dioxide (CO_2) in the atmosphere. The Schauinsland record (since 1972) is the longest available continental time series of CO_2 mixing ratios in Europe (Fig.11). The trend is still upwards, with an annual rate of around two parts per million (ppm). Seasonal variations are the result of photosynthesis and respiration by the continental biosphere. The annual changes in the rates of increase primarily reflect variations in the interaction between the atmosphere, the biosphere and the oceans.

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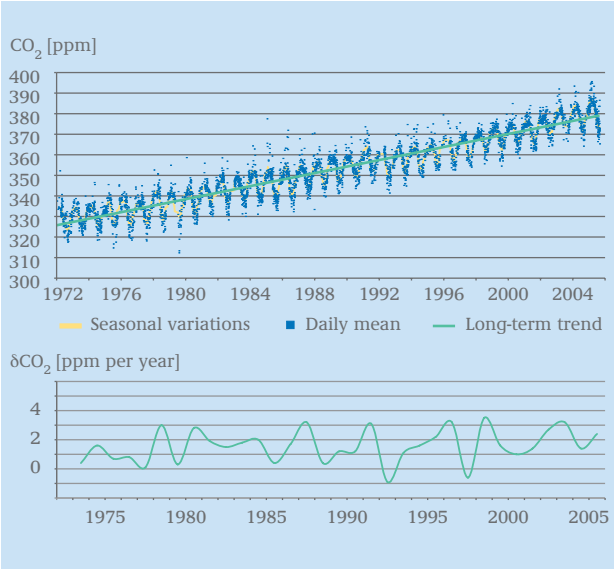
Figure 11: Development of concentrations of CO_2 at the Schauinsland monitoring station since 1972



Intercontinental transport of ultrafine aerosols

Due to its exposed position the Zugspitze is ideally placed for monitoring aerosols and nanoparticles, even from distant sources, more frequently from Eastern Europe, less frequently from North Africa, and in isolated cases even from North America. A research project has been set up to examine these aspects. On 25 August 2005 an air mass from the continental boundary layer of North America reached the Zugspitze within a relatively short period of time, where it led to increased level of ultrafine aerosols (Fig. 12). It took approximately eleven days for this aerplume to be transported from the eastern USA.

Current investigations indicate that not only transboundary but also intercontinental flows can play an important part in this problem of fine dust. The monitoring programme is intended to quantify the pollution in Germany represented by the transport of fine dust.

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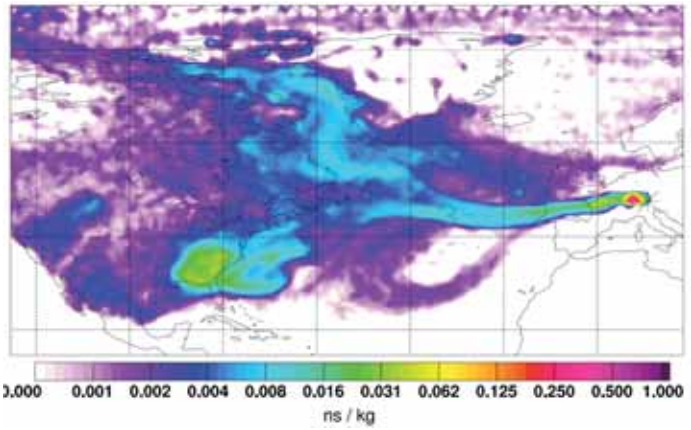
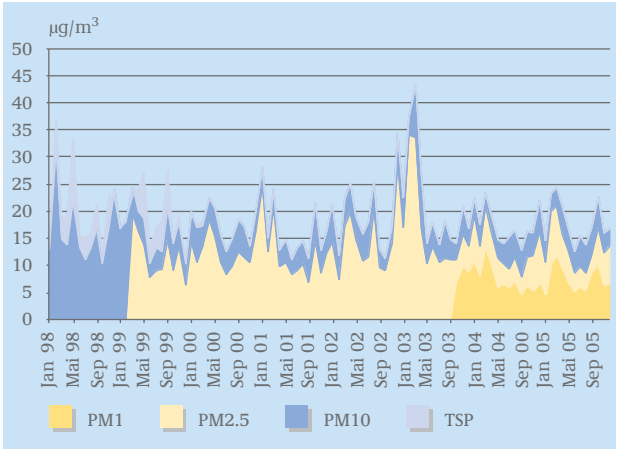
Figure 12: Emissions of the intercontinental transport of ultrafine aerosols being recorded at the Zugspitze GAW station



Fine dust particles

There are sharp fluctuations in the background pollution caused by fine dust particles, due to the fact that it is transported over long distances and to some extent they are a seasonal factor. Even at those UBA stations which have been set up to monitor background pollution the ambient quality standard of 50 millionths of a gram of fine dust particles per cubic metre of air (µg/m³) was exceeded several times in 2005, for example four

Figure 13: Trend in concentrations of fine dust at the Waldhof monitoring station since 1998 as well as proportions of the various size fractions



times at the Waldhof station. On one of these occasions the cause was the Easter fire. The proportion of the PM10 fraction that is accounted for by fine PM1 and PM2.5 fractions is very high and has remained remarkable stable over the past six years.

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Volatile organic compounds

VOC (volatile organic compounds excluding methane) are among the precursor substances in the formation of surface ozone. They can have either an anthropogenic, i.e. man-made (evaporation of solvents, combustion of biomass and coal, road traffic) or a biogenic source (forests – in particular softwoods, areas of water, meadows). The UBA network carries out central analysis of more than 25 substances at the Schmücke monitoring station. In 2005 the high quality of the analysis was verified in an international intercomparison test, with the UBA laboratory taking first place. In recent years the concentrations of VOC pollution have shown a slight downward trend. As a result of biogenic factors, in the summer months they are significantly higher, especially at those monitoring stations in the vicinity of extensive stands of softwoods.

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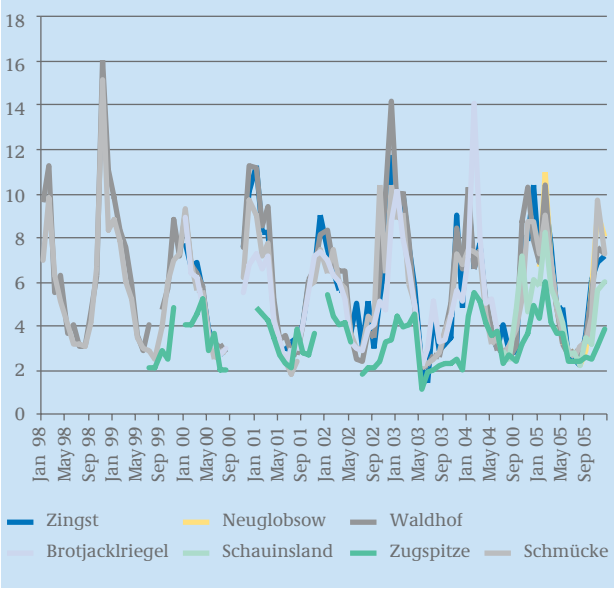
Figure 14: Trend in the total concentrations (ppb) of volatile organic compounds (excluding methane) at various UBA monitoring stations since 1998



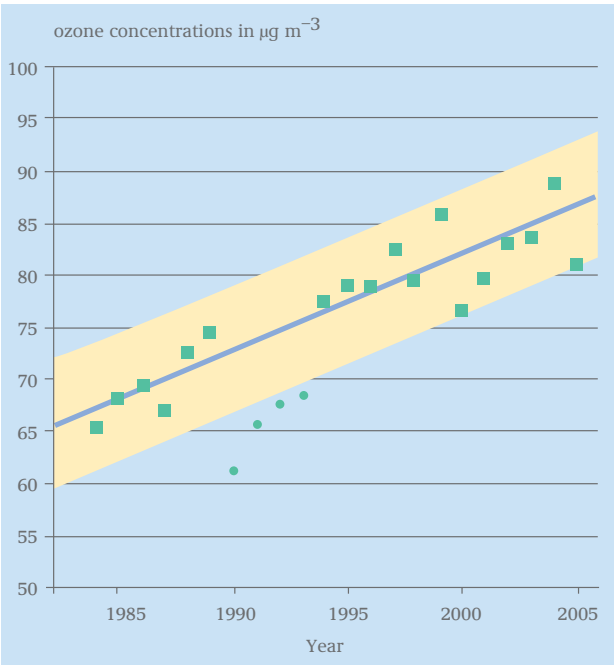
Rise in background concentrations of ozone in the northern hemisphere

Ozone can exist in the troposphere, the lowest layer of the atmosphere extending to a height of approximately 10 kilometres, for several weeks or even several months. This is long enough to circle the earth several times, carried by the global westward drift of the prevailing wind. This leads to its distribution over the entire hemisphere and to a substantial background concentration even in regions where no ozone forms. Local and regional measures to reduce ozone precursors are effective only up to this concentration.

The Westerland monitoring station, located directly on the North Sea coast, is ideal for determining and observing the so-called background ozone. To achieve this readings are selected in such a way that only the air masses from the North Atlantic are evaluated. The trajectories – the computer calculated origins of the air masses – reveal that this is the case with north-easterly winds (wind direction sector 300 – 350) and wind speeds of ≥10 metres per second (m/s).

Since 1984 the annual average of the ozone concentrations selected in this way has revealed an annual upward trend of approximately one millionth of a gram per cubic metre of air (µg/m³). This rise agrees closely with the observations made at comparable stations (for example at

Figure 15: Average annual readings of ozone concentrations selected to wind direction and speed obtained at Westerland monitoring station



Mace Head in Ireland). The most likely cause is the increase in emissions of ozone precursors (nitrous oxide, hydrocarbons) in Europe, North America and Asia.

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Mercury

Following the signing of the Heavy Metals Protocol in 1998 in Aarhus (see Annual Report 2004 of the Federal Environment Agency, p. 20), mercury (Hg) was included in the extended monitoring programme of EMEP. The UBA monitoring network determines mercury in ambient air and in precipitation. An international field intercomparison at the Waldhof monitoring station in 2005, involving eleven laboratories from eight European countries, was intended to determine the quality and comparability of Hg measurements within EMEP, in ambient air and in precipitation.

An initial evaluation revealed generally good comparability between the results obtained by most of the participating laboratories with regard to median concentrations, variability and rang measurements. This applies to precipitation and to ambient air measurements. The UBA monitoring network obtained very good results. The more in-depth evaluation is intended to reveal the remaining differences and produce recommendations on how the mercury readings conducted as part of the monitoring programme EMEP of the Convention on Long-range Transboundary Air Pollution can be optimised and harmonised.

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Ammonia

A substantial proportion of the reactive nitrogen entering the atmosphere is emitted in the form of ammonia. Agriculture is the main source, especially cattle production. The amount of nitrogen emitted is comparable to that of nitrous oxides, which are mainly the result of technical combustion processes in transport, energy extraction, homes and industry. Ammonia is the only alkaline reacting gas in the atmosphere and together with the "acidic gases" such as sulphur dioxide and nitrous oxide it forms products which can be found in precipitation and in the fine dust carried in the atmosphere. Thus ammonia accounts for much of the eutrophication of eco-systems by airborne contaminants and of dust pollution too.

The methods to monitor ammonia are very complicated. A few years ago this led the Centre of Ecology and Hydrology in Edinburgh to develop a suitable method for conducting cheap, routine measurements. This dispenses with a high time resolution in favour of simpler operation and greater reliability. This method has now been employed by the Neuglobsow monitoring station and has been successfully tested during routine operations. The initial findings reveal pronounced seasonal changes in the concentrations of ammonia with a clear maximum level in the warmer six months of the year and very low readings in winter.

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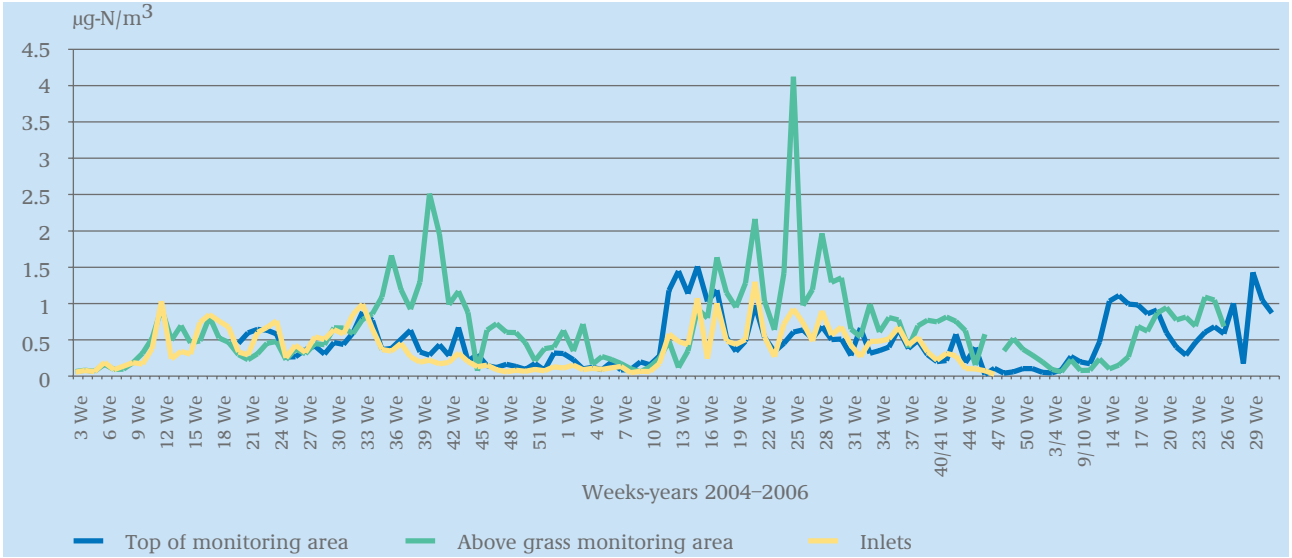
Figure 16: Trend in concentrations of ammonia as sampled at two different heights at the Neuglobsow monitoring station (blue: 2.5 m above ground level, green: 0.5 m above ground level)



DIVISION III "ENVIRONMENTALLY COMPATIBLE ENGINEERING – PROCESSES AND PRODUCTS"

How can production processes and technologies be designed to create the least impact on the environment and health while at the same time increasing the competitiveness of German companies and providing jobs with a high added value content? What requirements must products satisfy in order to be healthy and environmentally compatible, and how can their acceptance and sales be increased? How can waste and sewage be utilised and treated in a way that helps to conserve resources? These are the questions with which the three departments within this division are concerned.

Among the most important concerns of environmental policy are the identification of the causes of environmental pollution and the development of strategies and concrete measurements for its avoidance and reduction. In this respect the range of services of this division covers a number of different, integrated approaches such as sectors (for example the chemical industry), areas of particular need (such as construction and housing), product groups (construction equipment and electrical appliances) and selected environmental problems (health risks, energy efficiency, hazards).

Product related environmental policy is concerned with environmentally friendly design, encompassing the entire life cycle of the product. A various number of instruments are available to encourage the so-called eco-design, such as the "Blue Angel" eco-label, and environmentally friendly procurement, especially in the public sector. Sustainable consumption has an important role to play in this respect. The division organises a national dialogue and develop new forms of environmental to support these activities.

Environmental protection as an integral part of production involves observing the causes of pollution at each stage in the added-value chain, i.e. from the extraction of the raw materials and their processing, through production and utilisation, to eventual disposal. The division uses the knowledge about the various material flows and processes, combined with their environmental profiles, to develop criteria, requirements and standards, as well as identifying possible ways of relieving the burdens on the environment. The process is guided in line with the principles of sustainable development, i.e. ensuring long-term environmental compatibility of production processes and products. 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 and potential risks. Examples include nanotechnology and so-called white biotechnology. Other main areas of work consist of efforts to achieve continuous improvements in the safety of industrial plants at a national, European and international level, and the development of a sustainable waste and sewage management system, i.e. one that considers a specific perspectice on the flow of materials and helps to conse resource preservation.

For additional details about the division: http://www.umweltbundesamt.de/uba-info-e/e-fach3.htm

Department III 1 "Engineering and Products Assessment"

Eco-design: product-based environmental protection from the drawing board to disposal

Avoiding environmental pollution and the risks to health from products are important concerns for environmental policy. The entire added value chain, from the extraction of the raw materials and the production and use of products to their eventual disposal, imposes many different pressures on mankind and the environment, both of which require protection. Product-based environmental protection is therefore concerned with studying products throughout their entire life cycle. The life cycle approach identifies the causes of pollution and possible ways of relieving the pressure on mankind and the environment. In various life cycle assessments the Federal Environment Agency (UBA) has conducted a detailed analysis of the environmental impacts of prod-

ucts such as drinks packaging and recycled paper.

Product design is of particular importance because it is at this planning stage that the producers, paying attention to potential pressures on the environment and ways of relieving these pressures, can exert an influence on each subsequent phase of the product life cycle and can encourage innovations in the interests of health and the environment. Eco-design is the term used to describe this systematic inclusion of environmental and health aspects at the draft phase.

Aspects of eco-design

The important structural principles of eco-design are [83]:

- Attention to energy and material efficiency, for example by using lightweight construction or producing items with multiple functions;
- Avoiding or restricting the use of materials containing contaminants and hazardous substances;
- A preference for re-usable materials;
- Focussing on products with a long working life, by using modular construction or by making them easy to repair;
- Designing products which are suitable for recycling and disposal, for example with a limited number of different materials, ease of dismantling, and by avoiding the use of compound substances;
- Designing products to facilitate logistics, for example by reducing the volume of products and packaging used.

What is important about energy-using products

Environmentally suitable design requirements vary from one product group to another. Energy-using products such as domestic appliances form an especially important group from the point of view of environmental and health protection. Their main problem is that they use too much electricity, with all the negative aspects that this implies. Small-scale and domestic use of energy-using products accounts for 49 per cent of all the electricity consumed in Germany. This corresponds to 15 per cent of the carbon-dioxide emissions produced in Germany, with their associated harmful effects on the climate.

In an early research project [84] the UBA therefore examined the extent to which this electricity consumption could be reduced. This revealed that electricity consumption could be reduced by some 20 per cent if, when buying appliances and planning their electricity usage, 80 per cent of the equipment and technology chosen by private households and small users had a high efficiency rating. In a subsequent research project [85] the UBA investigated the best way of exploiting this potential reduction. The findings clearly showed that there is no easy way to achieve energy efficiency because of the wide discrepancies between the technology, target groups and obstacles involved. There is therefore a need for a political package made up of closely coordinated instruments and measures, focusing in particular on assistance, regulatory law and information. In the case of refrigerators and freezers this should take the form of a programme to encourage the purchase of highly efficient appliances, i.e. those in the A+ and A++ energy-saving category, combined with stricter maximum power consumption

levels and adjustment of the compulsory EU labelling to the state of the art.

One important approach is to limit the power losses caused by appliances that continue to consume electricity even when they are not fulfilling their proper function, i.e. when they are in no load-mode, e.g. stand-by. This applies, for example, if appliances cannot be completely shut down, and results in an annual cost to homes and offices in Germany in excess of four billion euros. The UBA is therefore endeavouring to ensure that all manufacturers of new appliances fit them with an easily accessible power switch so that the appliances can be completely isolated from the mains supply (see also page 104).

However, efforts to protect the environment should not only focus attention on the energy consumption of energy-using products. Disposal of the products is also of particular relevance for environmental protection, because the volume of such scrap items is increasing at a much faster rate than other kinds of domestic waste. This is due to the fact that many of these products, such as computers and consumer electronics items, after only a few years no longer meet their users' needs. It is not only the amount of waste that is a cause for concern but also the hazardous substances that it contains (heavy metals, fluoridated greenhouse gases, flame retardants). These substances may find their way into the environment or into the materials cycle during the course of disposal, where they can pollute the environment or present a health hazard.

Replacing flame retardants, which are a threat to health and the environment

In order to protect the consumer, energy-using equipment has to conform to certain fire safety requirements to avoid the risk of spontaneous ignition during continuous operation. However, the biodegradable qualities of some halogen-organic flame retardants are so poor that they can still be traced even in the Arctic, in human blood and in mother's milk. The use of penta- and octa-brominated diphenyl ethers has now been banned in the European Union (EU) because of their harmful impact on the environment and on health. To enforce this ban last year the UBA commissioned the elaboration and evaluation of a method of analysis [86]. The UBA also favours prohibiting the use of deca-brominated diphenyl ether. This is where eco-design can help, by replacing troublesome flame retardants with alternatives that are more environmentally acceptable and less of a health threat.

However, scrap appliances contain not only unwelcome substances but also valuable raw materials such as precious metals and pure grade plastics which would otherwise be lost during disposal of the scrap. Eco-design of energy-using products must seek to avoid substances that are harmful to the environment and health, to ensure that components and materials can be re-used and fully exploited, as well as providing products with a long working life.

The Electrical and Electronic Equipment Act – an initial step

With the promulgation in 2005 of the "Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment" (abbreviated as ElektroG) a firm legal basis was provided for these requirements. With this legislation two EU directives became incorporated into German law. Among its provisions were to specify maximum levels for specific pollutants in these products, minimum quotas for re-use,

Photo: BMU / R. Oberhäuser

All scrap, or is it? By no means. Worn out electrical equipment still contains useful raw materials. The ElektroG requires that such items should either be re-used or any useful materials that they contain should be recycled.

and the recovery of the materials and energy contained in the waste electronic and electronical equipment (WEEE). It also required that, from 24 March 2006, consumers should only dispose of WEEE in the collection systems provided, that the local authorities should collect the WEEE and make it available for transportation and disposal by the producers.

Manufacturers are required to collect WEEE and to dispose of it in accordance with specified environmental standards. The innovative concept at the heart of this law: producers have to take the responsibility themselves for ensuring that worn-out products are disposed of in an environmentally correct way. Eco-designed products are the best way for producers to ensure that they meet their responsibilities. The legislation stipulates that the UBA act as the competent authority and as such it is substantially involved in the implementation of ElektroG, with communication with all involved stakeholders being a particular concern. For example, the UBA supports a project by the environmental organisation Deutsche Umwelthilfe (DUH). One of the objectives of this project is to keep consumers informed about the aims of the ElektroG and to encourage them to play an active part.

Eco-design for energy-using products – a new EU directive

Approved in 2005, the European "Directive 2005/32/EC for establishing a framework for the setting of eco-design requirements for energy-using products", the so-called Eco-design Directive, goes a step further than the ElektroG. Its aim is to use eco-design to make energy-using products more environmentally compatible. The Eco-design Directive must be implemented in German law by 11 August 2007. It provides the framework within which subsequent directives, standards or self-imposed obligations on the part of industry will be used to formulate specific requirements for individual product groups in the years to come. The UBA used the occasion of the promulgation of the Eco-design Directive to intensify the dialogue between the various groups with an interest in the subject of eco-design.

At a conference of experts organised in Dessau by the Federal Environment Ministry and the UBA in October 2005 discussions took place between representatives from politics, science and environmental organisations, who explored the possibilities for using joint initiatives to create a fresh impetus for promoting environmentally compatible products. This year the UBA is continuing the dialogue on the subject of eco-design within the framework of the German "Dialogue process for sustainability in consumption and production" and in panels with various experts. An information website dealing with the Eco-design Directive is also being set up.

There must be a demand for eco-design too

If products that have been designed to be environmentally compatible are to succeed commercially there must be greater demand for them from consumers. Since public procurement in Germany accounts for some 13 per cent of the gross domestic product, procurement by the public sector should set a better example and influence the market in this direction. One of the main objectives of public procurement is that public purchasing must meet public sector requirements in an economical way. However, in practice decisions are often made on the basis of short term cost considerations rather than longer term life cycle costs, and almost never taking into account the cost to society of dealing with environmental damages. Taking life cycle costs into consideration offers many opportunities for significant cost savings and greater use should be made of the potential that this offers.

The UBA supports decision makers in procurement, for example with a website devoted to environmentally friendly procurement. The agency also cooperates with other major customers. In November 2005 the UBA invited the two main Christian churches and the network of cities known as the International Council for Local Environmental Initiatives (ICLEI) to Dessau to exchange information about the increased integration of major environmental aspects in public procurement.

The "Blue Angel" is an eco-label that plays an important part in environmentally friendly procurement. Scientifically based award criteria provide those responsible for procurement with reliable and independent guidance. The Blue Angel is also intended to encourage technical innovation. Thus the criteria list for awarding contracts for heat pumps that was approved last year specifies that from 2008 the Blue Angel will only be granted to heat pumps whose operation does not depend on the use of any climate-threatening halogen-organic substances. This technical innovation is so far only offered by a few manufacturers.

By enforcing regulatory law, by applying and developing suitable means of information and communication and by chairing various stakeholder meetings, the UBA is encouraging companies to ensure that their products are designed with the environment and health in mind and that demand for such alternative products will increase. The UBA believes that this offers innovative companies in Germany and elsewhere in Europe the scope for making a contribution to improving environmental protection, the quality of life and their own competitiveness.

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Sources:

[83] Tischner, Ursula et al. (2002): Was ist EcoDesign? Ein Handbuch zur ökologischen und ökonomischen Gestaltung. (What is Eco-design? A Handbook for ecological and economic design), ed. by Federal Environment Agency, Form Praxis Publisher, Frankfurt a. M.

[84] The study conducted by the Wuppertal-Institut and the engineering consultancy ebök "Klimaschutz durch Effizienzsteigerung von Geräten und Anlagen im Bereich Haushalte und Kleinverbrauch – Sachstand/Projektionen/CO_2-Minderungspotentiale" ((Climate protection by increased efficiency of appliances and equipment in the domestic and commercial/institutional sector – Facts/Scenarios/CO_2 Saving Potentials), may be loaned from the UBA library.

[85] The study conducted by ifeu-Institut: "Politikinstrumente zum Klimaschutz durch Effizienzsteigerung von Elektrogeräten und -anlagen in den Privathaushalten, Büros und im Kleinverbrauch" (Policy instruments force climate protection by increasing the energy efficiency of electrical appliances and electrical systems in private households and the commercial and small-scale sector), summary is accessible in English, French and Russian at:
http://www.umweltbundesamt.de/uba-info-medien/dateien/3054.htm

[86] The report "Probenaufbereitungs- und Analyseverfahren für Flammschutzmittel (Pentabromdiphenylether, Octabromdiphenylether) in Erzeugnissen" [Procedures for preparing retardant samples and conducting analyses on them (pentabrominated diphenylether, octabrominated diphenylethe) in products) (UBA-TEXTE 23/05)] can now be downloaded from:
www.umweltbundesamt.de/uba-info-medien/dateien/2954.htm

For additional information:

www.dialogprozess-konsum.de (web site dealing with the national dialogue process for sustainability in production and consumption)

www.blauer-engel.de (web site dealing with the Blue Angel environmental symbol)

www.beschaffung-info.de (web site dealing with environmentally friendly procurement)

www.green-electronics.info (web site dealing with the environmental organisation Deutsche Umwelthilfe, with details for consumers about ElektroG)

www.cleaner-production.de (Information platform on environmental friendly systems)

Federal Environment Ministry, Federal Environment Agency (2005): Ökodesign von Produkten:

Gestaltungsauftrag für mehr Umweltschutz und Innovation. (Eco-design of products: design with a greater emphasis on environmental protection and innovation). Special publication by the magazine Ökologisches Wirtschaften, Oekom Verlag, Munich.

Federal Environment Ministry, Federal Environment Agency, publ. (2005): Werte schöpfen – Ideen für nachhaltiges Konsumieren und Produzieren. (Creating values – ideas for sustainable consumption and production), Politische Ökologie No. 94, Oekom Verlag, Munich.

Department III 2 "Production"

Sustainable production using the chemical industry as an example

Pan-media environmental protection as an integral part of the production process forms an essential basis for the efforts by German industry to achieve sustainable development. Creativity and innovativeness are also needed, especially by the chemical industry. The Federal Environment Agency (UBA) agrees with the chemical industry that innovative technology will create opportunities for environmental protection and employment in Germany. One prerequisite for this is that our natural essentials for life should be retained by separating economic growth from the demands made on natural resources, and this applies in particular to the reduction in environmental degradation and risks to health emanating from the production of chemicals.

Alerted by the serious consequences of various accidents in the 1970s and 1980s, over the past 30 years the chemical industry has made strenuous efforts to promote pan-media environmental protection, including accident prevention. Combined sites were created for multiple plants, incorporating high levels of efficiency in terms of resources and energy, substantially improved safety levels and the reduced emission of contaminants.

As a consequence of this development Germany, is taking a leading role within the European Union (EU) under the "Seville Process" (description of the best available techniques in industrial sectors for implementing the IVU Directive), which, as an integral part of the production process, is a major component of environmental protection. In its capacity as a national focal point agency the UBA provides examples of innovative plants for defining the best available techniques, which is part of the exchange of information involved in the "Seville Process".

The progress achieved thus far in reducing demands on natural resources in the chemical industry do not go far enough: although the specific consumption of fossil raw materials fell by around 13 per cent between 1995 and 2002, dur-

Development of raw material and energy productivity in the chemical industry (1991–2003)

Source: Federal Statistics Office, UBA

ing the same period the production index for primary chemical materials rose by some 25 per cent. Thus the total amount of fossil raw materials used increased by a further three million tonnes of oil units [87].

Criteria for sustainable chemical production

The continued and necessary reduction in demands imposed on the environment by the chemical industry requires not only measures to deal with production but also an examination of the entire life cycle of the products. In its contributions to achieving sustainable development the UBA obtained criteria for a policy on materials in pursuit of environmental quality and action [88]. These consist of:

- a reduction in the amount of materials used in the manufacture of products,
- reduced consumption of natural resources,
- reduced energy input,
- increased long-term usability of the products,
- greater emphasis on the eco-design of products to enable them to be utilised after they have fulfilled their original purpose,
- a reduction in emissions to technically avoidable levels,
- a reduction in the complexity of the flows of materials,
- risk reduction, to avoid excessive environmental pollution by eco-toxic and toxic substances,
- development of substances with properties that are not inimical to health or the environment.

Innovative technology

Many people in politics and business expect the so-called key technologies, especially bio- and nanotechnology, to lead to an upsurge in innovations and improved competitiveness for German companies. But what about the sustainability of such technologies? To encourage the development of technologies that consume fewer resources and present less of a risk to health, the UBA assesses these technologies in terms of the risks that they present to the environment and to health, along with their potential for relieving some of the pressures on the environment, and draws up proposals for reducing such risks and for exploiting this potential.

Industrial biotechnology, also referred to as "white biotechnology", comprises those biological processes which are used in technical procedures and industrial production. Following a number of research projects by the UBA and other institutions it has been established that, in contrast to chemical processes, biotechnology processes should take place under relatively mild conditions in aqueous surroundings, at low temperatures, normal pressure levels and neutral pH-values. As a consequence many biotechnological processes make more efficient use of energy and resources, as well as presenting fewer risks to the environment and to health. Moreover a considerable potential exists for further improvements, for example by using renewable raw materials. Examples of biotechnological processes include the production of the vitamin B2 (riboflavin) and the antibiotic precursor products 7-7-aminocephalo-sporanic acid (7-ACS) and 6-aminopenicillanic acid (6-APS) [89].

Other research projects examined the possibilities for using biological rather than chemical processes, and obstacles to the use of biological processes, whereby alternative courses of action were found, aimed primarily at improving the communication between science and industry. The UBA, together with companies, science and other participants, will continue to encourage the positive effects of white biotechnology, for example by assisting in the development of suitable technology and through effective communication. For example, in collaboration with the Federal Environment Ministry (BMU), the UBA is planning a workshop in the autumn of 2006 to investigate the ecological and economic benefits of biotechnology. Moreover the UBA is providing an effective stimulus by supplying research findings to the national platform for research into white biotechnology as part of the European Technology Platform for Sustainable Chemicals (SusChem) [90].

Many experts are also expecting numerous innovative developments in nanotechnology in various branches of industry and areas of application. A number of these applications have already been launched commercially, including nanaoscalar catalysts and nanotechnology-based coatings to create scratch-resistant, non-reflective and non-adhesive surfaces (see Table 6). Experts

Table 6: Applications for nanotechnology processes and products

	Already commercially	Commercial availability	Under development	Available as concept
Chemicals	Anorganic nanoparticles Carbon black Polymer dispersions Micronised active agents Surface finishing Easy-to-clean coatings	Chemical sensors Nano-coating silicates Organic semi-conductors Dendrimers Aerogels Polymer nano-composites Paints and lacquers	CNT compound materials Highly efficient hydrogen reservoirs	Self-repairing materials
Car manufacturing	Tyre filling materials Components with hard coatings Anti-reflective coatings Scratch-resistant paints	Nano-pigments Magneto-electric sensors Fuel cells Nano-composites Fuel additives Anti-fogging composites Polymer windscreens	Thermo-electric use of waste heat	Switchable paints Ferro-fluid shock absorbers
Electronics	GMR-HDD	CMOS electronics <100 nm Polymer electronics FRAM MRAM	PC-RAM Molecular electronics RTD Millipeds	DNA computing Spintronics
Optical industry	White LED	Ultra-precision optics OLED	CNT-FED Quantum cryptography EUVL optics Quantum point lasers Photon crystals	
Life sciences	Bio-chips for solar protection	Antimicrobics Magnetic hyperthermics Drug delivery Contrast agents	Biosensors Lab-on-a-chip Tissue engineering	Neuronal artificial systems Biomolecular motors
Environmental technology	Membranes for sewage treatment	Exhaust gas catalysts	Filtration systems for separating out ultrafine dusts, products for cleaning groundwater and soil	

Explanation: GMR-HDD: Giant Magnetic Head – Hard Disk Drive, CMOS: Complementary Metal Oxide Semiconductor, FRAM: Ferroelectric Random Access Memory, MRAM: Magnetic Random Access Memory, PC-RAM: Personal Computer Random Access Memory, RTD: Resistance Temperature Detector, DNA: Desoxyribonukleinsäure, LED: Light Emitting Diode, OLED: Organic Light Emitting Diode, CNT-FED: Carbon Nanotube Field Emission Display, EUVL: Extreme Ultraviolet Lithography

expect the growing use of such nanotechnology-based products to result in increased concentrations of nanoparticles throughout the entire ecosystem over the next few years. However, few investigations have so far been carried out into the resulting health and environmental risks.

The UBA is currently in the process of compiling the available, environmentally relevant data and findings from various joint research projects and numerous events devoted to the subject of nanotechnology. No comprehensive picture exists yet of this area of technology and it was with the intention of adding to the knowledge in this field that the BMU and UBA joined forces with the Federal Agency for Employment Protection and Industrial Hygiene (BAuA) to organise a conference in the autumn of 2005 [91, 92]. The BMU prepared a dialogue paper on the current levels of knowledge and various unresolved issues. Based on existing knowledge the UBA will shortly be releasing a paper on the current situation and will be joining with other scientific organisations to investigate what research requirements exist, to identify the potential environmental risks and ways of alleviating them, and finally to undertake assessments.

The terms microreactor technology and microsystems technology systems refer to techniques that employ miniaturised components. These are used to improve the output and selectivity of chemical processes, thereby helping to conserve natural resources. They also help to improve the safety of processes. Forecasts by the Verband der chemischen Industrie (Association of the Chemical Industry) assume that, by 2010, between 10 and 15 per cent of all high-purity and specialised chemicals will be produced with the aid of microreactor technology.

Other innovative processes such as the use of new kinds of solvents, the so-called supercritical or ionic fluids, improved catalysts and optimised separation processes are also being studied by the UBA. Used together with management systems based on customer requirements, such as chemical leasing, these new technologies can help companies to optimise their use of resources and energy. One such example is the management system for the deployment and re-use of solvents for cleaning metals. In this field the UBA lends its support to technical projects financed and implemented by the environmental foundation Deutsche Bundesstiftung Umwelt (DBU) which are intended to inform the public about the opportunities and risks presented by such technologies.

Another purpose of sustainable chemical production is to ensure the integrity of material cycles. Mercury provides one example of the gaps that must be closed before the cycle can be considered complete. For many years the mercury recovered by chlor-alkali electrolysis plants was freely available on the world market, and was also used for non-approved purposes such as the non-industrial extraction of gold. In 2005 the European Commission published its mercury strategy with the aim of banning the export of European mercury by 2011.

Areas of action

Sustainable chemicals production is the objective and there is no other alternative course of action. In principle the requirements and the models for sustainable chemical production are applicable to all other industrial sectors. The UBA intends to play its part in resolving the discrepancies that still exist between demands and reality as part of ongoing efforts to achieve sustainable chemicals production. In so doing it supports and also initiates

- the development of models intended to point the way for innovation;
- efforts intended to reinforce the principle of prevention by proposing objectives for environmental action;
- assessments of the opportunities and risks represented by various technologies;
- examinations of extensions to the trade in emissions to include the chemical industry and the substance di-nitrous oxide;
- improvements to the links between possibilities for promoting sustainable chemicals and the dissemination of such information for the benefit of users;
- an intensified dialogue with the representatives of various interests in the chemical industry and with individual companies.

The measures referred to above also formed the focus of discussions at a conference on sustainable chemicals held in January 2006, organised at the Evangelische Akademie in Tutzing by the UBA, BASF AG and the Freiburg University Clinic. The main conclusion reached was that criteria are needed for assessing innovation-related risks. This would help to keep such risks to an accept-

able level as well as allowing scope for innovation. The proceedings will shortly be published by Metropolis-Verlag.

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Sources:

[87] Responsible Care Report 2004: Chemical industry data on safety, heath, environmental protection, VCI

[88] Federal Environment Agency (1999): Beiträge zur nachhaltigen Entwicklung 1: Handlungsfelder und Kriterien für eine vorsorgende Stoffpolitik am Beispiel PVC (Articles about sustainable development 1: Areas of action and criteria for a preventive materials policy), Erich Schmidt Verlag, Berlin

[89] For additional information: http://biotech.dechema.de

[90] The vision for 2025 and beyond – A European Technology Platform for Sustainable Chemistry: www.suschem.org

[91] For additional information: www.dialog-nanopartikel.de/downloads.html

[92] Closing report: Synthetische Nanopartikel, UFOPLAN-Projekt 205 61 220, iku GmbH, Dortmund 2005

Department III 3 "Waste and Sewage Management"

Ecotoxicological characterization of wastes. An important basis for the ecological management of hazardous waste

Modern waste management has considerable economic potential and is being transformed from a necessary evil to a profitable branch of industry. A change in political attitudes is needed to ensure that our environment, a limited resource, can be effectively and sparingly used while at the same time avoiding environmental damage. The high waste disposal standards involved in such an interaction offer competitive advantages for industry in its efforts to export innovative environmental technology but at the same time such high standards are an incentive to find and establish cheaper, alternative methods of waste disposal. One way in which the waste industry is doing this is to export its waste. Unfortunately unauthorised activities still occur, as in the case of the illegal export of waste to the Czech Republic in early 2006.

An extensive set of national and international regulations exists to combat such environmentally dangerous activities, and the legal system seeks, in a number of stages, to close any loopholes that may be identified. This is the purpose of the amended EC waste shipment regulation and of the EC Waste Framework Directive (WFD) that is currently awaiting amendment.

There is still a gap in the definition of the environmental hazards of waste materials, both in international law, for example the "Basel Convention on the Control of Transboundary Movements of Hazardous Waste", as well as in the European Waste List, although both sets of rules provide for a classification of the hazards represented by waste materials based on the environmental risks that they present. However, both at international and national level there is a lack of scientifically founded criteria and of suitable administrative instruments. It is against this background that the Federal Environment Agency (UBA) has proposed a strategy for identifying environmentally hazardous waste.

Biological testing methods for identifying environmentally hazardous waste

The European Waste List (EWL) comprises a coordinated list of wastes, with 405 types of waste classified as hazardous. Of these 172 are described as so-called mirror entries, in other words the classification of a waste stream depends on the amount of hazardous substances that it contains or is dependent on certain hazardous properties, for example its degree of flammability.

The EWL contains 14 hazard criteria for classifying waste. These criteria are obtained from the "EU Guideline 91/689/EU on hazardous waste". The table below shows the concentration limits at which a waste substance is classified as hazardous (Table 7, p. 80). Not all the criteria for classifying the level of hazard represented by waste products have been defined yet. These specific details have still not been included for the criteria shown in Table 8 (see p. 80).

Table 7: H criteria for the classification of hazardous substances

H criterion	Characteristic (§ 33 Section 2 AVV)	Limiting concentration of one or more substances
H 3	Flammable	Flash point ≤ 55°C
H 4	Irritant (R41)	≥ 10 %
H 4	Irritant (R36, R37, R38)	≥ 20 %
H 5	Harmful	≥ 25 %
H 6	(Very) toxic	≥ 0,1 %
H 6	toxic	≥ 3 %
H 7	Carcinogenic (Cat. 1 oder 2)	≥ 0,1 %
H 7	Carcinogenic (Cat. 3)	≥ 1 %
H 8	Corrosive (R35)	≥ 1 %
H 8	Corrosive (R34)	≥ 5 %
H 10	Teratogenic (Cat. 1 oder 2)	≥ 0,1 %
H 10	Teratogenic (Cat. 3)	≥ 0,1 %
H 11	Mutagenic (Cat. 1 oder 2)	≥ 0,1 %
H 11	Mutagenic (Cat. 3)	≥ 1 %

In the opinion of the UBA criterion H14, "ecotoxic", is of particular importance for assessing the environmental risks presented by waste. Only an investigation of the biological effects enables an assessment to be made of the risks to the living world that could be presented by waste which is often extremely heterogeneous and of unknown composition. The development of biological test methods in previous years forms the basis for applying the H14 hazard criterion "ecotoxic" in the enforcement of the WFD.

The Basel Convention as an example

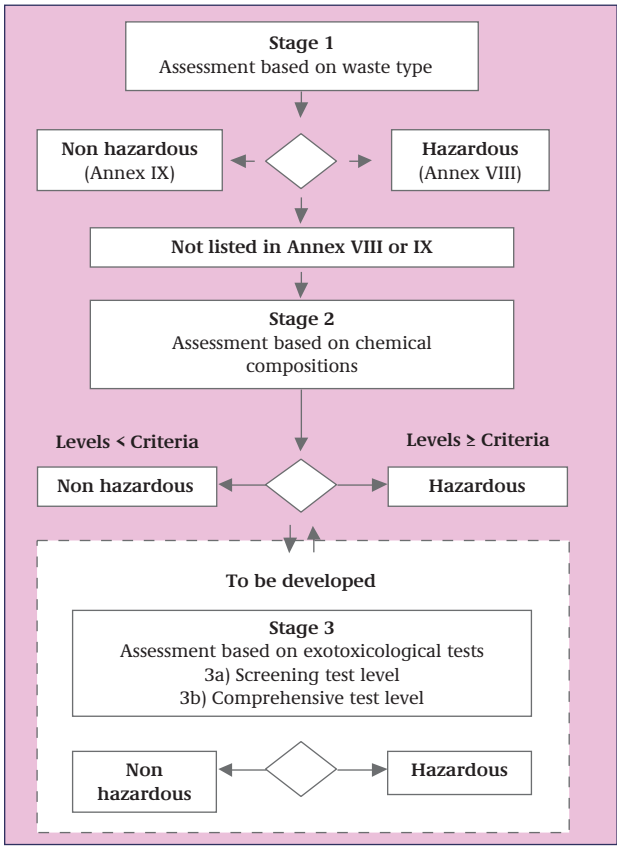
Determination of the intrinsic waste property of "ecotoxicity" is required not only in the implementation of the EWL but also in the Basel Convention on the Control of Transboundary Movements of Hazardous Waste. This international agreement determines the environmental hazards represented by a particular type of waste based on its ecotoxicity, its degradability and its accumulation in the eco-system.

Table 8: Non-defined criteria

H criterion	Characteristic (§ 33 Section 2 AVV)
H 1	Explosive
H 2	Irritant
H 9	Infectious
H 12	Substances and preparations which release toxic or very toxic gases in contact with water, air or an acid.
H 13	Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.
H 14	Environmentally hazardous (ecotoxic)

The experts from organisations that are parties to the Basel Convention, and which includes representatives of the UBA, have reached agreement on a three-stage concept for carrying out assessments: once the waste, classified as either hazardous or non-hazardous, is listed under the Basel Convention (Annex VIII and IX), it is then possible to obtain the classification. If the waste to be assessed is not listed, this can be done on the basis of its chemical composition. The limits are de-

Figure 17: Test strategy under the Basel Convention



rived from the readings obtained from investigations of aquatic toxicity, i.e. to determine the toxic effect on organisms living in water, and are based on OECD recommendations from 1988 on the classification of environmentally hazardous substances.

The ecotoxicological assessment of waste under the Basel Convention provides for an additional assessment stage, using two-stage ecotoxicological methods of testing. For orientation purposes a preliminary test is carried out at the start of the investigation as a low-cost method of assessment. Waste identified as presenting an ecotoxicological hazard during this preliminary examination can then be subjected to a more comprehensive biological analysis of its effects. For this purpose three aquatic and four terrestrial procedures have so far been proposed.

The UBA strategy for the ecotoxicological characterization of waste

The UBA has responded to these shortcomings in the assessment process, i.e. the lack of tests at EU level that can be applied to determine ecotoxicity, by taking the initiative and creating the conditions for a clear classification of waste based on a harmonised eco-toxicological assessment. The following problem areas have been identified:

- Until now there has been no harmonised range of tests in the EU using validated biotest methods for a uniform examination of wastes in order to determine their environmental risks.

- There is still no harmonised assessment procedure that defines the scope of the examinations required in order to obtain an ecotoxicological characterization and compares examinations of eluates with those of solid matter.

- There is insufficient knowledge to enable waste to be classified as hazardous or non-hazardous, using ecotoxicologically relevant threshold values, when enforcing the European Waste List (EWL).

In order to be able to define threshold values for the ecotoxicity of waste in the national enforcement of the EWL, experts, assisted by the UBA, will have to develop a waste assessment strategy incorporating standardised biotesting methods.

The European standardization committee CEN TC 292 “Characterization of waste”, in which the UBA plays a major role, has published a directive on the methodological specifications for taking and treating waste samples in preparation for a biological analysis of its effects. These parameters are augmented by a series of biological testing procedures suitable for examining waste samples. However, this consists merely of a collection of methods for information purposes and they do not as yet encompass any proposals for a harmonised range of tests or any description of a strategy for testing specific types of waste.

The UBA, together with the Joint Research Centre of the European Commission, organised a workshop under the heading of “The H-14 Criterion and (Bio)analytical Approaches for Ecotoxicological Waste Characterization” on 12 and 13 September 2005 in Ispra, Italy, with the aim of promoting European-wide harmonisation of ecotoxicological waste characterisation and thus the enforcement of the EWL. It featured in-depth scientific discussions about the methodology of ecotoxicological waste characterisation in EU member states. Most of the investigations of waste that were presented there relied on existing biotesting methods that have already been sufficiently standardised for other applications such as soil testing. The contributions revealed that member states have so far either failed entirely to achieve the methodological implementation of the hazard criteria “ecotoxic” or have adopted widely differing approaches to its application. Consequently the experts agree that a harmonised range of tests is needed which would take into consideration the special requirements involved in characterising waste. One important result of this workshop that was supported by the participants is the range of tests as defined by Table 9, comprising four aquatic and four terrestrial procedures, which are now being evaluated in an interlaboratory ring test in Europe.

Analogously to the graduated approach of the Basel Convention the UBA has also submitted a proposal for an assessment methodology describing the stages and decision-making process for the ecotoxicological assessment of waste in mirror entries of the EWL, which is current under discussion by the European standards committee CEN TC 292 WG 7.

This examination strategy makes use of all known or analysed constituents of the waste to determine the extent of the hazard. In addition to physical and chemical analyses of the waste substances this also includes the constituents of the waste eluate. If, on the basis of this information, the waste is not categorised as hazardous, the

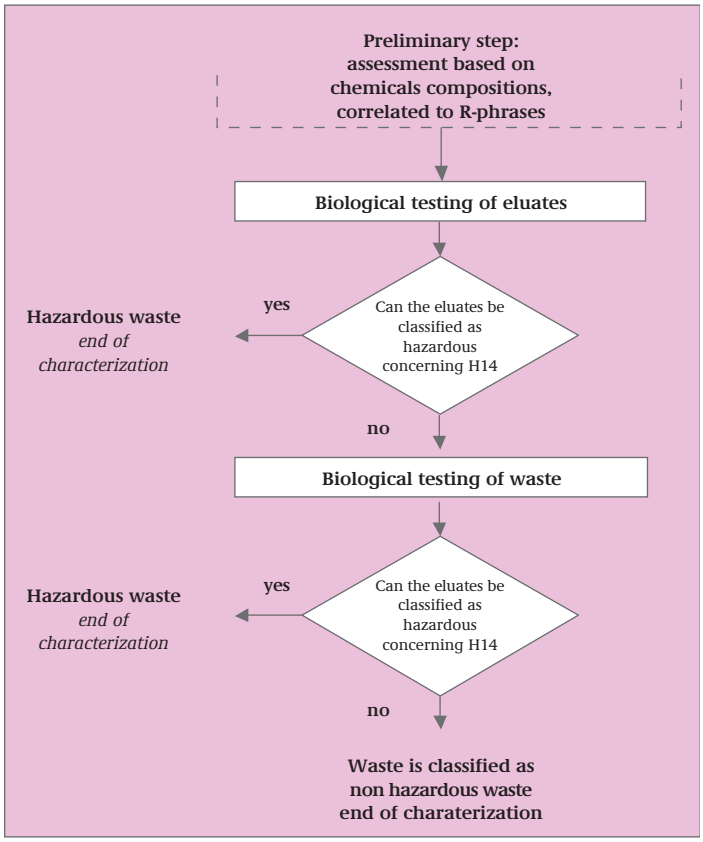
Table 9: Test battery for the Interlaboratory Comparison

Biological testing methods for examinating waste eluates	
EN ISO 11348-1	Determination of the inhibitory effect on the light emission of *Vibrio fischeri* (Luminescent bacteria test)
EN ISO 6341	Determination of the inhibition of the mobility of Daphnia *magna* Straus (Cladocera, Crustacea) - Acute toxicity test
EN ISO 8692	Freshwater algal growth test with single-celled green algae *(Scenedesmus subspicatus* and *Pseudokirchneriella subcapitata)*
Biological testing methods for examinating waste materials	
ISO 11269-2	Determination of the effects of pollutants on soil flora – Part 2: effect of chemicals on the emergence and growth of higher plants
ISO 11268-1	Effect of pollutants on earthworms *(Eisenia fetida)* – Part 1: determination of acute toxicity using artificial soil substrate

next stage consists of biotests of the waste eluate. If this too does not lead to categorisation as a hazardous waste the waste is then examined using terrestrial test methods. If in this final step the waste sample under examination does not reveal any ecotoxicity either, the waste can then be classified as non-hazardous with reference to the criterion H14 "ecotoxicity".

The two-stage ecotoxicological assessment (waste eluates and wastes) is not only required if there is a lack of analytical data, but is compulsory in the case of wastes which present a possible environmental risk, which are not allocated mirror entries or which are listed as hazardous waste. This can be important if the wastes are to be recovered. The ecotoxicological characterization of waste determines an intrinsic material property of the waste and cannot be used in place of risk assessment of the waste with regard to its utilisation, and in particular its re-use in an open environment. Because of the similarity of the methods employed in these investigations, which are used in both formulations, the ecotoxicological characterisation can, however, offer useful pointers for risk assessment in the recovery of waste.

Figure 18: Ecotoxicological characterization of wastes – as proposed by the UBA



Outlook

Over the next few months the standardization committee CEN TC 292 WG7 will be producing new proposals regarding the development of a test strategy, a process in which the UBA will be playing a significant part. In order to establish a harmonised series of tests, a European round robin test is being conducted under the leadership of the UBA and the European Committee for Standardization (CEN), which incorporates evaluation of the directive EN 14735 "Manufacture of waste samples for ecotoxicological investigations". With the successful completion of the work in drawing up this standard the UBA would be laying the scientific foundations for defining the threshold values for the ecotoxicological characterization of waste. It is on this basis that the shortcomings in the assessment process would be overcome and the associated revision of the Waste List Ordinance would become possible.

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Sources:

Gawlik, B.M. & Moser, H. (2006): „Problems around Soil and Waste III – The H-14 Criterion and (Bio)analytical Approaches for Ecotoxicological Waste Characterisation“, Workshop Proceedings, European Commission EUR 22152 EN

Interim guidelines on the hazardous characteristic H12-Ecotoxic (2003), Secretariat of the Basel Convention, ISBN 92-1-158622-4, 23 pages

A summary of the workshop “Problems around Soil and Waste III – The H-14 Criterion and (Bio)analytical Approaches for Ecotoxicological Waste Characterisation” can be downloaded at: http://ies.jrc.cec.eu.int/366.html

DIVISION IV "CHEMICALS AND BIOLOGICAL SAFETY"

Assessing chemicals – protecting people and the environment. Both departments of the division are focusing their attention on chemical substances, their impact on ecosystems and health, and the risks that they present to mankind and the environment. The division has an important part to play in the continued development and enforcement of substance-related legislation: the laws concerning chemicals, pesticides, protection against infection, biocides, washing and cleaning agents and pharmaceutical products, as well as the European Union regulations governing waste and detergents.

Laws have therefore been passed stipulating that the effects of new chemicals on human beings and the environment must be adequately investigated before they can be introduced onto the European market. The division assesses the environmental risks posed by materials and, if necessary, initiates measures to minimise such risks. Examples include conditions regulating the use of pesticides or medicines when granting licenses for substances or even imposing a ban on the use of certain substances. This process also includes the continued development of the scientific foundations for assessing substances, including in its own laboratories in Berlin, as part of a dialogue with experts from Germany and abroad. In the light of European and global policy on substances, the international work of the division is becoming increasingly important. In collaboration with international organisations such as the World Health Organisation (WHO), the United Nations Environmental Programme (UNEP) and the Organisation for Economic Cooperation and Development (OECD) staff prepare technical articles, for example on the international harmonisation of guidelines for testing, and on persistent organic pollutants (POPs), which remain in the environment for a long time.

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"

The environmental safety of medicinal products – a problem that has been underestimated for too long

Few people think of environmental problems in connection with the use of medicinal products. Instead one tends to associate medicines with their value in helping to cure ailments, and possibly with the risks to patients from side effects. It is therefore not surprising that the subject of environmental protection and the environmental compatibility of medicinal products is something that has only been discovered recently. Neither should it come as any surprise to learn that legislators did not initially consider the environmental consequences when planning the law regulating medicinal products, which has since proved to have been a mistake. Along with other authorities and scientific institutions the Federal Environment Agency (UBA), and in this case the Department IV 1 "Chemical Safety" in particular, is seeking to create a greater awareness of the environmental impact of drugs and medicines. In addition to medicinal products intended for humans, veterinary medicines also come under scrutiny.

Proven effects of medicinal products on the environment

In 2005 there was widespread media attention concerning reports about the deaths of vultures in Asia as a result of secondary poisoning with diclofenac, a commonly used painkiller. Large numbers of vultures were killed by feeding on the bodies of dead cattle that had been treated with this medicine. For the first time scientists were able to demonstrate that a medicinal product could be responsible for severe ecological damage throughout an entire region. In 2005 the Indian government responded by banning the use of diclofenac as a veterinary medication.

The fact that highly specific drugs can also have significant implications for the environment has also been demonstrated by the occasional use of

the active agents of various drugs to combat pests, for example the painkiller paracetamol, which is used against tree snakes, anti-epileptic drugs for pigeons, haemodilutants for rats and coffein for frogs. In individual cases humans can take advantage of these side effects, but usually they represent a risk to the environment that should not be underestimated, and one deserving of a detailed examination by environmental authorities.

Medicinal products in German waters

Initially, a few years ago, it tended to be the more accidental, unsystematic discoveries that revealed the presence of the active ingredients of medicinal products in the environment. A coordinated, nationwide programme of investigations by the Bund/Länder-Arbeitskreis für Chemikaliensicherheit (BLAC) – (Federal/State Working Group for Chemical Safety) has since provided a realistic picture of the actual environmental pollution caused by drugs and medicines in Germany. These findings prove the widespread presence of the active ingredients of medicinal products in surface waters. They also include the agent diclofenac, and, although it has not been approved for use as a veterinary medicine in Germany, some 90 tonnes are used in human therapy annually to treat pain and rheumatism. According to an evaluation of the findings, the River Rhine alone transports some three tonnes of diclofenac each year. Studies carried out in Germany reveal that diclofenac can also cause dangerous levels of kidney damage in fish.

Small doses – far-reaching effects

There is no doubt that, as a rule, measurements of the concentrations of active pharmaceutical agents in the environment are well below the doses of medications used for therapeutic purposes. But this does not mean that the environment is in the clear because, although the quantities of pharmaceutical residues to which the organisms are exposed are relatively small, this exposure is permanent, and the implications remain largely unresearched. Long-term exposure could, for example, have a negative impact on the sensitive reproduction systems of creatures inhabiting the water or the soil. One well-known example is the active ingredient in birth control pills and in some preparations for treating symptoms of the menopause,17 α-ethinylestradiol. When exposed to concentrations of less than one nanogram, i.e. 10^{-9} grams, which can certainly be found in the environment, laboratory fish are much less successful at reproducing.

Another example is provided by fluoxetin, the active ingredient of an antidepressant, which can have severe side effects not only in humans but also on the environment. Concentrations of just a few micrograms per litre of this psychotropic drug can have an impact on the environment, and this can be enough to delay certain stages in the development of fish roe, effects which could inhibit the reproductive capabilities of the fish population. Among the tasks of an EU research programme (ERAPharm – Environmental Risk Assessment of Pharmaceuticals) involving researchers from various authorities, industry and universities as well as experts from the UBA is the continued investigation of the environmental risks posed by this ingredient. This project will also seek to establish whether there is a need for new tests to identify specific effects when determining the environmental impact of medicines.

Photo: Britta Pohl / ECT Oekotoxikologie GmbH

Development of a method of testing using dung beetles in order to assess the environmental risks presented by veterinary medicines.

Licensing of veterinary medicines: legislation stands the test

There has been a proven need for the environmental assessment of veterinary medicines that has formed part of the Law on Medicinal Products since 1996. In recent years practical experience has shown that the use of some veterinary

medicines has created environmental risks and that consequently their licensing should be accompanied by certain conditions intended to help to protect the environment. The development of various guidelines for the environmental assessment of veterinary medicines was completed in 2005, thus ensuring international harmonisation of the requirements for such an assessment. The following section gives some practical examples of this assessment work.

The use of **pharmaceutical products for treating fish in aquaculture:** A pharmaceutical company recently applied to market a medicinal product in Germany for treating marine lice in salmon farms. From the studies into the effects of this medicinal product that were submitted by the applicant it was evident that such products not only killed the marine lice but also endangered other marine life such as worms, shrimps and shellfish. Laboratory studies also showed that the preparation was not biodegradable in the sediment on the sea floor. Extensive field trials under realistic conditions in Scottish and Canadian fish farms did nothing to reduce the concerns about a serious risk to the environment. Moreover, initial investigations showed that the medicinal product met the criteria for defining hazardous materials that have been imposed by the OSPAR Commission for the Protection of Marine Life in the North Atlantic. It is persistent, bioaccumulative (builds up in living organisms) and toxic. One of the aims of OSPAR is to achieve a complete ban on the discharge of hazardous substances into the sea in future. Consequently, for environmental reasons, the use of this drug in fish food was not possible. The manufacturer's application for Marketing Authorisation in accordance with Directive 2001/82/EG was withdrawn.

Antibiotics in agriculture: Veterinarians regularly use antibiotics to treat farm animals that are kept in sheds or on open grazing land. Each year some 700 tonnes of substances are used to restrict or kill bacteria, especially in cattle and pig production. Some categories of antibiotics are already well known for their toxic effects on plants and algae, quite apart from the fact that they change the composition of communities of microbes and can promote the spread of resistant bacteria. Before such drugs are authorised it is also vital to establish whether they break down in manure, which would reduce the environmental risk should the manure subsequently be spread on farmland.

Products for ridding dogs of fleas: Risk reduction measures intended to improve the environmental safety of veterinary medicines are not confined solely to farm animals. This is evident from the licences granted for the flea collars and drops used to treat parasites on dogs. The packaging of a number of these products includes advice not to allow the animals to swim in lakes and other surface waters for a certain period following treatment, in order to avoid any toxic effects on water creatures.

Environmental assessment of medicinal products for humans – a start has been made

In contrast to veterinary medicines, the environmental assessment of pharmaceutical products for humans has only just begun. One of the main reasons for this is that there has, until now, been no coordinated assessment concept for testing the environmental safety of human medicines. However, over the past three years, under the leadership of the UBA, significant progress has been made in developing the relevant guidelines, enabling the body responsible in the European Union (EU) to grant approval of this assessment concept in June 2006. The next few years will be dominated by the evaluation of the ecotoxicological findings associated with the authorisation, and by the work of gradually building up a picture of the impact and the way that human medicines react in the environment.

One particular task remains to be addressed by the UBA and the institutions in other EU countries that are engaged in the evaluation process. In the past only new medicines have been subject to an environmental assessment. However, in the case of animal medications it is mainly the older active ingredients that are used for treatment purposes. No strictly regulated environmental safety tests existed when they were first launched on the market and licensed. For this reason the UBA has for some time been urging the EU to introduce an environmental assessment programme for these ingredients in order to fill in any gaps in knowledge about environmental risk management and, where necessary, to produce a set of conditions that will guarantee the environmental safety of all veterinary medicines for the future. The EU legislation on medicines that was amended in 2004 now includes a test to investigate existing medicinal products. However, the structure of EU specifications still remains unresolved. Consequently a research project begun by the UBA at the end of 2005 is intended to produce a list of priorities for those existing veterinary medicines with the greatest environmental

priority, with reference to their ingredients. In addition this project should offer suggestions about the most effective and efficient environmental assessment of existing veterinary medicines, with the involvement of all European Member States and the European Medicines Agency.

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Department IV 2 „Risk Assessment"

Protecting the environment – assessing pesticides realistically

Some 95 per cent of farmers in Germany use pesticides to safeguard their harvests. Only five per cent largely reject the use of these products and practice organic farming methods. Pesticides must be authorised before they can be used in Germany and in the rest of the European Union (EU). The pesticide manufacturers apply for these authorisations and the applications are subject to scientific examination by a number of national authorities to determine the efficacy of the products.

The approval procedure is the same throughout the EU. The objective is to ensure that, if used correctly used pesticides do not harm humans or the environment. The Federal Environment Agency (UBA) examines whether unacceptable environmental risks can be ruled out and either grants or refuses to issue an authorisation for the active substance. Pesticides will only be approved provided that no unacceptable risks to humans and the environment can be expected. Products without UBA-authorisation due to likelihood of harmful environmental effects may not be used in Germany. This has occurred several times in recent years in the cases of products containing the following active substances: lindane, endosulfane, aldicarb, azinphos-methyl, fenthion, parathion and triphenyl tin.

Many efforts have been made in recent years to reduce the amount of pesticides used and increasingly effective substances have been developed, of which only very small quantities are needed in order to protect against pests. Nevertheless the amount of pesticides sold in Germany remains more or less constant (see Table 10).

Each year German farmers apply 34,000 tonnes of pesticidal substances to an area covering almost one third of the country. Pesticides are extremely effective biological agents and there are many ways in which they can affect the environment including the animals and plants that inhabit them. It is therefore vital that applications for licences for such products should be carefully scrutinised and assessed. This is the responsibility UBA's Division "Chemicals and Biological Safety".

Table 10: Sales of active substances used in pesticides in Germany (in tonnes)

Pesticides*)	Year								
	1994	1995	1996	1997	1998	1999	2000	2001	2002
Herbicides	14 834	16 065	16 541	16 485	17 269	15 825	16 610	14 942	14 328
Insecticides, acaricides incl. synergists	4 006	4 925	3 797	4 696	6 276	6 125	6 111	6 518	5 889
also includes inert gases**) for protecting stocks	*3 037*	*4 064*	*3 006*	*3 941*	*5 239*	*5 172*	*5 266*	*5 778*	*5 147*
Fungicides	7 698	9 652	10 404	9 397	10 530	9 702	9 641	8 246	10 129
Others	3 231	3 889	4 343	4 069	4 808	3 751	3 232	3 957	4 332
Together	**29 769**	**3 4531**	**35 085**	**34 647**	**38 883**	**35 403**	**35 594**	**33 663**	**34 678**

**)* *Includes products not yet ready for use (pre-formulations)*

***)* *Carbon dioxide and nitrogen*

Source: Annual Statistics on Food, Agriculture and Forests 2003

In the course of the examination attention is focused initially on exposure of the environment to these substances. The UBA carries out tests to determine concentrations of the substances under investigation and to which organisms in the environment are exposed. As a first step the distribution and decomposition of the substance and its accumulation in organisms are investigated. This is followed by an assessment of the concentrations which are likely to cause environmental damage.

The assessment is based on studies which the pesticide industry is required to conduct. In general laboratories carry out this work in accordance with harmonised rules for such tests as laid down by the EU or the Organisation for Economic Co-operation and Development (OECD). In order to obtain authorisations for substances of questionable environmental safety producers increasingly submit highly complex and detailed studies and commentaries. This work requires an ever rising amount of person work time substance investigated. The greatest challenge currently facing UBA is how to maintain a high level of environmental protection despite the increasingly complex and demanding assessments of such substances.

Table 11: Indicators for the use of pesticides in Germany

	absolute	proportionate
Area of country 2003	357031 km^2 [a]	–
Cultivated area 2003	118 281 km^2 [a]	33 %
Area under organic cultivation (proportion of agric. land) 2003	–	4,3 % [a]
Set-aside areas (proportion of cultivated land) 2003	–	7 % [a]
Area of land treated with pesticides	105 000 km^2 [c]	29,5 % [c]
Sales of pesticide agents 2002	34 678 t [b]	–
Amount of pesticide agents used	3,3 kg x ha^{-1} [c]	–

[a] *Federal Statistics Office, 2004*

[b] *Federal Ministry of Consumer Protection, Food and Agriculture (BMVEL), 2004*

[c] *calculation using above details*

Environmental exposure

Environmental exposure encompasses a description of the way in which the substance enters the environment (routes and quantities), the behaviour, the fate and the degradation of the active substance (and also its degradation products) in the environment. UBA considers the following aspects in its assessment of environmental exposure:

- the possible routes by which substances find their way from their use in agriculture into the environment and a quantification of the respective amounts entering the environment;
- the biological and physical transformation of material in the various compartments of the environment: air, water, sediment and soil;
- the expected initial, current and average environmental concentrations (Predicted Environmental Concentration, PEC) for different areas of the environment. The main routes by which these concentrations enter the environment must be identified and described in order to be able to calculate their amounts.

In carrying out its assessment for surface waters, i.e. rivers, lakes and the ocean, UBA considers the entry paths of drift, deposition following evaporation, surface run-off and drainage. In determining levels of environmental exposure calculations are made, enabling an estimate to be made of the appropriate concentrations of active ingredients of pesticides for their correct use in ground water, the soil and surface waters in accordance with regulations. Calculations are based on simple as well as complex mathematical and technical simulation programs.

The effective assessment of environmental exposure is ensured by using a tiered approach. At the lowest, first stage of the assessment general, realistic worst-case calculations are used. An ecotoxicological assessment is used to determine whether a more refined exposure analysis needs to be prepared, taking into account specific and more realistic parameters. In such cases additional, more detailed studies of the behaviour and fate of the active substances of pesticides are necessary. If, even taking into account an improved exposure assessment, the possibility that the substances are harmful to the environment still cannot be excluded, farmers may only apply these pesticides to the fields subject to certain conditions or regulations. These conditions may require that a certain distance from surface waters

be maintained when the pesticides are spread on the land, or restrictions may be imposed on the areas where they can be used, or on the quantities and the timing of their application. If, despite this reduced exposure, it is not possible to guarantee safe use of the substance, the UBA will not grant of a marketing authorisation.

Probabilistic estimate of exposure

An improved estimate of exposure (higher tier exposure assessment) can be regarded as more realistic but is often more specific. In such cases the carefully chosen framework conditions for the calculation models will determine how representative the result will be in revealing the general situation with regard to exposure.

In contrast to deterministic estimates of exposure, in which scenarios and models are defined according to individual, concrete values, which then automatically "determine" the corresponding environmental concentrations, the probabilistic approach tends to be used more by applicants and the regulating authorities when the estimated concentrations are higher and more specific. In such cases the assessment utilises distribution functions for determining the probability of the occurrence of certain values which characterise exposure. This also enables a probability distribution to be deduced for the expected environmental concentrations, which in turn can be used in a probabilistic, ecotoxicological risk assessment. In this way environmental risks can be "quantified".

Probabilistic impact assessment

The probabilistic impact assessment provides a higher tier risk assessment for pesticides similar to the probabilistic exposure assessment. Taking as its basis a number of effects tests for animals and plants, the assessment authority uses mathematical methods to model the distribution of the sensitivity of all species of organisms to a particular pesticide (Species Sensitivity Distribution, SSD). The risk to organisms in the environment can be quantified by comparing the probabilities for exposure distribution and the distribution of sensitivity, using the extent of overlap of the two curves. This form of data interpretation is being used increasingly in the approval process. However, so far no binding guidelines for the interpretation and assessment of this data have been agreed. Therefore the development of such guidelines is necessary in order to provide legal security for companies applying to licence their pesticides, while at the same time ensuring a high degree of protection for animals and plants. UBA is part of a European-wide partnership comprising authorities, 29 universities and industrial companies currently engaged in the European EUFRAM Project (www.eufram.com) to prepare the foundations for a standardised assessment of pesticides using probabilistic methods.

Moving water section of the installation for simulating flowing and standing water. Water and the aquatic communities they contain can be reproduced here.

Improved tests to determine effectiveness

Assessments of the effective properties of pesticides tend to be more extensive than standard tests. Improved tests at a higher level are being used in an effort to simulate reality in the field as closely as possible. The interpretation of such tests is more complex and so far little progress has been made in standardising the assessment criteria. In many cases, the more sophisticated tests do not only examine the impact on individual species but on communities that are exposed to the pesticides. If necessary it is important for the UBA to conduct random control and plausibility tests itself by employing ecosystem models and introducing some of the experience gained in previous assessments. For this purpose it operates a large experimental facility known as the Artificial Pond and Stream System (FSA) for simulating conditions in lotic and lentic waters. It is located at the Federal Environment Agency's testing facility in Berlin-Marienfelde and consists of a large, new and technically advanced research unit equipped with 16 flumes with a total length of 1.6 kilometres, 16 ponds and around five kilometres of pipes with more than 60 pumps and 360 valves and all the relevant test and measuring equipment. This installation can be used to simulate the conditions in surface waters, from streams and rivers to ponds and lakes, as well as river-fed lakes. The FSA is one of the largest model ecosystems, known as mesocosms, the link between simplified and easily monitored laboratory experiments and field studies.

Mixtures of pesticides

At present when pesticides are being authorised all substances are assessed as if they impacted independently on the environment. However, from analyses of the pesticide residues in food and the readings taken in surface waters it is apparent that, in many cases, multiple residues are present and that animals and plants could be exposed to a mixture of several different active ingredients of pesticides as well as other substances. Under unfavourable circumstances a separate assessment of the individual substances may cause the actual risk to be underestimated. The effects can be significantly intensified if several contaminants are present simultaneously. The combined European research project ACE (www.the-ace-project.info), which ended in 2005, created a scientific basis for assessing combinations of substances. Applying these fundamentals to practical assessments and regulation will be one of the main tasks in the risk assessment of pesticides and other substances during the coming years.

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DIVISION E "EMISSIONS TRADING. GERMAN EMISSIONS TRADING AUTHORITY"

The European Union (EU) introduced a new instrument for international climate protection on 1 January 2005: emissions trading, the trade in the rights to emit the greenhouse gas carbon dioxide. The EU Emissions Trading Directive that was approved in 2003 is put into practice in Germany as the Greenhouse Gas Emissions Trading Law (TEHG), as the Allocation Law 2007 (ZuG 2007), and as the Project Mechanisms Law (ProMechG). The public authority in Germany with responsibility for supervising emissions trading is the Deutsche Emissionshandelsstelle (DEHSt). It was set up in 2004 as Division E (Emissions Trading) of the Federal Environment Agency (UBA). The DEHSt is largely responsible for the infrastructure of emissions trading in Germany as it applies to European emissions trading system. As for the trading period 2005–2007, the DEHSt scrutinizes the applications for emission allowances from operators of installations, issues the certificates and verifies annual reports on emissions from these installations.

From the very beginning the EU has been considering an extension to this system. The five other greenhouse gases referred to in the Kyoto Climate Protection Protocol (methane (CH_4), d-nitrous oxide (N_2O), partially halogenated fluorohydrocarbons (H-FKW/HFC), perfluorated hydrocarbons (FKW/PFC), and sulphur hexafluoride (SF_6), could also be included in the European emissions trading system. The EU is already discussing the inclusion of other sectors, particularly aviation. These extensions would establish emissions trading on a broader basis.

The DEHSt is financed entirely through the revenue from fees. The authority adopts a service-based approach wherein all business processes are IT-based. The primary target groups of the DEHSt are operators of installations and expert bodies, i.e. large energy supply companies and industrial enterprises whose plants are a major source of emissions.

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 Services and Legal Matters"

A commitment to service

The DEHSt spent much of 2004 preparing for emissions trading, which resulted in a successful start. From the very beginning the DEHSt developed and consistently applied a communication strategy with the emphasis on service. When communicating with its customers and to improve its own work, the authority uses the latest facilities and especially electronic media for the new environmental policy instrument of "emissions trading". Companies, expert bodies, the federal states, consultants, as well as the media and the general public are the main target groups for the DEHSt in its public relations work and in meeting the needs of its customers.

The direct line to customers: one of the staff at the DEHSt customer service centre.

The internet brings everything closer

At the heart of its work of disseminating information the DEHSt relies on an extensive and comprehensive website, using a content-management system. As a result DEHSt web editors can always supply specific target groups with the latest, relevant details about current and imminent emissions trading requirements. There is a good response to the continuous flow of up-to-date communication. This is evident in particular from the large number of hits, peaking at more than 34,000 monthly, with up to 15,000 individual pages being accessed daily – and from the positive feedback about on up-to datedness and directions for users.

The website also provides access to a steadily increasing number of publications. In addition to general background information on the function of the system and its legal foundations, initial ducumentations and reports on the allocation process in 2004 have been available since mid-2005. Herein, DEHSt experts have analysed the distribution of the 495 million emission allowances issued annually for the period 2005 to 2007 according to federal states and the participating sectors of industry. The German Emissions Trading Authority (Deutsche Emissionshandelsstelle) can be found at www.umweltbundesamt.de/emissionshandel.

The direct line to customers

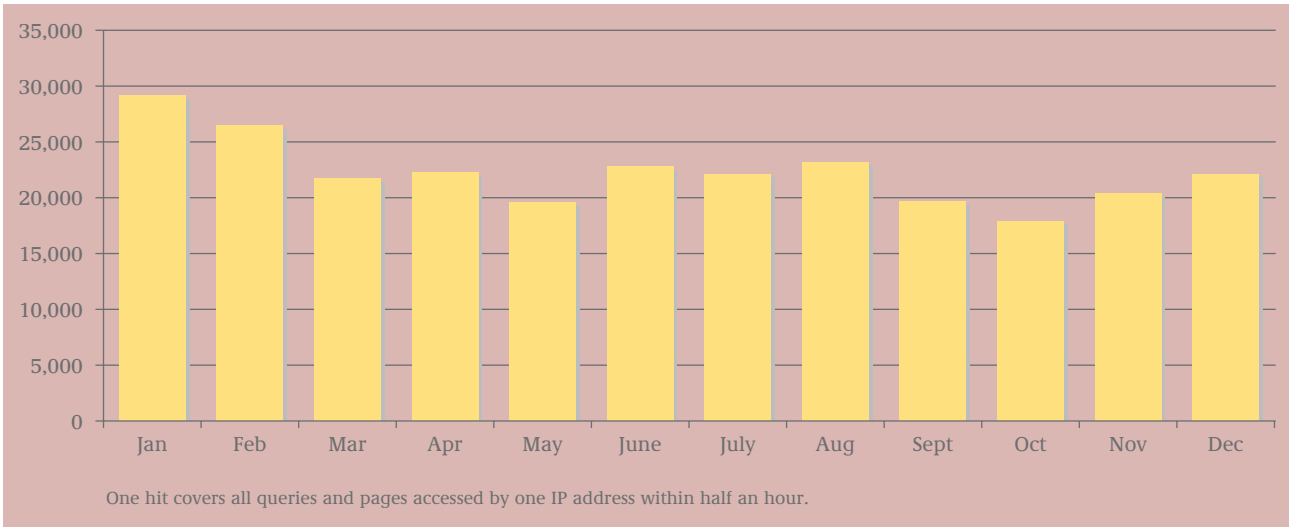
The DEHSt has set up a highly effective hotline to deal with individual queries, especially from the operators of about 1,850 participating installations and expert bodies. The hotline exemplifies the commitment to customer service by being a central and permanent contact centre for all queries concerning practical issues involving emissions trading. The DEHSt practises the approach of "one face to the customer", whereby customers only have to deal with a single organisational unit. Central Customer Service can be contacted by telephone on (+49(0)30/8903-5050) or by e-mail (emissionshandel@uba.de).

Since the launch of the hotline, the customer service staff handled between July 2004 and December 2005 over 23,000 enquiries, 13,000 of them during the first trading period 2005 (see figure 20, p. 93). These figures do not include enquiries from the press, radio and television. Additionally, customers receive the latest information and new details about various aspects of emissions trading, such as applications, the registratry, accounts and emissions reports directly by e-mail.

Public information

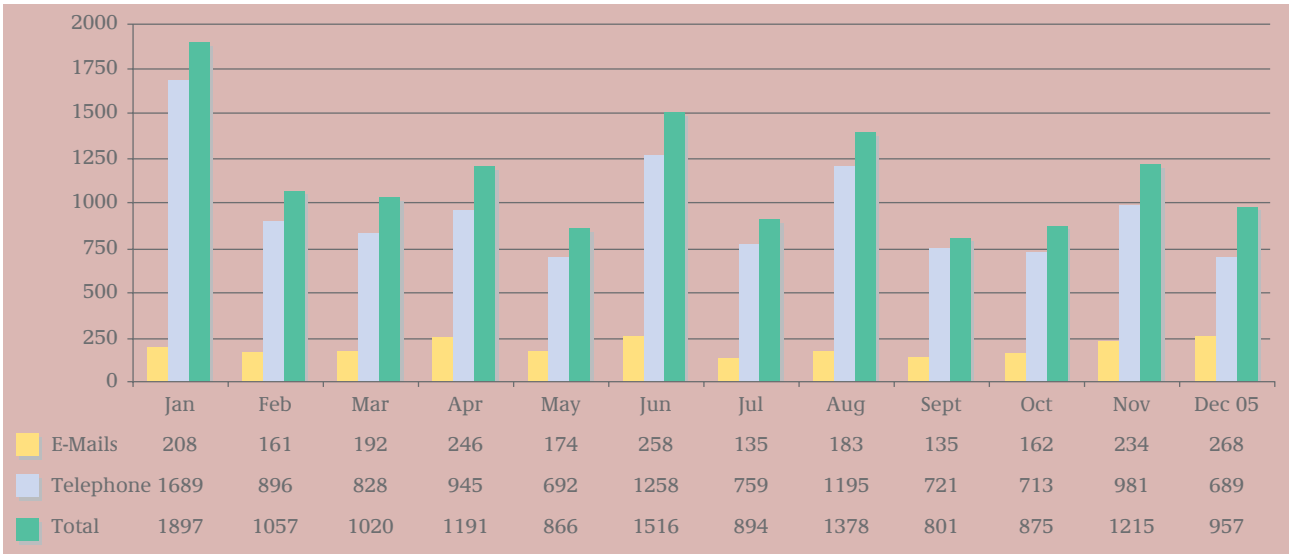
In 2005 the UBA issued five press releases on the subject of emissions trading. In addition the president and the head of the "Emissions Trading" Division conducted over 30 interviews and press conferences. This open approach to press work has proved highly effective: in 2005 UBA recorded numerous media references to the "Emissions Trading" Division, in particular in national dailies and in business publications. In addition DEHSt section managers reported on emissions trading to the participants of nearly 70 national and international information events.

Figure 19: Number of hits on the DEHSt web site in 2005



One hit covers all queries and pages accessed by one IP address within half an hour.

Figure 20: Number of enquiries acknowledged by the DEHTSt hotline in 2005



Emphasis on service

The various forms and methods of communication (internet, customer services, press releases, mailshots, papers) complement one another. Working together with the staff of the hotline and the DEHSt experts on emissions trading the web editors deal with the questions that are most frequently asked by operators of installations and expert bodies. These FAQs are then edited and posted on the internet. The communication specialists also edit and provide information for the specific target groups, which is forwarded via e-mails. The DEHSt seeks this sort of synergy in communication and adopts it as part of its public relations strategy. There is generally a very good public response to the customer services and public relations work.

A new legal area

The emissions trading system is a completely new legal field with no precedents elsewhere and with application and interpretation still undergoing further development. The European-wide launch took place on 1 January 2005, based on the European Emissions Trading Directive of 13 October 2003. With the German Greenhouse Gas Emissions Allowance Trading Law of 15 July 2004 and the Allocation Law of 26 August 2004, along with several German regulations, the federal government, Bundestag (lower house of the German parliament) and the Bundesrat (upper house) created the statutory basis for emissions trading within a relatively short period of time.

The DEHSt issued 1,849 relevant notifications as early as December 2004 as part of the allocation process for granting emission allowances for the trading period 2005–2007. However, recipients did not accept all these rulings unreservedly. Although the majority of allocations have since become final and absolute, a considerable number of operators of installations availed themselves of the opportunities to which every citizen is entitled when faced with administrative decisions. In an effort to obtain increased emission allowances appeals were submitted against the allocation ruling of 2004 and against decisions about the level of administrative charges to be imposed. Dealing with appeals accounted for a great deal of the work with which the legal department of the DEHSt was confronted with in 2005; and continued during the first half of 2006. Final clarification of disputed legal issues from the trading period 2005–2007 will not be obtained until final and absolute judgments have been made by the courts. DEHSt expects its correct work to be affirmed.

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Department E 2 "Energy Sector Allocations, Reserve Management, and Registry"

Components of the emissions trading system

In Germany the implementation of the European-wide trade in emissions is regulated by the German Greenhouse Gas Emission Allowance Trading Law (Treibhausgas-Emissionshandelsgesetz – TEHG) and the Allocation Law (Zuteilungsgesetz 2007 – ZuG 2007). From 2005 onwards the amount of harmful carbon dioxide (CO_2) emitted by installations subject to the TEHG must not exceed the amount stipulated in their emission entitlement. If their emissions exceed this level operators must purchase more rights or take steps to reduce their emissions. If the amount of CO_2 emitted by installations is below their allocated amount, for example as the result of a changeover to a fuel with reduced emissions, the operator may sell the emission rights that are not needed for his own plant.

From 2005 onwards for the first time the operators of installations that are subject to the TEHG have been required to prepare an emissions report, which must be submitted to the relevant state authority by 1 March 2006. Together with the allocation of emission rights, the monitoring of CO_2 emissions and the annual reports detailing the amount of CO_2 actually emitted form the main components of the emissions trading system. Preparatory work and assistance for operators formed one of the main features of the work of the Division E/DEHSt in 2005.

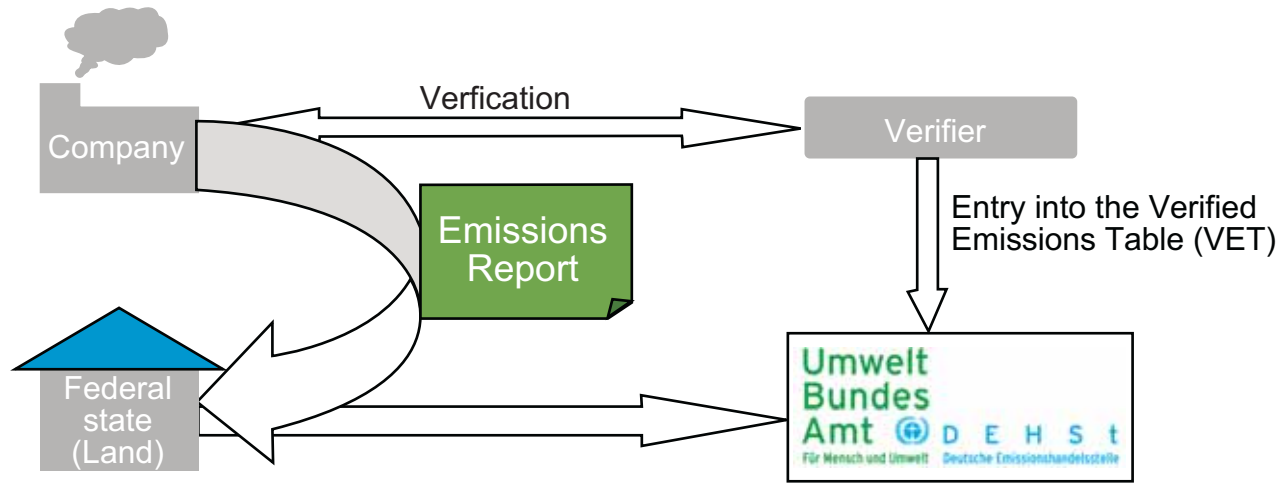
Reporting on emissions: drawing up an annual balance sheet

The basis for the annual "balance sheet", i.e. the surrender of emission allowances, is provided by the actual CO_2 emissions of an installation in the respective year. The annual emissions report is of major importance, in particular in terms of the accuracy and credibility of the recorded and reported CO_2 emissions. German and European rules of law therefore specify detailed requirements for reporting on and monitoring of CO_2 for installations subject to emissions trading. These so-called Monitoring Guidelines are central elements to which operators must comply. A further key element is the verification of the operators' installation by the relevant experts, who conduct the "on-site examination".

In the process of reporting and monitoring DEHSt receives the emission reports, together with the verifiers's test report from the competent state authorities. If the emission report is subject to random testing by the state authorities, the DEHSt also receives the results of this examination. If a proper report on CO_2 emissions is not submitted, DEHSt estimates the levels for the previous calendar year in accordance with rules laid down by the TEHG. This estimation is binding in regard to the obligation to surrender emission allowances.

The interaction between federal and state authorities

The DEHSt coordinates technical implementation of the requirements of the monitoring guidelines



between the federal and state authorities, primarily in the working group set up for this purpose, the "Technical Exchange of Information about Monitoring Guidelines". Within this working group DEHSt experts work together with coordinators for emissions trading coordinators appointed by the Federal Environment Ministry and the federal states' environmental offices. Their objective is to avoid unfair competition resulting from the differing ways in which the monitoring guidelines are applied in the various federal states, and to achieve the standardised application of the measurement and assessment regulations which form the quantitative basis for allocations and for the emission report.

Such harmonisation provides the participating companies with a high degree of legal security. At the same time the participating authorities are able to reduce their administrative work and the transaction costs for the companies and expert agencies can be kept as low as possible. Furthermore, as an opinion-forming forum for the review process on a European level, the working group follows the work of scrutinising the monitoring guidelines. The guidelines are revised on a European-wide level in order to effect further improvements to the monitoring of the trade in emissions and to ensure uniform implementation in all member states. All member states, the authorities concerned and other partners in the process, such as trade associations, are asked to contribute to this process.

For example this working group has harmonised the requirements imposed on the monitoring concept and the emission report, answered numerous technical queries relating to implementation of the monitoring guidelines, discussed the tasks and test criteria to be applied by the expert agencies and also coordinated a uniform format for reporting on emissions. The DEHSt subsequently published the results on its web site. They included a general sample monitoring concept and examples of monitoring concepts for specific industries, outline details of the 60 most important questions and the answers to them, a technical concept for reporting on emissions and an XML interface for CO_2 reporting software.

Filing reports electronically

Within the framework of the BundOnline 2005 initiative the DEHSt has developed a form management system for filing reports electronically in order to help operators of installations, verifying agencies and authorities in the work of reporting on installations subject to the emissions trading regulations and to provide them with practical assistance. The relevant software has been developed using the technical concept for reporting on emissions and applying the requirements contained in the monitoring guidelines. Since the beginning of 2006 it has been available free of charge to operators of installations, expert bodies, i.e. verifying agencies and state authorities.

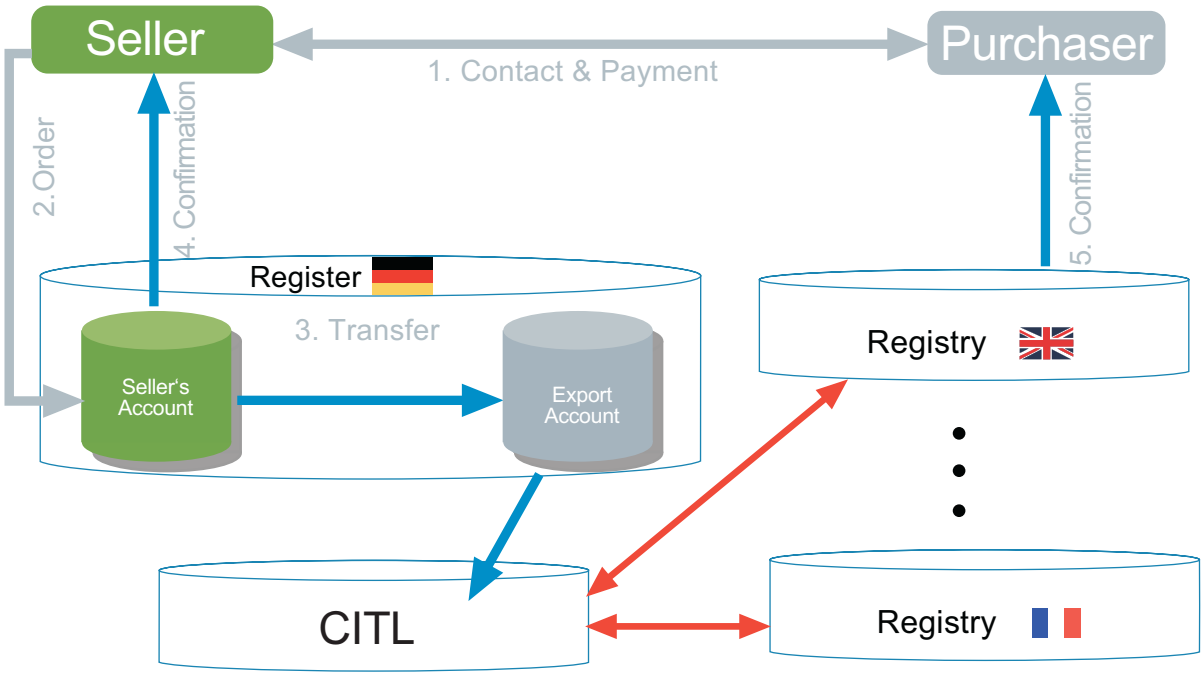
The registries and the European trade in emissions

Each of the 25 countries participating in the emissions trading system of the European Union (EU) is required to maintain a national emissions trading registry. The Community Independent Transaction Log (CITL) in Brussels is the central system in Europe, responsible for coordinating the national registries and the electronic communication between them. Transactions can take place between the accounts on a national registry as well as between accounts on the registries of the various European member states. The CITL examines and approves national and international transactions before these can be carried out. Emission allowances in Germany are administered by the National Emissions Trading Registry. Maintaining the central registry falls into the field of Department E 2 of the Deutsche Emissionshandelsstelle (German Emissions Trading Authority).

Electronic "cadastre"

The registry fulfils a function comparable to that of an electronic cadastre. Just as a land register compiles details about when real estate is purchased or sold, the details of certificate-holders are entered in this register. It provides a record of which certificates were assigned, between whom, and when.

For the first trading period, 2005–2007, the DEHSt issues about 1.5 billion emission allowances in annual tranches, each of one third. A special online platform has been developed not only to administer the emission allowances of operators and traders but also to register the transfer of allowances in accordance with EU regulations. The registry provides an electronic platform that enables emission allowances to be administered in a paperless form, meeting the highest safety demands and ensuring constant availability for the account-holder. Buyers and sellers access the registry through the internet portal in



order to initiate transactions for the transfer of emission allowances, to check the state of their accounts and the status of ongoing transactions.

How the registry functions

The operators of the approximately 1,850 installations of the energy sector and industries involved in emissions trading receive an account in the DEHSt registry. This account contains the emission allowances that they have been granted. In the course of the trading periods the operators of the installations as well as any other person can open additional accounts and can buy and sell allowances. The principle is that any individual or legal entity may set up an account in the emissions registry, allowing them to hold and trade allowances.

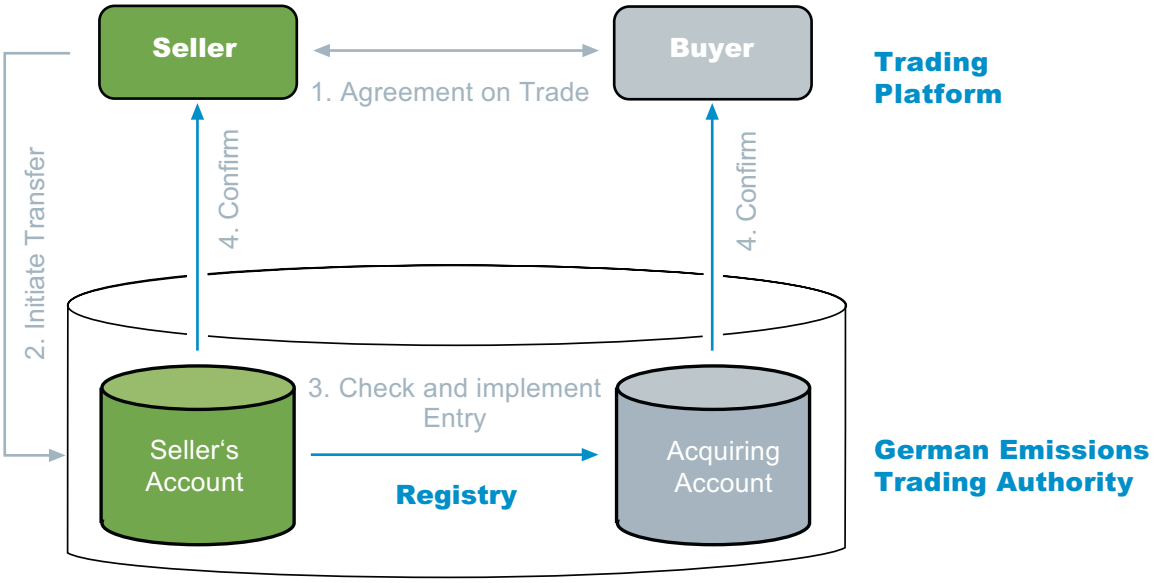
Following an agreement under private law for the sale of allowances the vendor makes an entry in the registry, enabling a transfer to be made from his account to that of the purchaser. Only when this entry has been made and the relevant debit and credit entries have been made in the accounts is ownership of the allowances transferred to the purchaser.

In addition to operator holding accounts the DEHSt has set up in 2005 so-called person holdings accounts for more than 130 legal entities and individuals. As a result the German Emissions Trading Registry is used by more traders than any other registry in Europe. For the entire trading period 2005–2007 the cost of keeping an account is a single payment of 200 euros, which covers all the account expenses and services.

European-wide cooperation has also been positive. The European central registry CITL is currently linked with 17 national emissions trading registries and preparations have already been made for the trade in emission certificates from the project-based mechanisms of the Kyoto Protocol – Joint Implementation and Clean Development Mechanism. Both the national and European-wide transactions affecting German accounts have been conducted securely and smoothly. By the end of 2005 there had been a sharp rise in the number and volume of transactions.

Positive balance sheet for the first year

One year after the introduction of European emissions trading the Federal Environment Agency has been able to draw positive conclusions about this new instrument for promoting climate protection. Over 100 million emission allowances have been transferred between March 2005, when the registry was launched, and early 2006. This represents roughly 20 per cent of the emission allowances issued in Germany in 2005.



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CENTRAL ADMINISTRATION

The Central Administration is responsible for administrative control and services for the Federal Environment Agency (UBA). These consist of traditional administrative tasks, personnel, budget, organisation, real estate, administrative supervision of research projects, IT services and supervision of the agency's business-oriented control and management instruments. These include cost and performance accounting (CPR) and combining technical and resource responsibilities in the specialist units.

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

Budget and permanent positions / Positions

In 2005 the UBA had a total operating budget of some 123 million euros. Table 13 shows the amounts allocated to selected areas.

In the 2005 budget the UBA was granted the full complement of 92.5 (permanent) positions for the first time for the Division E (German Emissions Trading Authority, see page 91). 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 was able to economize by cutting 16 positions.

Training

Under a "National Pact for Training and Specialist Trainees in Germany" the UBA provides a total of 65 training places in seven different occupations at four of its locations. In addition to administrative staff, media and information specialists, they consist of biology and chemistry laboratory assistants, information technology specialists, systems engineers and electricians specialising in building services and infrastructural systems.

Flexible working times at the UBA

Between March and December 2005 all operating units at the UBA tried out a new working time model which gave improved flexibility to staff working times while continuing to ensure that these units remained fully functional and able to meet the requirements of their customers. The period during which staff carry out their day to day work has been extended (Mondays to Fridays from 6 a.m. to 9 p.m., Saturdays from 6 a.m. to 1 p.m.). Instead of inflexible, compulsory working hours for all staff there are clearly defined service

Table12: Permanent positions / Positions (budgetary allocation)

Year	Total	Civil Servants	Employees	Worker
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	1,015.3	400	542,3	73
2005	1,136	410	653.8	72.2

Table 13: Budget of the Federal Environment Agency

		Target 2004 in 1,000 Euro	Target 2005 in 1,000 Euro
I.	**Budget of the Federal Environment Agency**		
I.1	**Total expenditure**	**97,676**	**85,205**
	comprising		
	– Personnel expenditure	51,654	55,457
	– Investment expenditure	26,704	10,428
	– Costs of scientific publications and documentation	338	355
	– Environmental information and documentation system (UMPLIS)	2,553	2,247
	– Information technology	4,537	4,184
I.2	**Services requested by Federal authorities and third parties**		
	– Federal authorities*	1,310	1,172
	– EU, others**	2,419	2,723
II.	**For administration of funds assigned from other sectors**		
including for			
	– investments towards pollution abatement	11	24
	– Award of research projects (UFOPLAN)	17,530	18,065
	– Environmental Specimen Bank	4,193	4,331
	– Subsidies for associations, federations, other organisations		
	– Institutional assistance	1,410	1,821
	– Assistance for projects	6,440	5,580
	– Environmental publicity	1,170	1,153
	– Advice about environmental protection in the countries of Central and Eastern Europe and in the Newly Independent States (NIS)	2,129	2,195
	– International cooperation	947	897
Sum total of the funds assigned for administration from other sectors		**33,830**	**34,066**

*** actual expenditure**

periods (Mondays to Thursdays from 9 a.m. to 4 p.m., Fridays from 9 a.m. to 3.30 p.m.) when all units can be contacted and are required to be able to deal with queries. The precise structuring of these service times and the services provided is a team process.

A survey conducted at the end of the trial phase revealed that

- more than 80 per cent of employees want to retain the flexible working times,
- over 60 per cent identified positive effects on the functioning of the work units, the clarity of work processes, teamwork and individual responsibility,
- 50 per cent have become aware of improved customer satisfaction and
- 80 per cent notice a greater degree of work satisfaction and motivation as well as improved ways of combining a career and a private life.

Initially these flexible working times will remain in force until the end of 2006 but it is eventually planned to introduce them on a permanent basis.

Administrative project support

The section Z 6 "Administrative Project Support" 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 the statutory enforcement tasks and commissions for services supported by UBA budgets.

In order to assure the success of a specialist project it is important to plan and follow its progress as comprehensively as possible, to examine it from a technical and administrative viewpoint, and to incorporate its findings in the Agency's services. In 2005 the Section dealt with a total of 566 projects for payment (Table 14), of which 190 were newly awarded, the remainder consisting of commissions or subsidies that have been ongoing for several years.

Table 14: Projects for which Section Z 6 provided administrative support in 2005

Designation	Expenditure in millions of euros	Number of projects
Environmental Research Plan (UFOPLAN 2005)	16.27	405
Support for UBA/BMU in fulfilling their tasks by making use of external specialist knowledge	1.81	46
International environmental cooperation	0.41	20
Operating the National Environmental Samples Bank (UPB)	4	7
Advice on environmental protection for the countries of Central and Eastern Europe and the Newly Independent States	2.2	51
Operation of a network of stations for monitoring cross-border atmospheric pollution	0.75	15
Institutional assistance		
– Deutscher Arbeitsring für Lärmbekämpfung (German Noise Abatement Organisation) – Verein Deutscher Ingenieure (Kommission Reinhaltung der Luft) [German Engineers' Assn. – Air Purity Commission]	1.37	2
– Support for the standardization activities of the standards organisation 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	2.72	15
Other projects		
– UNEP course „Environmental Management for Developing Countries" – Programme of the Climate Technology Initiative (CTI) – Measures for implementing the Law for Protection against Aircraft Noise – Support for membership of UBA/BMU in various associations and federations (17 in all) – Centrally based advanced training for specialists and executives	0.84	5

100

Combining specialist responsibilities with the responsibility for resources

The UBA is endeavouring to combine technical responsibility with the responsibility for resources, and to make performance and costs more transparent. For this purpose three main components, supported by data processing, have already been implemented:

- Cost and performance accounting (CPR),
- procedures for recording working times using an electronic budgetary management system, and absorption costing supported by vouchers,
- fee management for the Division E (German Emissions Trading Authority)

In future, as part of the work of product planning and medium-term capacity planning, the Central Administration will supply the Agency's decision-makers (those with responsibility for cost centres and products) with data that will provide them with a substantially improved basis for the planning and control of services.

During the course of 2006 the UBA will be drawing up a product budget as the basis for cost centre and costing unit (products) budgeting. In the future the calculation of charges and remuneration will become an increasingly important aspect in the financing of services at the UBA too. The CPR will provide the data required for this process. Decision-making processes will have to be adapted to cope with the growing diversity and complexity of the tasks. The controlling introduced in 2005 represents a significant step in this direction. It is intended to support the divisional management and encourage the decentralisation of technical and resource responsibilities.

The Federal Environment Agency in Dessau

On 2 May 2005 the Federal Environment Agency (UBA) began work at its new headquarters in Dessau. Of the 1,300 employees in the country as a whole, more than 750 moved into offices in the newly constructed building in the historic „Gasviertel" area of the city. Where industrial buildings formerly lined the railway tracks an elongated, four storey building has been constructed as a successful example of contemporary architecture. The decision to move the headquarters of the Agency from Berlin to a another city, the home of the Bauhaus, 120 kilometres away, can be traced back to a decision in 1992 by the Federalism Committee of the Bundestag, the lower house of the German parliament, to relocate some federal authorities to the former East German states. For the Agency and its staff this represented a significant turning point and a major challenge.

The logistical tasks were dealt with very rapidly and within seven days the workplaces of the 750 staff, together with all the associated infrastruc-

Making its mark: the new headquarters building is an outstanding example of ecological construction.

ture, were transferred to Dessau from two sites in Berlin, without significantly affecting the operating capabilities of the Agency. However, more time was needed for staff to acquaint themselves with the new building, and to learn about some of its technical and structural constraints and associated architectural changes in the concept of the offices. Although initially something of a construction site, after a few days the situation largely reverted to normal, although some defects still remained. The UBA is monitoring the situation in order to obtain evidence about the efficiency of the sustainable, ecological building work that has been undertaken.

An example of ecological construction with outstanding aesthetic qualities

The architects Louisa Hutton and Matthias Sauerbruch have designed a building with many curves and a façade of timber, steel and glass, enclosing an atrium. Apart from the unusual flowing lines of the building the use of many different colours is a distinguishing feature. In between the wood panelling the colourful glass panels in various shades of green, red and blue fill in the spaces between the windows to create an expanse of mosaics.

This new administrative building is not only striking in an aesthetic sense but also sets new standards for environmental and economical construction. The UBA has always emphasised the advantages of ecological construction and strongly favours environmentally friendly and healthy working and living areas. It was therefore a matter of its own credibility in seeking to meet these demands with its own new building. The glass-roofed atrium is the "green heart" of the Agency as well as serving as a heat buffer. Heat loss from the outward-facing rooms is minimised by the use of a newly developed, highly insulating wood and glass façade. Renewable energy – solar panels for cooling, photovoltaics and a heat exchanger in the soil, providing preliminary heating of the ambient air in winter and cooling it in the summer – help to achieve energy consumption levels 40 per cent lower than those specified by the relevant legislation.

Now that the building has been in use for a year the results are plain to see: at 73 kilowatt hours (kWH) per square metre annually the total electricity and heating requirements are some 48 per cent lower than those of comparable new buildings. Compared with refurbished older buildings the UBA is currently achieving energy savings of 63 per cent. The UBA supports the introduction of the energy pass, as prescribed by the European directive 2002/91/EC for improving the overall energy efficiency of buildings. It is participating in the field trials being conducted by the Deutsche Energie-Agentur (Dena) and in May 2006 it received an energy pass which, in a similar form, will be binding for all new and existing buildings in future [93].

The atrium, a roofed and planted inner courtyard, forms the green heart of the Agency.

In the entrance area the auditorium emerges like a rock from the filigree of steel and glass forming the face of the building.

To settle in Dessau or commute?

For most of the 750 staff the move from the banks of the River Spree to those of the Mulde confronted them with a major decision: whether to base their lives in the Dessau region or to commute. As expected, a large proportion of them commute daily or weekly by rail, others by car. By now some 30 per cent of the staff are resident in Dessau, including those from the region who have since joined the Agency. For this reason and in particular because of the large volume of visitors, including those on business, the quality of the rail services connecting Dessau with the intercity rail network is vital. However, these connections have been deteriorating for several years. By 2007 there will be only one direct IC (express) service between Berlin and Dessau. It is essential that the UBA can be easily reached by environmentally friendly forms of transport if the Agency is to effectively accomplish its many different tasks at home and abroad. The deterioration in the rail connection is a threat to the levels of efficiency that have been achieved so far.

The Agency's new headquarters in Dessau are still attracting a great deal of interest. During the past 12 months over 20,000 people from Germany and abroad, including many building experts, have visited in order to learn more about this ecological and architectural concept [94]. Many trade publications specialising in architecture and construction have also reported on the building. On 8 December 2005 the achievements of the architects and officials responsible for the management of the project were acknowledged by the organisers of the German Architectural Prize, which has helped to give ecologically based construction a stronger presence in everyday building practice, which was one of the main objectives of this project.

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Sources:

[93] The energy pass for the UBA headquarters in Dessau is available as a PDF document at:
http://www.umweltbundesamt.de/dessau/energieausweis.pdf

Additional details about guided tours can be found on the internet at:
http://www.umweltbundesamt.de/uba-info/besucher/index.htm

PRESS AND PUBLIC RELATIONS WORK

To be truly effective, the work of environmental protection needs majority support and committed citizens, for which a well-founded environmental awareness is essential. This does not just happen. "Because we want environmental protection to remain an important concern we have to increase our efforts at communication", insists Prof. Dr. Andreas Troge, President of the Federal Environment Agency (UBA). Environmental issues have to compete with everyday political themes such as the economic situation, the labour market and social policy. The public will only consider such information to be important if it resonates with their own personal experience as well as offering them specific benefits.

Protecting people and the environment, explaining connections

In its public relations work the UBA aims to ensure that as many people as possible are not acquainted with the facts but can also play an active part. This is the task of Section I 1.3 "Environmental Information, Central Answering Service". The information that it provides ranges from advice on reducing electricity consumption in the home to the ways in which the environment can affect our health, as well as such complex issues as climate protection.

On the subject of reducing electricity consumption: each year electrical appliances left in no-load mode, e.g. stand-by, cost German households and bureaus some four billion euros. Among other reasons this is because many televisions, video recorders and stereos cannot be turned off completely, and when left in no-load mode they continue to consume electricity. This unexploited potential for conserving energy can make a significant contribution to climate protection and to protecting resources, as well as helping to cut costs in the home. The UBA is one of the initiators of a campaign entitled "No-Energy", which calls on people to "turn off, conserve energy, protect the climate". In 2005 the UBA succeeded in attracting some heavyweight partners to help with this campaign: the chain of builders' merchants OBI and the National Electricians' Association. Both of them are valuable allies and are assisting the UBA in its work of informing the public. For example, on payment of a deposit, they will loan so-called energy cost monitors to detect losses due to equipment being left in no-load mode in homes and offices. The message is getting through, as the thousands of enquiries received by the UBA and the "No-Energy" campaign confirm. An increasing number of people are taking up this offer in order to find out just where electricity is being wasted in the home.

Photo: Aktion No-Energy

Seeking out the secret electricity-wasters: the energy cost monitor is plugged in between the wall socket and the appliance to be investigated and indicates the consumption.

Environmental pollution can take the form of contaminants in the air or in products, as well as noise and radiation, all of which can seriously affect our well-being and health. So environmental protection that sets exacting standards is also good health care. Efforts in both of these areas frequently pursue the same objectives and call for common strategies. "Environment and Heath" is therefore an interdisciplinary task affecting many different areas of work, including those of the UBA. The main objectives of the "Action Programme Environment and Health" (APUG) initiated by the German government are: to provide the public with better information about health

risks and environmental influences, and to improve risk management and collaboration in the areas of health and the environment at both a national and an international level. In addition to the UBA three other higher federal authorities are also involved in implementing this plan of action.

In 2005 the UBA published a wide range of information on health topics. The publications included titles such as “Umwelt und Gesundheit in Deutschland – Beispiele aus dem täglichen Leben” (The environment and health in Germany – Examples from everyday life), “Gesünder Wohnen – aber wie? Praktische Tipps für den Alltag” (Healthier living – but how? practical, everyday advice) and “Kinder, Kinder! Was hat die Umwelt mit der Gesundheit zu tun?“ (Children, children! What does the environment have to do with health?).


Photo: dbb

Using various media the UBA can provide information for just about every age group and target group.

The internet has now become established as the fourth mass medium, along with print, television and radio. This development presents new challenges for communicating environmental ideas but also offers many opportunities. Communication using online media is faster, the required target groups can be addressed with greater precision and in many more ways, the means available are interactive, and with the new communication channels a wider range of instruments is also available. The UBA is making the most of the available opportunities with its website www.umweltbundesamt.de, with a growing range of services and facilities. These are meeting with an increasing response and attracted 2,613,168 hits in 2005. Most of these were recorded by the sections devoted to “Altlasten” (Existing waste), “Gewässerschutz” (Water and Water Protection), “Bodenschutz“ (Soil and Contaminated Sites), “Wassergefährdende Stoffe“ (Water-hazardous substances) and “Verkehr“ (Transport) – followed by “Lösemittelarme Produkte“ (Products with reduced solvents), “Umweltmedizinischer Informationsdienst“ (Environmental Medicine Information Service) and “Raumbezogene Umweltplanung“ (Environment and Spatial Planning). PDF documents of various sizes have been downloaded 800,000 times from the UBA web pages.

The UBA continues to receive a vast number of enquiries. In 2005 a total of 103,743 enquiries and orders for brochures and other informational material were received. 12,773 members of the public came for personal meetings and to learn about the range of information available from the Agency.

Special Environmental Library

The new main location of the specialized Environmental Library was opened to the public in September 2005. A former factory building, now listed, and another building connecting it to the office building, are used to house more than 300,000 books and other media such as periodicals, microfiches and slides.


Photo: dbb

With over 5,000 visitors within the first three months after its opening this library soon became a magnet, especially for pupils and students. It provides up-to-date information and an extensive range of literature for the agency’s staff as well as for the public, from general publications with relevance to the environment to technical literature. An interlending 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.

Various reading areas, balconies and booths provide plenty of space for quiet study or intensive group work. Special events are organised for schools in the region as part of the library's efforts to also alert children and young people to environmental issues. Various picture books for children and literature for young people, all dealing with environmental subjects, are intended to spark interest in the younger generation and provide an appropriate introduction to the environmental subjects for various different age groups.

Here at the UBA library children can learn how our everyday lives affect the environment.

Now in Dessau: the UBA Press Office

Following a brief decline media interest in information about environmental protection has again increased: last year the press office dealt with 3,327 enquiries from the media (2004: 3,138) and arranged 328 interviews with various agency experts (2004: 238). Journalists from Germany and abroad, numerous associations and other institutions continue to make good use of the press work conducted by the UBA, despite the fact that the agency reduced the number of its press releases to 77 in 2005 (2004: 122). This decrease was mainly due to the fact that much of the specialist information is now available in the free electronic newsletter "UBA aktuell. Informationen aus dem Umweltbundesamt". The newsletter was launched in 2004 with two issues, in 2005 there were five, and it is now firmly established as an addition to the press office's range of services. It is regularly used by more than 4,700 subscribers, especially from the private sector, as well as public sector authorities, research establishments and industry.

Following the move to Dessau the press office has been able to expand its links with the media and journalists and has also made many new contacts in the region. In 2005 press releases in German were accessed 210,802 times by the media and by members of the public with a particular interest in environmental issues, while the equivalent figure for English-language releases was about 42,000. In addition the PDF version of the UBA annual report for 2004 was accessed 192,564 times, the background papers on specialized subjects such as climate protection, clean air, transport or the environment and health were accessed a further 181,392 times, with some 28,000 alone for the background paper on the subject of fine dust.

The media topic for 2005 was fine dust: How high are local pollution levels? Where does fine dust come from, and how? What regions are particularly badly affected and why? What can the state, municipalities or companies do in order to reduce pollution by hazardous fine dust? Journalists from every branch of the media dealt with these and similar questions throughout the year.

Another topic to attract a great deal of attention was that of hygiene in enclosed spaces, especially the issues of healthy living and working conditions. The UBA Press Office received numerous queries about ways of dealing with damaging fungal moulds in the home and about various aspects of organic farming/renewal, as well as about low-emission construction and renovation products such as paints and lacquers, carpets and carpet adhesives. Many enquiries were also received about the use of energy-efficient heating and solar systems. 2005 was also the first year of emissions trading. Agency experts explained to the press how this innovative instrument for climate protection functions.

Dialogue between science and the region

Many events were organised in 2005 by the Presidium, supported by the Technical Units of the UBA, and attracted a great deal of interest. The highlight was the Party for the People on 11 May 2005 to mark the relocation to Dessau. During the official ceremony the Federal Construction Minister at the time, Dr. Manfred Stolpe, officially handed the building over to its new occupants, the UBA. An estimated 8,000 to 10,000 visitors came to learn all about the new offices and the Agency's work, and stayed until late in the evening. The city of Dessau and the Land of Saxony-Anhalt were also represented at the Party for

Official opening: The UBA's move to Dessau was rounded off by a Party for the People which attract several thousand visitors.

the People. The programme was rounded off by plenty of music and dancing, a fashion show and numerous information stands.

Back in 2001 the UBA, together with the nature conservation organisation Bund für Umwelt und Naturschutz Deutschland (BUND) and Karstadt GmbH, provided advice about an environmentally correct approach to starting school with the campaign "Clemens Clever – the hedgehog with the eco-symbol". A brochure and the website http://www.clemens-clever.de/ have been prepared to assist children, parents and teachers in learning more about environmental protection at home and in the school. Last autumn 35,000 pupils participated in the "Clemens Clever" painting competition, intended to encourage an ecological start to schooling, and providing the eco-hedgehog with a new and colourful outfit.

When it relocated the UBA established a new tradition by initiating the "Dessau Discussions", which are now being continued in an informal way with papers by prominent figures on environmental issues. They are intended not only for staff of the Agency, and these open events are now attracting growing interest among the population of Dessau and the surrounding region. The Agency holds "open days" to promote a dialogue between science and the region.

In October 2005 the head of Deutsche Bahn, Hartmut Mehdorn, presented his vision of the future of the railways at a very well attended discussion. During the meeting he addressed a number of critical questions: the many visitors from the city, the region and the Agency wanted to know whether rail travel would become more expensive or cheaper in the future, how the railways intend to attract more passengers and more freight onto the rails, and the future prospects for rail services to and from Dessau. In November the Director of the economic institute Deutsches Institut für Wirtschaft, Prof. Dr. Michael Hüther, explained the prospects for environmental policy at the start of the 21st century from his organisation's point of view. At the beginning of 2006 the UBA continued this series with a paper entitled "Learning from Nature" by the recipient of the German Environmental Award for 2005, Prof. Dr. Berndt Heydemann. What will be environment be like in ten years time? The UBA used this slogan for its conference on 22 July 2005 to mark the 75th birthday of its founding president, Prof. Dr. Heinrich Freiherr von Lersner. Werner Schenkel, former divisional director at the UBA, chaired the discussions, which were attended by some 100 guests from science and politics.

Art and the environment

The UBA continued its series of events entitled "Art and the Environment", which have been taking place for more than twenty years, with two exhibitions at its new headquarters in Dessau. "Constellations" was the title of the project by the internationally renowned performance artist Regina Frank, inspired by the relocation of the UBA. Together with members of the Agency's staff she marked the move by creating a kind of ritual that took as its subject matter the connections between tradition and a new beginning, and between departure and arrival.

Staff selected objects from their Berlin office that they wanted to accompany them to their new place of work as reminders, lucky charms or "friendly spirits". Frank photographed and classified these objects and, using the "Konstellationen" website, created virtual networks between colleagues who had chosen items that were similar, related or the same. The installation went on show at the UBA opening celebrations. To accompany this presentation Regina Frank displayed blow-ups of the staff and of the objects, and used her performance to focus on the Agency's internal and external relations in the form of processes that constantly require new stimuli.

The well-attended exhibition "RE-Art One – Art in the context of waste and recycling" took place from November 2005 to January 2006. Over fifty artists from nine countries used bottle, tins, ashes, scrap, paper, plastics, old books, textiles, shoes and even hair in their work. This transformation of used items to create art works was intended to encourage people to reflect on the utility and intrinsic value of everyday objects, and to take a critical look at patterns of consumption and disposal by individuals and society as a whole. Curated by the Heidelberg artist Samuel J. Fleiner, this exhibition was chosen by Unesco as the official contribution to the UN World Decade "Education for Sustainable Development", and subsequently went on show in Nairobi.

The transformation of used, everyday items into works of art – one of the exhibits.

Dr. Thomas Holzmann, Vice President of the Federal Environment Agency (front right), opens the exhibition "RE-Art One".

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Umwelt Bundes Amt
For Humanity and Environment

The Federal Environment Agency's Berlin offices on Bismarckplatz and the regional office at Langen (Hessen) have been registered as participants in the European eco-management audit system EMAS and have at their disposal an environmental management system which has been granted ISO 14001 certification.

EMAS
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D-107-00093