

ENVIRONMENTAL HEALTH IN GERMANY

Everyday Examples

This brochure is a contribution to the Action Programme Environment and Health and its public relations activities. Expenses for printing and photographs have been covered by the Federal Environmental Agency (Umweltbundesamt) and the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz).

Published by

Bundesamt für Strahlenschutz
Federal Office for Radiation Protection
Postfach 10 01 49
D-38201 Salzgitter
Germany
Internet: www.bfs.de

Robert Koch Institute
Nordufer 20
D-13353 Berlin
Germany
Internet: www.rki.de

Bundesamt für Verbraucherschutz
und Lebensmittelsicherheit
Federal Office for Consumer Protection
and Food Safety
Messeweg 11/12
D-38104 Braunschweig
Germany
Internet: www.bvl.bund.de

Umweltbundesamt
Federal Environmental Agency
Postfach 33 00 22
D-14191 Berlin
Germany
Internet: www.umweltbundesamt.de

Bundesinstitut für Risikobewertung
Federal Institute for Risk Assessment
Thielallee 88-92
D-14195 Berlin
Germany
Internet: www.bfr.bund.de

Editors

Dr. med. habil. Jutta Dürkop and Dr. med. Norbert Englert, Umweltbundesamt

Status as of April 2004

Translators

Andrea Bartel, Berlin; Manfred Frank, Berlin

Printed by

KOMAG mbH, Berlin

This brochure is available free of charge

from the publishing institutions mentioned above
or from the Office of the Action Programme Environment and Health,
Federal Environmental Agency:
Geschäftsstelle zum Aktionsprogramm Umwelt und Gesundheit (APUG)
im Umweltbundesamt

Corrensplatz 1
D-14195 Berlin
Germany

It has also been published on the internet (www.apug.de) as a PDF document that can be downloaded.

ENVIRONMENTAL HEALTH IN GERMANY

Everyday Examples

CONTENTS

PREFACE	5
1 FACTORS INFLUENCING HUMAN HEALTH	7
2 MEASUREMENT AND OBSERVATION	10
3 THE HOUSING ENVIRONMENT	13
3.1 The home	13
3.2 The air we breathe	20
3.3 Where does the noise come from?	28
4 ROAD TRAFFIC	33
4.1 How do you move forward?	33
4.2 Always by car?	34
5 LEISURE TIME AND RECREATION	38
5.1 Music – the louder the better?	38
5.2 Everyday on the sunny side?	41
5.3 Undisturbed pleasure on the beach	45
5.4 What about the mobile phone?	48
6 FOOD AND NUTRITION	51
6.1 Do we eat the right foods?	51
6.2 Is our food safe enough?	54
6.3 The water we drink?	58
6.4 Breastfeeding: Pros and cons	62
7 WHAT REMAINS TO BE DONE?	66
8 CONTRIBUTORS	69
9 FREQUENTLY USED TERMS AND ABBREVIATIONS	71
10 PICTURE CREDITS	73

PREFACE

This brochure 'Environmental Health in Germany' (German title: "Umwelt und Gesundheit in Deutschland") is addressing a set of topics related to environmental health – to *our* health and *our* environment. It is illustrated by everyday examples.

From a series of representative surveys conducted in Germany (the most recent one in 2002), we know that one fourth of the German population think that environmental problems have a strong or very strong impact on human health. Two thirds are even afraid that future generations will suffer from adverse health effects caused by the environment.

The public is often confused due to a lack of balanced information and a poorly differentiated or even wrong rating of health consequences of environmental contamination. Even science has not always been able to find immediate and comprehensive answers to newly arising questions.

In Germany, regulations and voluntary agreements have led to a variety of improvements for the environment. Although on the whole, adverse influences on health from the environment have clearly decreased, many people are afraid of health risks arising from a variety of environmental factors.

Keeping in mind the central role of environmental protection for health maintenance, the Federal Ministry for the Environment and the Federal Ministry of Health agreed on a joint Action Programme Environment and Health for Germany. It was presented at the Third Conference of the European ministers of health and the environment held in London in 1999.

But not only Germany has developed such an action programme. Since the situation in other European countries is comparable to that in Germany, the subject has been tackled also on the international level. In 1989, the First European Conference of ministers of health and the environment was held in Frankfurt/Main. At the Frankfurt Conference, which had been initiated by the World Health Organization and actively supported by Germany, the European Charter on Environment and Health was adopted (see Box 1). For the first time, this opened the way for a

Box 1

Every individual is entitled to

an environment conducive to the highest attainable level of health and well-being,

information and consultation on the state of the environment, and on plans, decisions and activities likely to affect both the environment and health,

participation in the decision-making process.

European Charter on Environment and Health, 1989

comprehensive political approach to environmental health issues, with binding objectives.

Such political approach, which was initially focussed on the European region of the World Health Organization, is also contained in the documents of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. Agenda 21, on sustainable development, which was adopted by more than 170 participating states from all over the world, dedicated a separate chapter to the subject of Protecting and Promoting Human Health.

At the Second European Conference on Environment and Health, organised by the World Health Organization and held in Helsinki in the summer of 1994, the European ministers of health and the environment took another important step towards the development of the respective terms of reference laid down in the Helsinki Declaration. Concrete strategies for action were

Box 2

"We commit our respective health and environment departments to developing jointly, not later than 1997, action plans on health and the environment..."

Helsinki Declaration on Action for Environment and Health in Europe, 1994

adopted in the Environmental Health Action Plan for Europe. At this conference, the European ministers of health and the environment also decided to develop national environmental health action plans in their countries (see Box 2). Germany has implemented the decisions of Helsinki by means of the Action Programme Environment and Health.

This linkage between environment and health was the reason to initiate an intensified collaboration between the responsible federal ministries and the associated superior federal authorities, i.e. the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz – BfS), the Robert Koch Institute (RKI), the Federal Environmental Agency (Umweltbundesamt – UBA) and the Federal Institute for Health Protection of Consumers and Veterinary Medicine (Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin – BgVV).

In the context of the reorganisation of consumer health protection in Germany, the Federal Office for Consumer Protection and Food Safety (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit – BVL) and the Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung – BfR) were formed as successors to the Federal Institute for Health Protection of Consumers and Veterinary Medicine in November 2002. Both institutions are responsible to the Federal Ministry of Consumer Protection, Food and Agriculture (Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft – BMVEL).

Therefore, the latter is also involved in the implementation of the Action Programme Environment and Health.

For details of the contents and objectives of the Action Programme, see www.apug.de.

This brochure tries to describe the situation in Germany in an easy to understand and illustrative way by using examples from everyday life. It intends to communicate consolidated facts and point out existing gaps of knowledge. Different positions have been mentioned without further reference to details.

This publication does not claim to be exhaustive nor is it meant to serve as a textbook on environmental hygiene. More detailed information can be obtained by contacting the institutions listed at the end of each chapter.

We hope that this brochure will provide some interesting information on the topics of environment and health. Maybe the subjects addressed will also lead to further reflections and promote a general exchange of information.

The editors gratefully acknowledge the technical support of all participants in this exercise, whose involvement enabled the publication of this brochure.

April 2004

1 FACTORS INFLUENCING HUMAN HEALTH

The environment and as a consequence, also human health have been affected by mobility and energy consumption as well as by modern production methods in agriculture and industry. Some of these factors have already resulted in environmental changes of global extent. The effects of others have remained limited to certain regions. Realising these facts made the nations understand that there is a need for a more permanent and environmentally friendly (in other words 'sustainable') development. Sustainable development shall provide for maintenance and improvement of living conditions also for future generations.

In Germany, many improvements in the quality of the environment have been achieved by legal provisions and voluntary agreements. Such development may be clearly seen from the data presented in: "Daten zur Umwelt – Der Zustand der Umwelt in Deutschland" (Data on the environment. The environmental situation in Germany) which is periodically published by the Federal Environmental Agency (UBA). Nevertheless, according to a representative survey conducted among the population in 2002, one fourth of Germans think that environmental problems have a strong or very strong impact on health. As many as two thirds even fear that this will be true for future generations.

Do these survey results in fact reflect the current situation? What is the real state of environment and health in Germany? Is it true that the environment does affect human health?

In order to form your own opinion you are invited to continue reading.

▼ Health

Am I healthy if I feel well? The concept of health is associated with certain ideas that may vary not only from person to person but also with different situations in a person's life.

Health has been defined by the World Health Organization (WHO) as 'A state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity' (Constitution of the WHO signed on 22 June 1946).

Such comprehensive concept of health has been critically discussed again and again. It has the undisputed advantage of encompassing living conditions such as work, home, food and education. It is of great importance as a model for health policy. However, it sets extremely high standards by demanding complete well-being.

▼ Environment

In the context of this brochure, environment is that part of the global environment humans are in interrelationship with for their entire life, which is needed, exploited, influenced and changed by them and to which they have to adapt permanently. In that sense, also all other

members of the human species belong to the environment. This, however, is a broad interpretation of the term, environment.

For some, 'social environment' does not form part of the environment in the proper sense. In their classification, the term environment is focussed on the environment without humans (however, with man-made changes).





▼ Age and sex

Children are no small adults, and women often react differently from men. A child's body is not yet fully developed. As related to their body weight, children breathe, eat and drink more than adults do. A number of metabolic processes in children are different in terms of metabolic rates and partly, also in their pathways. As a result, children react with a higher sensitivity than adults, in some situations but not always.

In elderly people, many processes take place at a slower speed than in younger ones since the function of some organs is reduced. This may result in lower resilience, but again, exceptions exist: For example, senior citizens are less sensitive to ozone than younger ones are.



Hormonal and other influences are the reason why women and men react differently in some respects, both physically and mentally. Susceptibility to a number of diseases is very different in women and men, and life expectancy of women is markedly higher than that of men (a difference which, however, is less pronounced for women working full-time).

▼ Inherited from the parents

There has been scientific evidence that the susceptibility to certain diseases is based on genetic factors. Common examples are type I diabetes and allergies. If both parents are suffering from an allergy, the child faces a 50–70 % risk of developing an allergy as well.

▼ Education, income and lifestyle

Education and income are closely linked, and the resulting socio-economic status is an important factor influencing people's health. Social inequity may also lead to inequity in terms of health. The factors accounting for a generally worse state of health among population groups with a lower social status ask for further elucidation.

Experts have seen associations with the mostly less favourable living conditions in housing and working environments on the one hand and a less developed health consciousness, on the other. Persons with a higher educational standard usually live a healthier life, smoke less, eat a more balanced diet and are less exposed to health risks at their workplaces. In addition, they often live in regions or districts where environmental pollution is lower. The medical care they receive is of a better quality which contradicts the objective of equity.

Physical exercise keeps us fit. Lack of exercise contributes to overweight and may promote the development of a number of diseases.

▼ The occupational situation is also of importance

The conditions people are exposed to at their workplace have an important influence on their health. This is particularly true of great and unbalanced physical strain, excessive or insufficient mental demands and the atmosphere at work. In

addition, people may be exposed to a great number of disturbing, impairing and harmful influences in their working environment such as noise, vibration, harmful substances, unfavourable indoor climate or weather conditions when working outdoors. Beyond this, income and the associated social status may constitute a factor influencing susceptibility to disease.

▼ Excessive stress causes disease

When considering people's working environments and private surroundings, the factor of stress must not be forgotten. Principally, stress is not a new phenomenon, being typical of modern times only. It constitutes a basic behavioural reaction determined by human evolution. By means of increased attention and muscular tension, the body prepares for situations where fleeing or fighting is required. Everything that is seen, heard or felt may result in a more or less intense activation of the body that is referred to as stress.

Today, (excessive) stress is considered as one of the factors causing a number of civilisation diseases. A well-known example is angina pectoris, also referred to as stress disease. Where does normal stress turn into disease-producing stress? In this respect, different persons will react in different ways. Demands are evaluated differently by individuals – and eventually, everybody affected has to find her or his own way to control excessive stress.

▼ Environmental factors in a narrow sense

Environmental factors in a narrow sense include e.g. homes with their design and furnishings, ambient air, drinking water, food and bathing waters at beaches. In this brochure, information has been limited to these environmental factors although of course, also sewage and municipal refuse and everyday necessities such as clothes and cosmetics have to be included.

The environmental factors may be combined with a presence of undesirable chemical substances or other environmental contaminants,



Waste separation is 'child's play'

pathogens or microbial toxins (poisons) or may be linked to noise or radiation.

These factors influence the human body via the respiratory tract, the digestive system or the skin, which may result in health impairment. In the case of noise, the ears, as a sensory organ, are affected.

The major part of contamination has to be attributed to human activities. Most prominent examples are exhaust gases caused by motor traffic and noise. Among other consequences, increasing industrialisation has also brought about global environmental changes. Common examples are the 'ozone killers' such as HCFCs (hydrochlorofluorocarbons) that destroy the earth's protective ozone layer in the stratosphere, and greenhouse gases produced by man. Even at our geographical latitude, they have caused an intensification of UV radiation and a warming of the lower layer of the earth's atmosphere.

2 MEASUREMENT AND OBSERVATION

The compulsory measuring programmes in Germany and the monitoring systems described below are important instruments to detect the effects of measures taken within the scope of environmental and health policy. If required, they also serve as a basis for a further development of current legal regulations.

The measuring and monitoring programmes run by the federal Länder and by the superior federal authorities involved in the Action Programme Environment and Health (i.e. Federal Environmental Agency – UBA, Federal Institute for Risk Assessment – BfR, Federal Office for Consumer Protection and Food Safety – BVL, Federal Office for Radiation Protection – BfS, and Robert Koch Institute – RKI) meet at the interface between environment and health.

Some of these programmes and monitoring systems will be presented in the individual chapters of this brochure. On the basis of data obtained from these sources, the current situation in Germany will be described.

▼ Routine programmes for environmental monitoring

Institutions of the Länder and also of the federal authorities continuously examine ambient air, food, drinking water and bathing waters at beaches for the presence of contaminants that might be harmful to human health. As far as drinking water and bathing water are concerned, Germany – just like the other member states of the European Union – is obliged to regularly submit reports to the European Commission.

Among other parameters, the BfS monitors environmental radioactivity and jointly with the UBA, population exposure to solar UV radiation.

Such measurements are performed in order to check whether contaminant and radiation levels do not exceed limit values or maximum levels, so that in the event of non-adherence timely action can be taken to minimise or avoid health risks posed by the environment. If limit values or maximum levels are exceeded, harmful effects cannot be excluded.

▼ Limit values must be observed

Nevertheless, adverse health effects may originate from water, soil, air and food even if legal limit values are observed. This may be the case when contaminants or other noxae (harmful influences) are present that have not yet been taken into account and monitored. It is also possible that simultaneous exposure to several known influences via different routes of exposure may have additive effects. However, limit values are generally set up for individual agents and not for combinations of these.

Sometimes there is a call for more stringent limit values. An important prerequisite is an answer to the question whether and to which extent the specific environmental factors can be held responsible for the development or aggravation of a disease. Observations in humans, particularly those made in the context of epidemiological studies are important tools to address this objective. Socio-economic and psychosocial factors that may have an influence on the exposure to environmental contamination have to be included in the evaluation of the results (see also Chapter 1, Factors influencing human health).



Monitoring site Waldhof (Lüneburger Heide). Samplers for rainfall and dust can be seen in the front.

▼ Special health and environment programmes

In contrast, no corresponding legal provisions exist for the monitoring of health or disease, except for cancer registries and the reporting of communicable diseases under the Infection Protection Act (Infektionsschutzgesetz). A number of programmes are run on the federal level, which are designed to provide basic information for the assessment of relationships between environment and health.

In this context, above all, the National Health Interview and Examination Surveys and the German Environmental Surveys have to be mentioned which are carried out from time to time using random samples representative of the adult German population. The National Health Surveys have been designed to examine the state of health of the population and record several factors having an influence on health. The Environmental Surveys performed among a subsample of participants of the National Health Survey mainly focus on contaminants in blood and/or urine, in house dust and in drinking water as supplied to private homes.

▼ This time, the young generation has its turn

In these surveys, the RKI and the UBA work in close collaboration. Surveys were conducted so far in 1985/86, 1990/92 and 1997/99. Meanwhile, a national survey was started in May 2003, with the RKI examining for the first time the health of children and adolescents from 0 to 17 years of age (see also Chapter 7, What remains to be done?).

The project has been designed as a modular system. The core survey is to collect benchmark figures on a wide range of health issues. Three additional modules enable more detailed examinations of subsets of participants regarding

- ▶ mental health and behaviour,
- ▶ motor development and
- ▶ environmental contamination in the immediate environment of test persons.

The UBA is involved in the last-mentioned module performing special examinations to detect environmental influences in children.

The corresponding inquiries will be completed in 2006. They will be followed by a period of



Medical examination.

evaluation. First results are expected to be available still in 2006.

The data on the body burden of environmental pollutants in humans collected in the context of the Environmental Survey will for instance constitute an important basis for the work of the Commission on Human Biological Monitoring of the UBA. The task of this group is to derive reference values to be used also by doctors in individual medical care.

▼ Students as contemporary witnesses

Another monitoring system run by the UBA is also dealing with the body burden of environmen-



Preparation for blood pressure measurement.



A great variety of domestic and imported products is examined under the Food Monitoring scheme.

tal pollutants in humans, i.e. the national environmental specimen bank part of which is the human specimen bank.

Since 1984, blood and other samples have been obtained every year from young adults (cohorts of students). Mainly blood and urine are exam-

ined for a number of certain environmental contaminants prior to being stored in a deep-frozen state for later examinations.

An important purpose of the human specimen bank is to make samples available for examinations at a later time, which may be particularly useful if contaminants so far unknown become a subject of discussion. Thus, it is possible to trace back whether the respective contaminants have been present for some time already or are of recent occurrence and to find out when and in which concentration this was the case.

▼ Focus on foods

In addition to official food control required under the law, a food monitoring scheme has been carried out since 1995 by the Federal Institute for Health Protection of Consumers and Veterinary Medicine and since 2002, the BVL in cooperation with the Länder in order to provide an adequate number of data as a basis for evaluation of the intake of undesirable substances in food by the consumer. Similar objectives have been pursued by the breast milk and dioxin database run at the BfR in cooperation with the Länder. This database for the documentation and evaluation of analytical results has been run since 1980.

CONTACT ADDRESSES

Bundesamt für Strahlenschutz
(Federal Office for Radiation Protection)
Postfach 10 01 49
38201 Salzgitter
Internet: www.bfs.de

Bundesamt für Verbraucherschutz
und Lebensmittelsicherheit
(Federal Office of Consumer Protection
and Food Safety)
Rochusstr. 63
53123 Bonn
Internet: www.bvl.bund.de

Bundesinstitut für Risikobewertung
(Federal Institute for Risk Assessment)
Thielallee 88-92
14195 Berlin
Internet: www.bfr.bund.de

Robert Koch-Institut
(Robert Koch Institute)
Postfach 65 02 61
13302 Berlin
Internet: www.rki.de

Umweltbundesamt
(Federal Environmental Agency)
Postfach 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

3 THE HOUSING ENVIRONMENT

Germany has approximately 82 million inhabitants. Almost 72 % live in towns and cities with a population of more than 10 000. This causes considerable demands on the infrastructure in urban agglomerations. The infrastructure includes public transport and road systems (see Chapter 4, Road traffic), drinking water and food supply (see Chapter 6, Food and nutrition), disposal of municipal solid wastes and sewage treatment, medical care, educational institutions, leisure facilities and service industries and last but not least, jobs.

Great importance is attributed to the availability and the quality of housing. In Germany, people spend a daily average of about fifteen hours in their homes, six hours in other indoor situations and no more than three hours in the open (results of the German Environmental Survey 1990/92).

Whether people are content with their homes does not only depend on the level of comfort, the state of repair of the building or intact relations with neighbours, but also on the residential environment.

The quality of the latter may be impaired above all by air pollution and noise. While for a long time, the most important causes of pollution were found to be industrial establishments, power plants and combustion by heating systems, the main factor held responsible today is road traffic.

3.1 The home

On an average, 2.2 persons live in a home of 72 m² in the new, and of 88 m², in the old federal Länder. 30 % of homes are situated in buildings erected before 1949.

Constructional rehabilitation measures may have a direct or indirect influence on the conditions important for human health. An example is the replacement of lead pipes for drinking water supply in older buildings (see Chapter 6.3, The water we drink). Conversion to energy-efficient central heating systems has brought about a reduction of air pollution in homes and housing environments. The thermal insulation measures required under the German Energy Conservation Act 2002 are binding both for newly erected and (with restrictions) existing residential buildings. Reduction of heat loss is intended to save heating energy and thus, reduce the release of the greenhouse gas, carbon dioxide into the atmosphere.

▼ A comfortable indoor climate

Comfortable conditions in a home are not only determined by individual furnishings but also by the indoor climate. Important factors include air temperature, airflow velocity (e.g. draught) and the temperature of radiating surfaces (e.g. cold walls, a warm tiled stove).

The comfort range in terms of relative humidity is between 30 and 65 %. Indoor fountains intended to increase humidity are unnecessary, as a rule, and may even contribute to the spreading of pathogens. There is no indoor climate equally optimal for every person staying in a room because the feeling of thermal comfort depends, among other factors, on clothing, physical activity and individual sensitivity.



Box 3

Temperature ranges recommended for homes	
Living room	20–23 °C
Bedroom	17–20 °C
Kitchen	18–20 °C
Bathroom	20–23 °C
WC	16–19 °C
Corridor	15–18 °C

▼ Classical air pollutants

A healthy housing environment requires clean air. This cannot be taken for granted, however. Indoor air may become contaminated with many harmful substances formed e.g. during heating or cooking or released from construction materials, carpets or furniture, household chemicals and tobacco smoke or during decoration work (see Box 4).

▼ Bad atmosphere?

In Germany, more than 40 % of households use gas for heating and cooking. During these processes, nitrogen oxides are formed from the nitrogen present in indoor air. While flue gases from hot water and heating boilers are discharged through the chimney, those released during cooking may remain in the indoor air. Nitrogen dioxide is an irritant gas that may increase breathing difficulty in persons suffering from respiratory disease. Carbon monoxide is a product of incomplete combustion taking place for example in poorly drawing stoves fuelled with coal or wood and also during tobacco smoking. Carbon monoxide is poisonous, it will block the transport of oxygen in the blood.

Tobacco smoke is one of the most hazardous air pollutants. It contains many carcinogenic substances. About 90 % of cases of lung cancer in males and 66 % of those in females are to be attributed to smoking. Also passive smoking may cause cancer.

Tobacco smoke has continued to constitute an essential indoor air pollution problem also affecting children. By means of determination of nicotine and cotinine levels in the urine and hair of

Box 4

Source	Selected compounds released, classes of compounds
Human	Carbon dioxide, steam, body odours
Heating and cooking	Nitrogen and carbon oxides, VOC ¹ , steam, particulate matter
Tobacco smoking	As for heating and cooking, in addition, nicotine, nitrosamines, cyanides, benzene, formaldehyde, benzo(a)pyrene
Household and DIY products	VOC ¹ (volatile aromatic and aliphatic hydrocarbons, alcohols etc.)
Furniture	VOC ¹
Construction and decoration work	VOC ¹ and semi-volatile organic compounds, pesticides, mineral fibres
Outdoor environment	Ambient air pollution, radon
1 VOC, Volatile organic compounds	

test persons, the Environmental Survey conducted in 1990/1992 has demonstrated that as many as 25 to 50 % of children aged 6–14 years are exposed to tobacco smoke.

In children, passive smoking promotes the development of bronchitis and pneumonia, infections of the middle ear and allergic diseases. Both active and passive smoking of pregnant women may result in developmental disorders in the child.

Radon is of importance in certain mountainous areas of Germany. Radon is a radioactive noble gas (radium 222) formed in the ground by decay of naturally occurring uranium. It may enter buildings through leaks and cracks in the foundation or the brickwork. Radon is carcinogenic. The Federal Office for Radiation Protection (BfS) has recommended measures to reduce radon levels in homes with a radon concentration of more than 200 Bq (becquerel) per m³, for example sealing of the external envelope of buildings against the soil.

Today, volatile organic compounds (VOCs) have become common indoor air pollutants in every home. VOCs include numerous synthetic and natural substances which are released from different

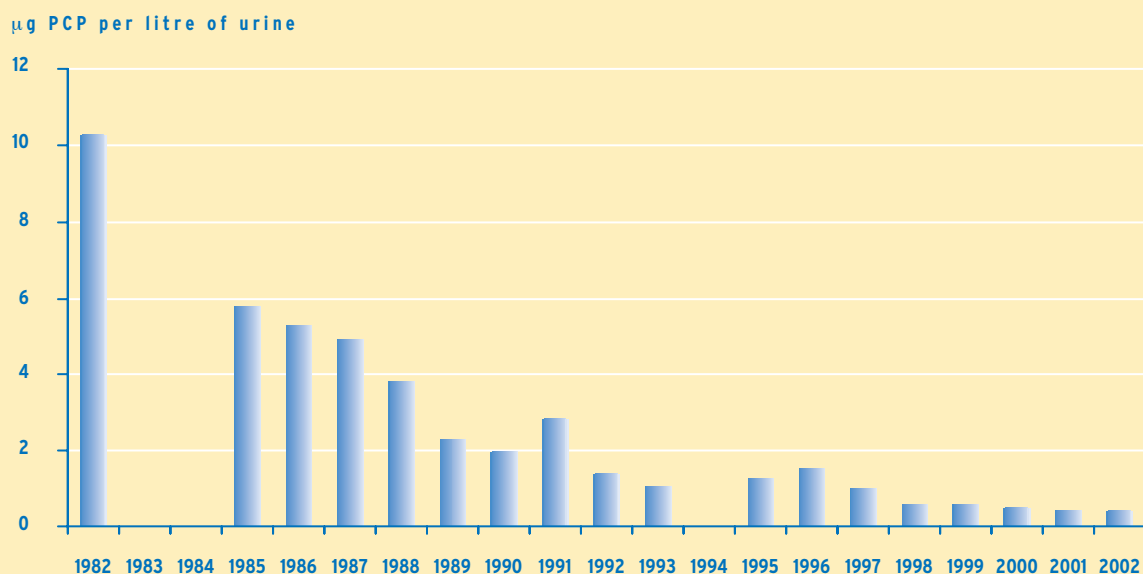


materials and products at room temperature. VOCs are e.g.

- ▶ aromatic hydrocarbons such as toluene, which are still used as solvents in a number of glues and glossy paints and also in freshly printed paper products,

Figure 1

Source: Federal Environmental Agency, environmental specimen bank - human specimen bank



Pentachlorophenol (PCP) levels in humans:
Detection of PCP in urine specimens of cohorts of students of Münster University



Spider mites (right, natural size: 0.5 mm) are a pest infesting potted plants kept in homes. The specimen depicted is being approached by a predatory mite (left). Predatory mites are beneficial organisms that may be used instead of pesticides for the biological control of spider mites.

- terpenes, which are natural wood components released from wood panelling, from so-called 'natural' paints or from detergents, cleansers and cosmetics to which terpenes have been added, e.g. as fragrances.

The use of new products in households has resulted in a permanent change in the range of foreign substances emitted into indoor air.

The health risks posed by low concentrations of the individual volatile and semi-volatile organic compounds and the great variety of mixtures of



Oil lamps should never be left unattended.

substances are largely unknown. High concentrations may cause olfactory disturbance and irritation of the conjunctiva of the eyes and of the mucosa of the respiratory tract, but also headache, vomiting, vertigo and tiredness. Such manifestations may be caused by 'chemical' products as well as by 'natural' products.

Some people increasingly feel to be more or less helplessly exposed to an almost inestimable number of foreign substances in their homes. Often, health complaints are attributed to such exposure. The association of such complaints with the clinical picture referred to as multiple chemical sensitivity (MCS) is a subject of controversial discussion at present.

▼ House dust has a 'memory'

In house dust, a number of heavy metals and semi-volatile compounds as well as fungal spores, pollen and house dust mites may be detected. Such contaminants may either originate from within the home or have been introduced from outside. The chemical compounds involved have been studied best. Some of these are discussed below as examples.

House dust has a 'memory' so to speak, covering a number of foreign substances used or emitted in homes. Thus, house dust analyses may reveal for example whether pesticides were applied to potted plants and upholstered furniture or if wood preservatives were used. It is also possible to detect the products involved. House dust analyses carried out in the context of the German Environmental Surveys 1985/86, 1990/92 and 1998 have demonstrated that contamination with the wood preservative, pentachlorophenol (PCP) has continued to decrease from an average of 0.91 to 0.33 and then to 0.25 mg/kg house dust. PCP had been used in homes as a wood preservative until 1978. Since 1989, it has been generally banned in Germany (Regulations to Ban PCP).

Long-term analyses of urine samples of young adults have shown that also the PCP levels found in humans have been on a continuous decrease since the mid-1980s (see Fig. 1). However, exposure to PCP may still be caused by PCP-impregnated reclaimed wood and imported wooden objects, leather goods and textiles. A number of symptoms attributed to the indoor use of PCP has become known as the so-called 'wood preservative syndrome'.

Pest control products are also referred to as biocides. Since 2002, their use has been regulated by the Biocidal Products Act converting the EC Biocidal Products Directive (98/8/EC) into German national law. Under conditions of intended use of approved plant protection products and wood preservatives, it can be assumed that no impairment of health will occur.

Pyrethroids have been used to control pests infesting potted plants and for the finishing treatment of wool carpets to make them mothproof. Permethrin, a substance belonging to the group of pyrethroids, was also detected in house dust in the context of the German Environmental Survey. The concentrations found hardly changed between 1990/92 and 1998. Average levels were around 0.22 and 0.24 mg/kg house dust.

In the context of the Environmental Survey 1998, house dust was also examined for polychlorinated biphenyls (PCBs). PCB concentrations detected were within the range of the limit of determination. PCBs were used as plasticisers in joint sealing compounds and as an insulating liquid in transformers, e.g. those fitted in fluorescent lamps. They were used in public buildings rather than in private homes. The health effects of low indoor PCB concentrations have again become a subject of controversial discussion. PCB compounds (congeners) are fat-soluble. They are ingested mainly in foods of animal origin (see Chapter 6.2, Is our food safe enough?) and accumulate in human fatty tissue. They may cause damage to the immune system and thus increase susceptibility to infections.

Plasticisers such as diethylhexylphthalate (DEHP) have been used in many products and are found in house dust in relatively high concentrations (up to more than 1 g/kg house dust, Environmental Survey 1998). At present, no reliable assessment can be made as to health risks related to such exposure. Animal studies have revealed impairments of the reproductive capacity. For reasons of preventive health care, it is necessary to reduce DEHP exposure to levels as low as technically achievable.

▼ Household chemicals should be kept under lock and key

Cases of acute poisoning resulting from accidental ingestion of cleansers or other household chemicals are of a completely different character.

Under the Chemicals Act, the Federal Institute for Risk Assessment (BfR) has recorded and evaluated reports on cases of poisoning submitted by physicians in order to analyse the causes and give recommendations for prevention. Until 2002, approximately 6 600 cases of poisoning and suspected poisoning in children and adults that occurred in the private sector were registered. As many as 18 % of these were attributed to cleansers, disinfectants and personal hygiene products, cosmetics and liquid fuels (predominantly lamp oils).

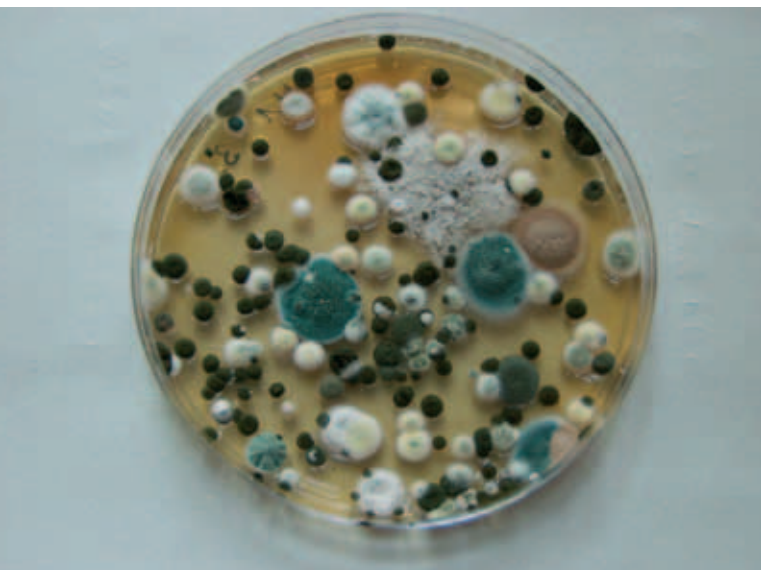


Liquid products are often coloured and therefore easily mistaken for beverages or syrup if they are not stored separately from food and are insufficiently labelled. Household chemicals should be kept under lock and key, particularly where children live in the household.

In the period mentioned, almost 460 accidents involving children occurred which had been caused by paraffin-containing lamp oils. When lamp oil is ingested, aspiration often occurs as a natural reflex. This may result in severe pneumonia with a lethal outcome.

▼ Mould-infested homes

Recently, there has been an increasing number of inquiries concerning the presence of moulds. Mould growth is promoted when the relative humidity exceeds 65 %. Elevated humidity levels may result from a variety of conditions:



Cultivation of moulds from an indoor air sample.

- ▶ In old buildings or structurally defective new buildings not constructed according to the relevant regulations, humidity may penetrate into walls, floors and ceilings through roof leaks or cracks in the brickwork.
- ▶ Thermal bridges or incorrect insulation may result in elevated relative humidity at surfaces or even in condensation.
- ▶ Also the habits of the occupants may increase indoor air humidity. Correct ventilation may help to avoid problems with moulds (see Box 5).



Black soot deposition occurred in this room six months after decoration work.

Moulds do not only cause damage to materials. Their spores may be responsible for asthma, dermal and mucosal irritations or influenza-like symptoms.

▼ Black soot deposition

The phenomenon of black soot deposition in homes has occurred with increasing frequency since the 1990s. It is characterised by black oily-greasy deposits on walls and ceilings. The problems arise particularly during the heating season, mostly within a short period after decoration work has been performed (see photograph).

In order to investigate this problem, the Federal Environmental Agency (UBA) conducted inquiries by means of questionnaires and comprehensive measuring programmes. The results have shown that the formation of the black deposits is caused by the joint action of certain factors (see Box 6). In this process, not all factors must be present at a time. The black deposits consist of particles containing semi-volatile organic compounds (SVOCs).

After decoration work, such compounds, among them for example plasticisers, are emitted from paints, PVC floor coverings and floor adhesives or vinyl wallpapers. They bind to particulate matter, which is transported by circulating air and deposited on surfaces having a lower temperature. Also cleansers and polishes, e.g. those applied to furniture, may contain SVOCs.

SVOCs evaporate into the indoor air slowly but over a relatively long period. Decoration work performed in summer may be followed by the formation of a soot-like greasy film on walls, ceilings and furniture, mostly in the following autumn and winter months when rooms are heated and less ventilated.

Such deposition is primarily an aesthetic problem. According to the present state of knowledge, no acute health risk is involved. Nevertheless, removal of the deposits is recommended since also in this case, the precautionary principle should be adhered to.

▼ A healthy home

Everybody can contribute a lot to a good indoor air quality in one's home. For instance, it is an important measure to open the windows in order

to exchange bad air in the rooms for fresh air. Proper ventilation (see Box 5) does not only remove bad smells but also reduces high humidity and pollutant levels.

When choosing materials for decoration work or new furniture, preference should be given to low-emission wall paints, floor coverings, floor adhesives and also furniture which have been labelled with the environmental label, Blue Angel (see picture).

Also for the home office, correspondingly labelled printers and fax machines are available. For more detailed information, please consult www.blauer-engel.de.

The awarding procedure for the environmental label is a joint activity of the Environmental Label Jury, the UBA and the RAL – Deutsches Institut für Gütesicherung und Kennzeichnung e.V. (RAL German Institute for Quality Assurance and Certification), Sankt Augustin.

You may still find some products labelled “Umweltzeichen weil...” (Environmental Label awarded for ...). This is the old version of the Environmental Label currently replaced by the new one shown.

The brochure published in 1992 under the German title, “Konzeption der Bundesregierung zur Verbesserung der Luftqualität in Innenräumen”

Box 5

How to care for good indoor air?

- ▶ Homes should be ventilated intensively several times a day for 5-10 min, which is most effective if opposite windows are opened.
- ▶ Rooms should be ventilated every time steam is produced (during cooking, after taking a shower etc.).
- ▶ Work involving strongly smelling substances should always be performed under conditions of simultaneous ventilation.
- ▶ A continuous air exchange should be ensured when cooking on kitchen ranges using coal or gas as fuel.
- ▶ Also rooms used less often should be ventilated regularly.

Box 6

Factors promoting black soot deposition

- ▶ Decoration work (see text)
- ▶ Room furnishings such as PVC floor coverings and decorative tiles containing PVC or made from other synthetic materials etc.
- ▶ Use of smoking candles, small oil lamps in the room
- ▶ Constructional conditions such as thermal bridges, reduced air exchange
- ▶ Indoor climate and weather influences such as increased electrostatic charge, low humidity etc.

(Concept of the Federal Government on the Improvement of Indoor Air Quality) provides an overview of the great number of regulations concerning indoor air quality which are mostly of a general character.

One of the bodies dealing with regulations on indoor air conditions is the Commission on Indoor Air Hygiene (Innenraumlufthygiene-Kommission) at the UBA comprising representatives of the federal and Länder authorities and of scientific institutions. This Commission has published, among



Environmental label Blue Angel for low-pollutant glossy paints (RAL-UZ 12a).

others, a manual for indoor air hygiene in school buildings ("Leitfaden für die Innenraumlufthygiene in Schulgebäuden"), which is also applicable to private homes. A manual for the prevention, examination, evaluation and removal of indoor mould growth ("Leitfaden zur Vorbeugung, Untersuchung, Bewertung und Sanierung von Schimmelpilzwachstum in Innenräumen") has been published recently. Both publications contain recommendations to consumers concerning the prevention and reduction of indoor contamination.

Great practical importance is to be attributed to the European Construction Products Directive (89/106/EEC) which has been converted into na-

tional law by the German Construction Products Act. Under the above legislation, construction materials must undergo an assessment procedure as to health risks from components that may be released from such products into rooms. The Commission for Health Assessment of Construction Products ("Ausschuss für die gesundheitliche Bewertung von Bauprodukten") has developed a template for that purpose.

The WHO Collaborating Centre for Air Quality Management and Air Pollution Control established at the UBA plays an important role in coordinating the work that deals with health-relevant problems of indoor and ambient air hygiene.

CONTACT ADDRESSES

Bundesamt für Strahlenschutz
(Federal Office for Radiation Protection)
Postfach 10 01 49
38201 Salzgitter
Internet: www.bfs.de

Bundesinstitut für Risikobewertung
(Federal Institute for Risk Assessment)
Thielallee 88-92
14195 Berlin
Internet: www.bfr.bund.de

Umweltbundesamt
(Federal Environmental Agency)
Abt. Umwelthygiene,
Abt. Technik- und Produktbewertung
or Zentraler Antwortdienst
Postfach 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de



3.2 The air we breathe

In Germany, a nation-wide monitoring of air pollutants is required by law. For this purpose, about 500 measuring sites situated between Westerland on the island of Sylt in the north and the Zugspitze peak in the south are run by federal and Länder institutions. Since June 2001, the Federal Environmental Agency (UBA), in cooperation with the responsible Länder institutions, has published on the internet current data on air pollution for the whole of Germany on an hourly basis (www.umweltbundesamt.de/luft).

Air pollutants spread in the environment irrespective of national boundaries. The WHO Collaborating Centre for Air Quality Management and Air Pollution Control established at the UBA

plays an important coordinating role in activities to improve air quality (see also Chapter 3.1, The home).

▼ Successful air pollution control

Results of monitoring performed for many years have demonstrated a clear decrease of concentrations, mainly those of sulphur dioxide, particulate matter and lead, polycyclic aromatic hydrocarbons (PAHs) and dioxins.

The improvement in air quality was also reflected in the opinions stated in a representative inquiry into environmental awareness in Germany in 2002 (Umweltbewusstsein in Deutschland 2002). Only 5 % of persons participating in the inquiry found air pollution to be the most serious environmental problem in their home communities. 20 % considered road traffic and 9 %, waste and waste management as problems of primary importance.

The legally required progress was achieved owing to the introduction of an improved heating technology, among other measures. The Federal Act on Protection against Ambient Pollution, particularly the Technical Instructions on Air Quality Control based on the Act, and the EC directives on air pollution control have been in the centre of interest concerning these efforts and will result in a further improvement of air quality.

For a long time already, smoking chimneys (as seen in the photograph) are not typical of a modern industrial society any more. Air pollution caused by sulphur dioxide and particulate matter has decreased tremendously. Typical winter-type

Box 7

- **Smog** is an acronym derived from the words, smoke and fog.
- **Winter-type smog** has also been referred to as 'London smog'. Because of certain weather conditions (atmospheric inversion), contaminant levels in ambient air increase excessively near the ground. During the well-documented smog episode in London in December 1952, mortality among the population was more than twice as high as usual. People affected were mainly those suffering from pulmonary or cardiovascular diseases. Levels of sulphur dioxide and particulate matter were as high as several mg/m³.

smog episodes (see Box 7) have virtually disappeared so that regulations on winter-type smog are no longer needed.

There has been a substantial reduction of acute health risks associated with winter-type smog. Also the incidence of chronic respiratory disease attributable to long-term exposure has decreased. From 1991 to 2002, the Ministry of Health of the federal Land of Saxony-Anhalt (east Germany) financed a study involving more than 20 000 school-beginners. A comparison with beginners of the federal Land of North Rhine-Westphalia (west Germany) revealed that during the study period, the incidence of respiratory diseases in the East had dropped to the low level found in the West. This decreasing trend could also be demonstrated by the Bitterfeld Study commissioned by the UBA and carried out between 1992

Box 8

Classification of particulate matter (PM) by particle size

Coarse particles	> 10 µm are mainly retained in the nasopharynx < 10 µm (PM ₁₀) may pass the larynx and reach the lower respiratory tract
Fine particles	< 2,5 µm (PM _{2,5}) may reach the pulmonary alveoli
Ultrafine particles	< 0.1 µm (PM _{0,1}) may penetrate the pulmonary alveoli

µm = micrometre, the thousandth part of a millimetre

and 1999 among almost 5 400 schoolchildren in three different polluted regions of the east German Land of Saxony-Anhalt (including Bitterfeld, a town known for heavy industrial pollution in the past).

Examinations performed in the context of the German Environmental Surveys 1990/92 and 1998 have demonstrated a decrease of the PAH burden among people living in the new federal Länder. The levels of PAH metabolites detected in the urine of test persons living in the east German Länder have meanwhile dropped to those found in persons in west Germany. Obviously, this decrease is also owing to the installation of modern heating systems.

▼ Particulate matter

Improvements in heating and filter technology have resulted in a considerable reduction mainly all of the larger dust particles. This is why smaller particles have reached higher shares in the total particulate matter. Fortunately, the overall contamination with airborne particles has decreased. Since 1997, the average total concentration of particulate matter on the national level has dropped to below 40 µg/m³ (see Fig. 2).

In Germany, concentrations of the health-relevant suspended particulate matter fraction PM₁₀ (see Box 8) have been monitored since 1999. In 2002, the annual average concentration from all measuring sites was 26 µg/m³. Nevertheless, an annual average concentration of 40 µg/m³ was exceeded at 3 % of measuring sites. From 2005, this value will constitute a standard that must be met.

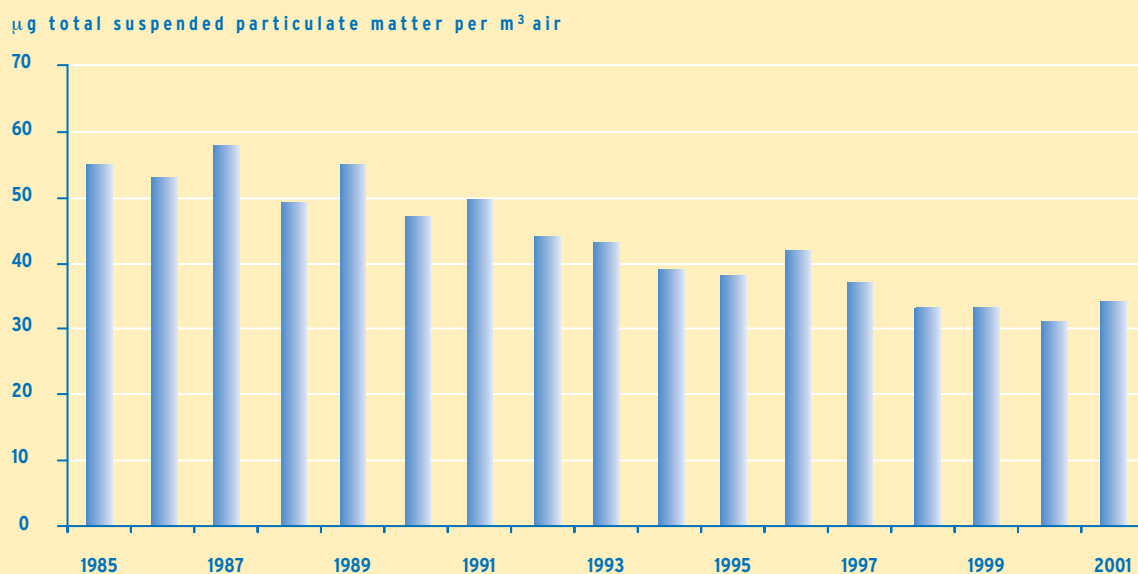
In the future, concentrations of particulate matter will decrease only slowly since the potential of reducing measures has been largely exhausted. Transport by the wind of particulate matter over long distances and across state borders will continue to play a role.

Suspended particulate matter is a substance mixture classified according to particle size (see Box 8). During inhalation, the relatively large particles will be retained in the upper airways. They are wrapped in mucus and swallowed or removed by sneezing or blowing one's nose. Particles of less than 10 µm in diameter will enter the trachea and bronchi and partly, also the pulmonary alveoli. This may result in bronchitis and respiratory symptoms such as cough.

Particles smaller than 0.1 µm in diameter may even penetrate into the pulmonary alveoli and

Figure 2

Source: Federal Environmental Agency and federal Länder



Annual averages of total suspended particulate matter concentration measured by all measuring networks of the federal Länder between 1985 and 2001

affect directly or indirectly the airways and also the cardiovascular system. Particularly in elderly people and persons suffering from respiratory and cardiovascular diseases, exposure to fine particles may increase the incidence of health complaints and mortality. Substances such as heavy metals may be inhaled as constituents of particulate matter.

A number of other airborne substances may adhere to the surface of the particles and, together with these, enter the lungs where they are deposited. They may increase the health-damaging effects of particulate matter.

▼ Motor vehicle emissions

Germany is among the countries with the highest per capita numbers of cars. Fuel consumption is correspondingly high. In 2001, for example, 45 700 million litres of fuel were consumed for passenger and 22 300 million litres, for goods traffic. A part of the fuel will enter the environment due to evaporation or incomplete combustion together with the exhaust gases.

The most important contaminants produced by road traffic include volatile organic compounds (VOCs) originating from fuels, and nitrogen oxides, carbon monoxide, carbon dioxide and dust particles such as soot. Road traffic has a high share in the emission of such substances (see Table 1).



Racing start – a lot of exhaust and noise.

Nitrogen dioxide is an indicator of contaminants emitted by road traffic. As compared to petrol-driven cars, diesel cars emit up to ten times as much nitrogen oxides. At present, the average annual concentrations recorded in urban areas are between 30 and 60 $\mu\text{g}/\text{m}^3$. At single measuring sites, up to 80 $\mu\text{g}/\text{m}^3$ may be recorded. In contrast, levels in rural areas are mostly below 10 $\mu\text{g}/\text{m}^3$. From 2010, the annual average concentration must not exceed 40 $\mu\text{g}/\text{m}^3$.

Nitrogen dioxide causes irritation of the respiratory tract. In susceptible persons suffering e.g. from asthma, increased concentrations may

Source: Federal Environmental Agency, 2003

Table 1: Contribution of road traffic to total emission in 1990 and 2001¹

Pollutant	1990		2001 ¹	
	Total emission (kilotons)	Share of road traffic (%)	Total emission (kilotons)	Share of road traffic (%)
Nitrogen oxides	2 706	57	1 592	61
Carbon monoxide	11 213	62	4 797	50
VOCs ²	3 221	48	1 606	21
Carbon dioxide	1 014 000	17	871 000	21
Particulate matter	1 858	4	247	22

¹ preliminary figures; ² VOCs, volatile organic compounds



result in dyspnoea. It has been discussed whether emissions produced by road traffic may promote the development of allergic diseases. Such diseases, however, are characterised by a very complex clinical picture. Family predisposition and lifestyle factors such as the number of family members, the furnishing of rooms and keeping of pets in the home have to be taken into account.

Carbon monoxide is produced by incomplete combustion of fuel. Elevated concentrations of carbon monoxide are very toxic, impairing the oxygen transport by haemoglobin. To prevent poisoning, working on cars with running engines in closed rooms such as garages must be avoided. Complete combustion will produce carbon dioxide, a greenhouse gas indirectly affecting human health.

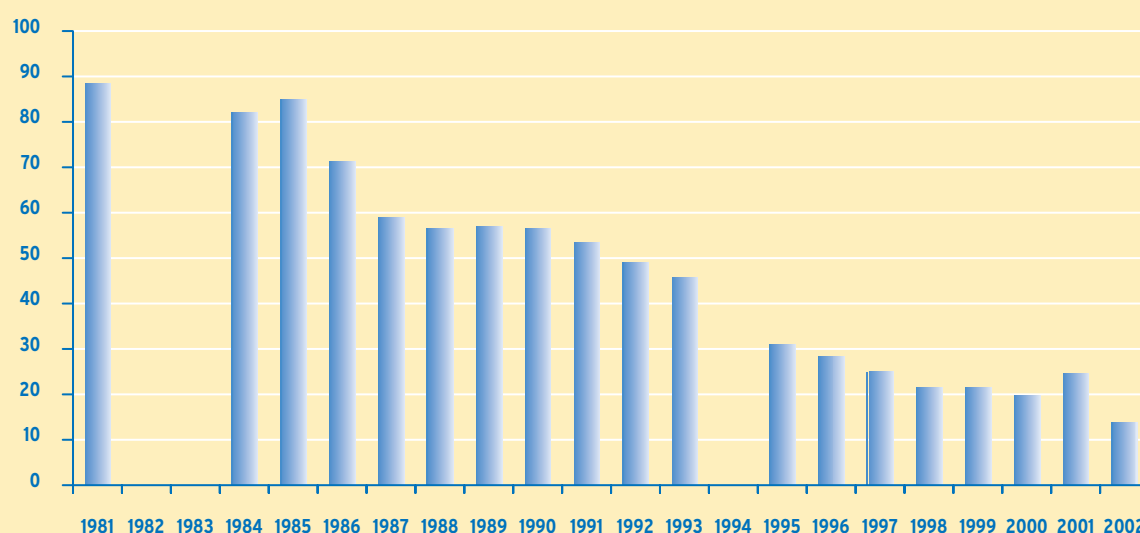
Part of the VOCs produced by road traffic is released during incomplete combustion, and the remaining share, as a consequence of evaporation due to tank aeration, through leaks on the vehicle and during refuelling. Also transport and storage of fuels have to be taken into account. A considerable decrease in VOC emissions in Germany has been achieved by exhaust emission regulations for motor vehicles and above all, the exchange of two-stroke engine cars for cars powered by modern engines in the east German Länder.

An important contaminant among the VOCs is benzene. Its admissible concentration in petrol is up to 1 % by volume. Benzene is carcinogenic and causes in particular leukaemia. To protect human health, the annual average benzene concentration in the air must not exceed $5 \mu\text{g}/\text{m}^3$ as

Figure 3

Source: Federal Environmental Agency, environmental specimen bank - human specimen bank

μg lead per litre of blood



Lead levels in humans:

Lead concentration in blood specimens from cohorts of students of Münster University

from January 2010. The highest benzene concentrations in ambient air have been measured on busy roads, particularly in street canyons. In some large cities such as Berlin, Leipzig, Essen, Magdeburg and Wiesbaden, the average annual benzene concentrations in 2000 varied between 2 and almost 6 $\mu\text{g}/\text{m}^3$. An obviously decreasing trend has been observed as compared to the concentrations measured in the 1990s. Meanwhile, the average annual benzene concentrations at 90–95 % of measuring sites have reached levels between 0.5 and 5 $\mu\text{g}/\text{m}^3$. In rural areas, concentrations are only around 0.5 $\mu\text{g}/\text{m}^3$.

In particular, exhaust gases from diesel engines contain soot particles. They have a considerable share in air pollution with particulate matter since the share of diesel cars in the number of fresh registrations in Germany has more than doubled in recent years. Meanwhile, the share of diesel cars has reached almost 40 %. Therefore, in spite of stricter exhaust emission standards, the concentration of fine particles has not decreased at measuring points situated close to road traffic. Fine particles increase mortality among persons suffering from respiratory and cardiovascular diseases. In animal studies, emissions from diesel engines have proved to be carcinogenic, with the main carcinogenic effect being attributed to soot.

The use of noble metals in catalytic converters has led to accumulation of platinum and palladium in road dust. At present, there are no data available yet on possible effects of these metals on the environment or human health.

In humans, no increased platinum levels attributable to the use of catalytic converter-equipped cars are found at present. This is one of the findings of examinations performed in the context of the Environmental Survey 1998. Elevated levels found in urine were linked to the platinum content in alloys used for dental treatment (inlays, crowns, bridges).

▼ Measures to reduce motor vehicle emissions

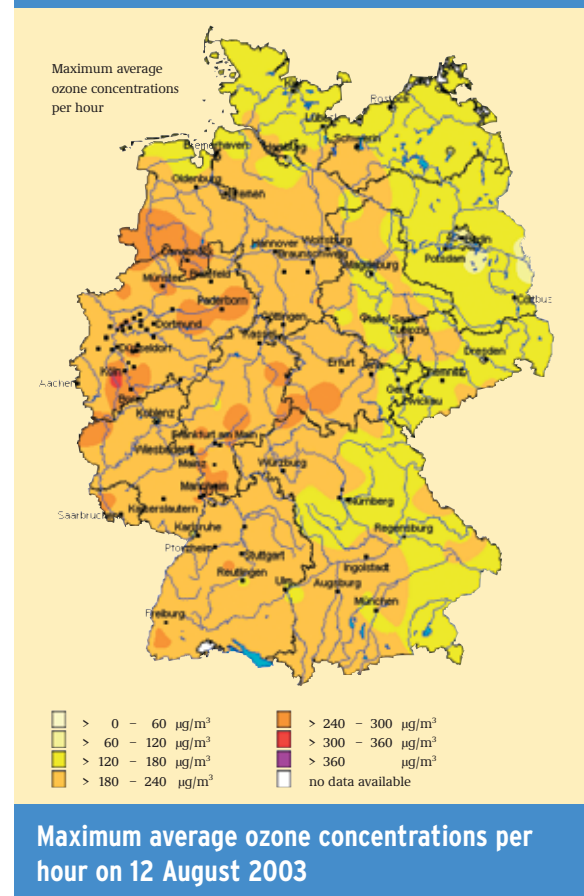
The total emissions could be considerably reduced during the 1990-2001 period (see Table 1). This decrease can be attributed to technological progress such as improved fuels and advanced car technology resulting in a reduction of fuel consumption and emission of pollutants.

However, such progress has been partially outweighed by increasing numbers of car registrations and longer distances covered by motor vehicles (see also Chapter 4, Road traffic). While the relative share of road traffic in the total emission of nitrogen oxides, carbon monoxide and carbon dioxide has remained almost unchanged during this period, the share in VOCs could be reduced considerably.

Introduction of the three-way catalytic converter for petrol engines has resulted in a reduction of carbon monoxide and nitrogen oxide emissions by approx. 90 and 50 %, respectively, at sufficiently high operating temperatures. However, such temperatures are not reached over short distances. The emission of carbon dioxide as a final combustion product may be reduced only by a reduction of fuel consumption. Introduction of the controlled catalytic converter started in the mid-1980s. In 2000, 87 % of petrol-driven cars were equipped with catalytic converters, while in 2003, this was the case already in 95 %.

Source: Federal Environmental Agency and federal Länder, 2003
www.env-it.de/luftdaten/start.fwd

Figure 4





'Los Angeles Smog'

To operate vehicles equipped with catalytic converters, only unleaded petrol can be used. This fact has promoted the production of such fuels. To protect human health, the 1971 Act on Lead Levels in Petrol brought about a strong limitation of lead levels in petrol followed by a complete ban. This has resulted in a continuous decrease of the lead burden in humans.

Such decrease has been very clearly demonstrated by the long-term analysis of blood specimens from young adults (see Fig. 3).

The German regulations on vapour recovery systems ("Saugrüsselverordnung") have brought about a reduction of fuel evaporation during refuelling. In Germany, the term "Saugrüssel" (literally: suction proboscis) is used for petrol nozzles providing for vapour recovery that were developed in the 1990s. A further decrease can be expected because from April 2003, such vapour re-

Box 9

- ▶ **Summer-type smog** has also been referred to as 'Los Angeles smog' since it was observed for the first time in this city in the 1940s.
- ▶ The precursor substances include, above all, nitrogen oxides and volatile organic compounds. By complex photochemical reactions (i.e. reactions caused by light), they form ozone and a number of so-called photochemical oxidants.

covery systems have been equipped with a detection system providing for automatic interruption of fuel supply if a malfunction of gas recovery is not corrected within 72 hours. Appropriate conversion of all filling stations is supposed to be finished until December 2007. According to estimates made by the UBA, VOC emissions can be reduced by 5 000 tons until 2010, including 40 tons of the carcinogenic benzene.

Also in diesel vehicles, emissions were reduced by technological improvement of the engines. Due to the ecological and health effects of exhaust gases from diesel vehicles, a marked reduction of exhaust emission standards for particles and nitrogen oxides has been considered as necessary by the UBA. Already at present, technical measures are available for the reduction of particle emission such as the diesel particulate filter, which is already offered by a number of manufacturers in serially produced cars. Further development of exhaust emission standards for passenger cars, light commercial vehicles and commercial vehicle engines has been demanded also on an international level. Fine particles including diesel soot particles have been considered as a primary issue in environmental hygiene also by the WHO, the European Commission and the US Environmental Protection Agency (EPA).

▼ Ozone and summer-type smog

Summer-type smog is a mixture of several environmental pollutants. It is formed by atmospheric reactions of a great variety of precursor substances when exposed to sunlight.

Ozone is considered as the adequate indicator of summer-type smog. It has the highest concentrations of all the substances involved and is also of prominent importance as to its health effects.

The latter will mainly consist in irritation of the respiratory tract. Irritation of the eyes is mostly to be attributed to the other photochemical oxidants present. Ozone concentrations will be high during episodes of 'fine' weather with intense sunshine mainly around noon and in the early afternoon. During these times of the day, outdoor physical activity should be limited. It is recommended to ventilate rooms mainly in the morning and evening hours.

Since 1990, there has been a decrease in the number of days with peak ozone concentrations

exceeding $240 \mu\text{g}/\text{m}^3$ (one-hour average). However, the annual averages have increased from 41 to $46 \mu\text{g}/\text{m}^3$ during the 1990–2002 period.

During the summer months, current ozone levels are published on the internet on an hourly basis and national ozone level prognoses are provided by the UBA to inform the population (for an example, see Fig. 4). In some cases, ozone levels and prognoses are also published by the Länder for their respective regions.

▼ Is there a man-made climate change?

It is a fact that the greenhouse effect is a natural phenomenon in which solar radiation and the so-called greenhouse gases play a role. Life on earth would be impossible without this warming effect.

Water vapour and atmospheric trace gases such as carbon dioxide, dinitrogen oxide, methane and ozone permit the passage of large shares of the short-wave solar radiation through the atmosphere. However, the long-wave thermal radiation emitted by the earth is absorbed by them (see also Chapter 5.2, Every day on the sunny side?). As a result, similar to the conditions found in a greenhouse, the earth's surface is heated to an average global temperature of 15°C . Without this natural greenhouse effect, the temperature on the earth's surface would be about 33°C lower. Life would be impossible under such conditions.

Human activities have resulted in an additional release of such greenhouse gases accumulating in the atmosphere (see Box 10). As a result, the natural greenhouse effect is reinforced by human interference, leading to an increase of the average global temperature. Such changes of the climatic conditions result in a great variety of problems.

Since 1861, an average global warming by approx. 0.6°C has been observed. Continued global

Box 10

Greenhouse gases and their most important emitter groups in Germany

Carbon dioxide: Combustion of fossil fuels, heating plants and power stations, industrial furnaces, road traffic

Methane: Agriculture, oil and natural gas production, local gas distribution networks, waste management

Dinitrogen oxide (nitrous oxide, laughing gas): Mainly agriculture and waste industry, also traffic and chemical industry

Hydrochlorofluorocarbons and sulphur hexafluoride: Refrigerants, e.g. in air conditioning systems in cars, propellants in aerosol cans, insulating gas

warming is most likely to have adverse effects on human health and the ecosystem.

In order to fight the additional man-made greenhouse effect, the European Union pledged to reduce greenhouse gas emissions by an average of 8 % until 2008/2012 against the 1990 levels. Such commitment was based on the Kyoto Protocol adopted by the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 1997.

Germany has agreed to reduce emissions of greenhouse gases by 21 % until 2008/2012. With a view to national objectives in terms of climate protection, Germany has adopted the National Climate Protection Programme in 2000. An important component consists in the Energy Conservation Act aiming at a reduction of CO_2 emissions produced by heating of buildings (see Chapter 3.1, The home).

CONTACT ADDRESSES

Umweltbundesamt
(Federal Environmental Agency)
Abt. Verkehr, Lärm, Abt. Umweltschutz-
instrumente, Klimaschutz und Energie,
Abt. Umwelthygiene, Abt. Luft

or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
e-mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

3.3 Where does the noise come from?

Box 11

- For the classification of noise exposure, the sound-pressure level is expressed in decibel [dB(A)]. The letter A means that for evaluation the fact that sensitivity to noise will vary at different frequencies has been taken into account.
- In the case of common environmental noise, a rising of the sound-pressure level by 10 dB(A) would be perceived as double intensity.
- Two sources with identical sound emission levels (e.g. 50 dB(A)) will not add to a (double) value of 100 dB(A) but to a total level of 53 dB(A). Ten such sources will not add up to 500 dB(A) but will result in 60 dB(A).

Environmental noise has been one of the subjects most intensively discussed by the public. Sounds that are unwanted are referred to as noise. Therefore, noise is mostly perceived as being caused by others.

Noise effects do not only depend on physical properties but also on a number of individual factors. Among these are sensitivity to noise or the fact whether the person affected is handling the noise source, e.g. a washing machine or lawn mower, and benefits from it. Therefore, the individual nuisance thresholds of noise may vary.

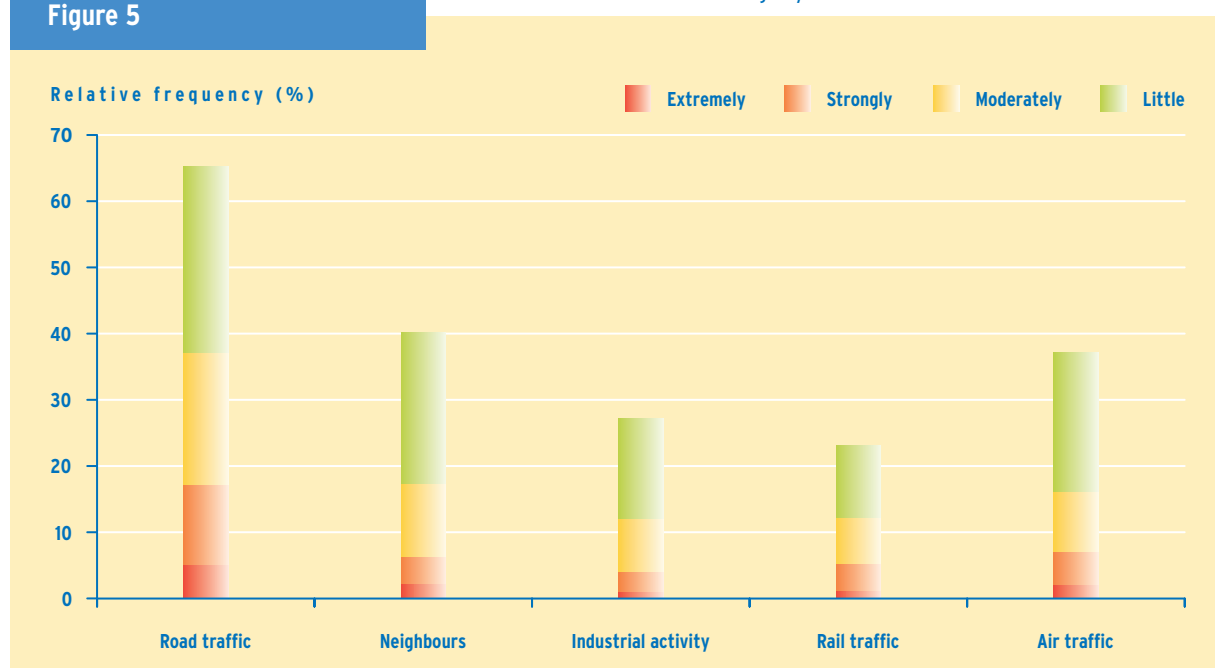
Depending on the time of day when noise is experienced, it may affect the quality of life in many ways. Particularly in the silence of the night, attention will be attracted by sounds that are not perceived during the day.

▼ Road traffic is the greatest nuisance

Adverse effects of environmental noise mainly refer to nuisance. Such nuisance consists e.g. in interference with person to person communication, interference with rest and relaxation both indoors and outdoors, disturbed concentration during mental activity, impaired well-being and limitations to the use of homes.

Figure 5

Source: Federal Environmental Agency: "Umweltbewusstsein in Deutschland im Jahr 2002"



Noise as a nuisance: Replies to the question whether the participants of the study felt disturbed or annoyed in their home environment within the last 12 months by the noise sources listed.

The share of persons interviewed who did not experience any disturbance or annoyance from the respective source of noise corresponds to the difference to 100 %.

Road traffic has continued to be the dominating source of noise. Two thirds of persons interviewed felt annoyed by it, however to a varying extent. This has been the result of representative inquiries about the issue of environmental awareness in Germany ("Umweltbewusstsein in Deutschland") conducted by the Federal Environmental Agency (UBA) at regular intervals since 1984. Questionnaires also included queries on disturbances and annoyance by environmental noise. In Fig. 5, some results from the 2002 inquiry are shown.

Since the spring of 2002, the UBA has been conducting an on-line inquiry into annoyance from noise in Germany www.umweltbundesamt.de/laermumfrage.

Up to the present, more than 10 000 citizens have participated and their opinions given clearly demonstrate that noise from road traffic, but also that from next-door neighbours and air traffic is perceived as a problem in Germany.

▼ Noise may also lead to disease

An effect of noise generally known to occur at high intensities (from 85 dB(A)) is damage to the inner ear. This will result in noise-induced hearing impairment that is irreversible. However, environmental noise will rarely reach sound-pressure levels sufficiently high to cause such damage (see Chapter 5.1, Music – the louder the better?).

Also below the levels resulting in noise-induced hearing impairment, permanent and loud environmental noise may, in addition to being a nuisance, cause health impairment. A number of studies have suggested an association to exist between continuous noise from road traffic and certain diseases, mainly such of the cardiovascular system. For instance, persons exposed to a sound-pressure level of 55 dB(A) or more (8-hour average) measured in front of their bedroom windows were treated for hypertension twice as often as those exposed to average sound levels below 50 dB(A). Studies on myocardial infarction have demonstrated an association with exposure to traffic noise at levels of 65 dB(A) and higher (equivalent sound-pressure level over 16 hours outside homes).

Evidence strongly suggests that such effects are induced by stress hormones that put the body on alert. These hormones will affect a number of or-



Noise gets on someone's nerves.

gans, mainly those of the cardiovascular system. In addition to smoking and overweight, noise is therefore another serious risk factor for the development of cardiovascular diseases.

▼ How many people are exposed to traffic noise?

In Germany, the share of the population exposed to road and rail traffic noise is estimated by model calculations. In such calculations, factors such as numbers and types of vehicles, their noise emission, speed and types of road surface are taken into account.

It has been demonstrated by these model calculations that in many places, exposure to noise is high during the daytime. Almost 50 % of the population are exposed to sound levels exceeding 55 dB(A) and almost 16 %, to sound levels exceed-

Box 12

- The assessment of noise exposure is not based on individual sound events but on averaged sound-pressure levels. These levels are calculated from individual sound levels determined over a defined period of time (equivalent sound-pressure levels).
- A level of zero dB corresponds to the normal hearing threshold level at 2 000 Hertz (Hz).



Traffic noise is the predominant noise source.

ing 65 dB(A). Even at night there is hardly any improvement of the situation. About 17 % of the population are exposed to sound levels exceeding 55 dB(A) at night.

Some individual sound events from everyday life may give an idea of the intensity of the sound levels (see Box 13).

▼ Noise in the home

In the home, conditions should permit a good person to person communication and an undisturbed sleep. As a rule, no problems will arise even with windows tilted for ventilation, if outdoor sound levels (equivalent sound-pressure lev-

els) are below 50 dB(A) during daytime and 40 dB(A) during the night.

As a rule, speech is understood well at sound levels below 40 dB(A). For children, however, levels of interfering noise should not exceed 35 dB(A). This applies to homes as well as to classrooms. As compared to adults, the acoustic memory is not yet fully developed in children. As a consequence, they are often unable to distinguish between similar-sounding words at interfering background sound levels. This will result in a reduced understanding of speech and also in an impairment of language acquisition.

Disturbance of sleep by noise may indirectly affect health since the quality of sleep is very important for health. Noise-induced sleep disturbance can be largely avoided if the equivalent sound level does not exceed 30 dB(A) and individual sound events in the bedroom do not exceed 45 dB(A).

▼ Observation of resting hours

Noise abatement can be practised by everybody. Mutual courtesy may avoid or solve many problems. This can be practised for example by observing established resting hours. The respective regulations are not completely identical everywhere. Resting hours at night will commonly be fixed to begin at 22 h. Special rules apply to the outdoor use of appliances and machines in residential and recreation areas (see Box 14).

Box 13

How loud are the different noises?	
Leaves on trees moved by a mild breeze	10 dB(A)
Ticking of a wrist-watch	20 dB(A)
Whispering	30 dB(A)
Normal conversation	55 dB(A)
Passenger car in urban traffic	75 dB(A)
Heavy goods vehicle in urban traffic	85 dB(A)

Box 14

Resting hours established for the use of certain equipment	
Weekdays	20.00 to 7.00 h
For the use of brush cutters, grass edge trimmers, leave blowers and leave collectors, the following additional resting hours should be observed	
	7.00 to 9.00 h 13.00 to 15.00 h 17.00 to 20.00 h
Sundays and public holidays	all day and night
<i>Regulations on the Protection against Noise from Appliances and Machines of 29 August 2002</i>	

These regulations are not always and everywhere complied with, which may partly also be due to unawareness of their existence.

▼ The Blue Angel label for low-noise appliances

For gardening works, there are for example low-noise shredders and chain saws available that have been labelled with the Blue Angel label (see also Chapter 3.2, The air we breathe, and on the internet www.blauer-engel.de, under Products and Label Users: There you can find a list of all labelled products.).

Meanwhile, there is also machinery available for the construction industry that has been awarded the Blue Angel. Its use may result in a considerable reduction of annoyance by and exposure to noise produced by construction sites in the vicinity of residential and recreation areas. At the same time, reduction of the levels of noise produced by construction machinery is immediately contributing to health protection and occupational safety of the staff working on building sites.

▼ Protection against road traffic noise

Based on the Federal Immission Control Act and relevant EC directives, a number of legal provisions have been issued for the protection against environmental noise. They refer for example to traffic, construction and operation of industrial plants and the above-mentioned use of machines and appliances. In Germany, a number of legal provisions exist concerning the protection against traffic noise.

For passenger cars, heavy goods vehicles and buses, there are standard driving noise levels under the Road Traffic Licencing Regulations that must not be exceeded. Since the appropriate tests are performed under defined conditions rarely found in the reality of road traffic, the driving noise emitted may be louder. This may apply for example to racing starts and high-speed driving, or driving on cobblestone pavement. Speed limits or diversions for heavy goods vehicles to avoid certain streets or even districts will result in traffic calming and thus reduce exposure to noise.

For new construction or essential changes of roads or railways, standards for ambient noise



Environmental label Blue Angel for low-noise shredders (RAL-UZ 54).

levels have been fixed in the Traffic Noise Ordinance (Federal Immission Control Ordinance No. 16). Under certain circumstances, the construction of noise barriers will be required to comply with noise standards. However, also in the case of existing roads and railways, for which there are no binding regulations, noise abatement measures may be taken under certain conditions.

Also airplanes must comply with defined noise control requirements for their registration. Under the Act on the Protection against Air Traffic Noise, a noise protection area consisting of two protection zones has to be established around commercial airports operating scheduled flights and military airports used by jet aircraft. For ex-



A 'green wall' for protection against road traffic noise.



Traffic calming walking speed only.

ample, the construction of residential buildings in protection zone 2 is only permitted if certain structural noise control requirements are com-

plied with. An amendment to the Act on the Protection against Air Traffic Noise is to markedly improve protection against such noise at night.

▼ Sustainable traffic policy to protect health

Measures to avoid unnecessary traffic and shift transport of passengers and goods to eco friendly means of transport are of primary importance (see also Chapter 4.2, Always by car?).

In contrast to the locally restricted effects of noise attenuation barriers and noise-insulated windows, such measures will have beneficial effects for a wide area. Noise control measures in residential buildings have to be regarded as a last resort because this means that there will be no more protective measures on the outside.

For more information on assistance regarding noise-related problems, please consult www.umweltbundesamt.de/laermprobleme.

CONTACT ADDRESSES

Umweltbundesamt
Federal Environmental Agency
Abt. Verkehr, Lärm, Abt. Umwelthygiene,
Abt. Technik- und Produktbewertung

or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
e-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

4 ROAD TRAFFIC

We all are set in motion by traffic. Some would, in a passive way, have themselves moved by a car, public transport, train or plane while others would move actively by walking or cycling.

To all of us, to be mobile means a high degree of freedom and quality of life. Mobility has gained an ever increasing importance for commuting to and from work, in professional life and during leisure time.

Trade and industry have a vital interest in passenger and goods traffic to work as smoothly as possible.

According to all prognoses, a further considerable increase in the volume of traffic has to be expected within the next years. This is due to the economic development, European integration and the eastward enlargement of the European Union. This means a great challenge for traffic policy which will have to ensure that we are not choked by traffic. Such policy should be aimed at an intelligent use and linking of all means of transport in order to avoid an unbalanced growth of traffic at the expense of ecologically friendly means of transport.

The influence of cars on the quality of life and the environment is rated in different ways. For some people, the car is tantamount to freedom and flexibility, others would regard it as the most prominent environmental polluter. Therefore, some would demand more roads, others, more limitations of traffic.

One thing is for sure: Road traffic is an environmental factor having an important impact on the health of children and adults.



4.1 How do you move forward?

Results of the Environmental Survey 1990/92 have revealed that adults in Germany spend almost one hour per day in road traffic. The major part of this time (about 45 min) is spent inside cars.

In contrast, children between six and twelve years of age spend almost 1.5 hours in road traffic. For an average period of half an hour a day, they are out on bicycles or walking. They would spend only an average of six minutes in cars. Although these figures are not really up to date, they may provide a rough idea of the situation.

▼ Bad air also inside the car

Every year in May, the Federal Environmental Agency (UBA) would organise a conference on aspects of indoor hygiene, in cooperation with the Verein für Wasser-, Boden- und Lufthygiene e.V. (Association for Water, Soil and Air Hygiene), un-

der the German name of “WaBoLu-Innenraumtage” (WaBoLu is a German abbreviation mean-



The right way: Children with helmet.



Fasten seat belts – for your child and the seat!

ing water, soil and air). For the first time in 2002, the air quality in means of public and private transport was a subject considered in the context of this event. Means of transport referred to airplanes, buses and trains but above all to passenger cars.

Pollutants occurring inside of motor vehicles include mainly volatile organic compounds, among these fuel components such as alkanes, benzene and toluene. Also suspended particulate matter and components of exhaust gases, such as carbon monoxide and nitrogen oxides (for health impacts see Chapter 3.2, The air we breathe) can be detected inside cars. Concentrations of these pollutants inside the vehicle are often higher than those in ambient air.

VOCs, for example, may leak from fuel-supplying parts and tubes and from lubricants. From spare cans carried in the boot of a car, small quantities

of fuel will constantly evaporate and may accumulate in the passenger compartment.

Car ventilation systems will provide for an exchange of the air inside the car for ambient air at different rates, depending on the performance of the fan. Air-exchange rates of 100 per hour are not unusual. As a result, exhaust gases from vehicles going ahead (carbon monoxide and VOCs) and particulate matter will enter the passenger compartment. Comparative studies performed in the city of Berlin have revealed that car passengers are often exposed to higher concentrations of pollutants than for example underground train passengers or even pedestrians.

Above all, strongly smelling substances will often be emitted into the interior of new cars. As a rule, this is due to the materials used. These include, in general, plastic materials (polymers) fitted and used together with solvents, adhesives and paints. Polymers may release semi-volatile compounds, particularly plasticisers, which may deposit in the passenger compartment. Ageing of the materials of the car interior will result in a gradual reduction of emissions.

CONTACT ADDRESSES

Umweltbundesamt
(Federal Environmental Agency)
Abt. Umwelthygiene
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

4.2 Always by car?

As compared to former times, today's traffic system has considerably enlarged our range of action. It has become much easier to reach destinations even in far away countries.

In spite of a well-developed railway system, the road has remained to be the most important route for transport of passengers and goods in

Germany. In terms of passenger kilometres (Pkm, the number of passengers transported multiplied by kilometres covered), the traffic performance in passenger transport has increased from almost 875 000 million Pkm in 1991 to almost 936 000 million Pkm in 2000. Transport by private cars has the highest share in these figures, i.e. more than 75 %. During the last ten years, proportions

have shifted to a minor extent only in favour of the use of railways and airplanes. The use of local public transport has decreased slightly.

▼ Continuously rising numbers of registered vehicles

The number of registered motor vehicles has been continuously increasing (see Table 2). In 1999, 42.3 million passenger cars, 2.6 million heavy goods vehicles and 4.9 million motorcycles, mopeds etc. were registered. Measured by the traffic performance, the increase recorded for the 1991–1999 period was ‘no more’ than 7.7 % for motorised private transport, but as much as 50 % for motorised goods transport.

It is therefore not surprising that the representative inquiry into environmental awareness in Germany performed in 2002 (“Umweltbewusstsein in Deutschland 2002”) revealed road traffic to range first among the environmental problems in communities as perceived by the population (see also Chapters 3.2, The air we breathe and 3.3, Where does the noise come from?).

Often, increasing traffic performance in passenger transport has been considered as tantamount to increasing mobility. However, it is important for the individual whether destinations are within easy reach. The examples of Amsterdam and Zurich have demonstrated that this aim may also be achieved with less car traffic if bicycle traffic and public transport can provide appropriately attractive conditions.

On German airports, about 1.84 million aircraft movements were recorded in 1999, 1.75 million of

these on commercial airports. The number of airline passengers recorded was 110.2 million in 1999. Also in air passenger traffic, an increasing tendency has been observed since 1991. The main reason is that flying has become cheaper and cheaper and therefore gained in popularity. As a consequence, however, environment and health have become increasingly exposed to exhaust gases and noise.

▼ Lack of physical exercise

According to the results of the Environmental Survey 1990/1992, adults would spend almost one hour per day in private or public means of transport. This means additional physical inactivity on top of jobs that are mostly of a sedentary nature.

Lack of physical exercise in connection with an unhealthy diet is known to pave the way for the development of a number of civilisation diseases. The resulting overweight will promote hypertension and its sequelae (see Chapter 6.1, Do we eat the right foods?). Unfortunately, this is not only true of adults but has increasingly been observed in children as well. Being seated over long periods may also result in problems of the locomotor system, particularly such linked to the spinal column.

Often, parents consider the way to school to be too long or dangerous for their children. Therefore, many children are taken to school by car.

▼ Fewer deaths in road traffic accidents

Road traffic has been an essential source of accidents in Germany. In 2001, the police recorded about 2 million road accidents that caused mate-

Sources: Federal Statistical Office, 1983, 2002; Statistisches Jahrbuch der DDR (Statistical Yearbook of the GDR) 1989

Number of motor vehicles		1980	1985	1990	1995	2000
Total	FRG ²	29.2	32.1	36.7	48.5	52.3
	GDR ³	4.6	5.3	no data ¹		
Passenger cars	FRG ²	23.2	25.8	30.7	39.9	42.4
	GDR ³	2.7	3.3	no data ¹		

1 No data were available for the German Democratic Republic (GDR) 1990
 2 FRG, Federal Republic of Germany; 3 GDR, German Democratic Republic



A cross by the road to commemorate someone killed in a traffic accident.

rial damage and 375 000 accidents in which people were injured.

Although the number of recorded road accidents has slightly increased as compared to 1991, the number of deaths and persons who suffered injuries has decreased (Fig. 6).

Within towns or communities the main causes of accidents involving injured persons are violations of the right of way, insufficient distance, driving at excessive speed and inappropriate behaviour of pedestrians. Factors promoting the occurrence of accidents include lack of driving experience and driving under the influence of alcohol or other drugs.

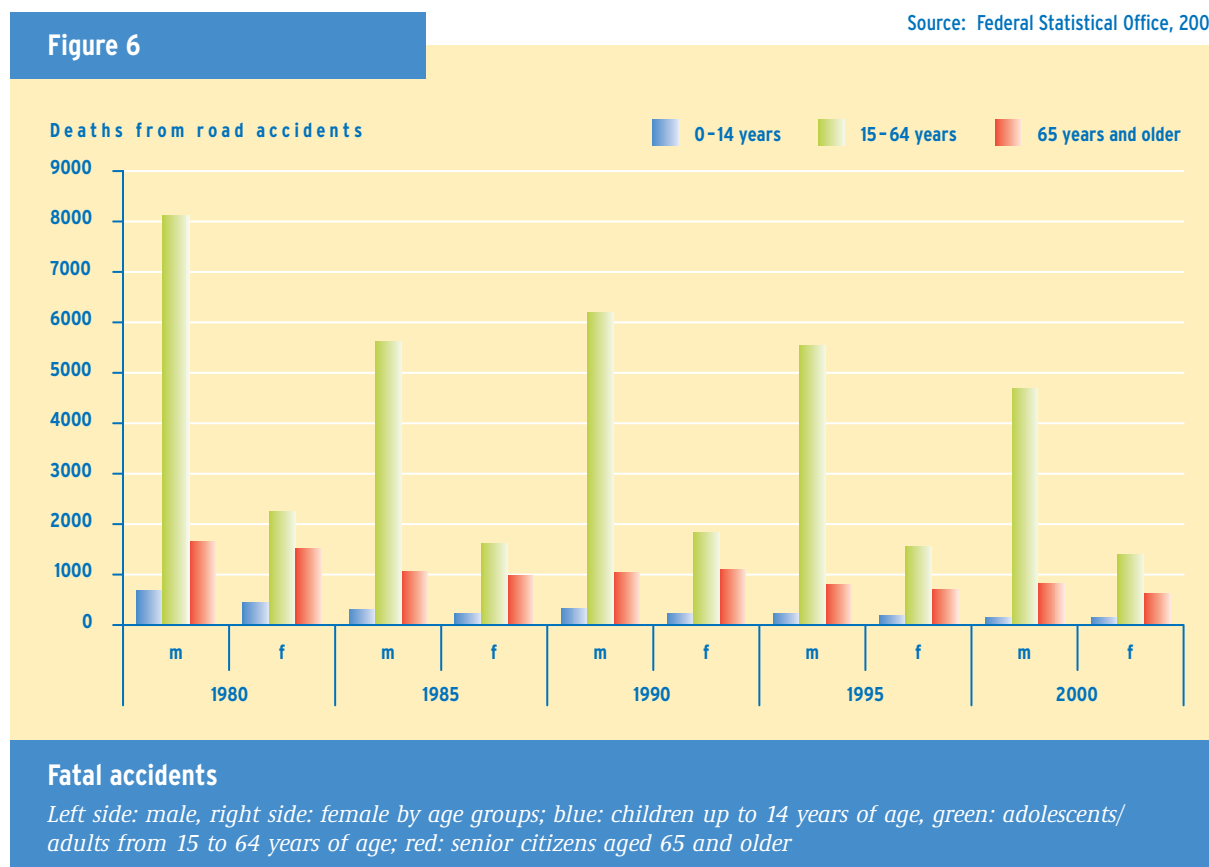
Road traffic accidents are the most frequent cause of death particularly among young males aged 18-29 years. Almost 50 % of pedestrians and cyclists killed in accidents are senior citizens. In 2000, 240 children up to 15 years of age became victims of road accidents. This is the lowest figure since 1953 (start of recording). Most accidents involving personal injuries (64 %) occur within communities. Two thirds of the victims lost their lives on country roads and 12 % on motorways.

▼ National bicycle traffic plan

Increasing motor traffic has resulted in alternative types of locomotion such as walking or cycling to be considered as unattractive or too dangerous.

Figure 6

Source: Federal Statistical Office, 2002





Especially in urban agglomerations where distances covered by 50 % of all car travel are shorter than 5 km, the bicycle provides a number of clear advantages. It does not cause any noise nor emissions and in addition, it keeps the cyclist fit. There is no need to search for car parking space and of-

ten, the destination can be reached in less time than by car. Although after hiking and swimming, cycling is the third-most popular leisure time activity of Germans, the number of kilometres covered by car during leisure time is twice as high as that for job-related reasons.

In the context of the national bicycle traffic plan of the Federal Government (the plan's title "FahrRad!" includes both the German term for bicycle and an invitation to use it), a number of measures have been initiated to increase the attractiveness of this means of transport.

At present, a model project on cities friendly to pedestrians and cyclists (fußgänger- und fahrradfreundliche Städte) is supported by the UBA. It has been the aim of the project to demonstrate that improvements in urban infrastructure, public relations activities and integration of a corresponding policy will create conditions that encourage people to walk more often or use the bike. In these efforts, cooperation with schools has been an important starting point in order to improve the safety on routes to schools and to leisure time activities.

CONTACT ADDRESSES

Umweltbundesamt
(Federal Environmental Agency)
Abt. Verkehr, Lärm, Abt. Umwelthygiene
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de



Countryside trip by bicycle.

▼ Streets become safer

Two programmes have been developed by the Federal Government to improve safety in road traffic ("Besser sicher – Sicher besser: 10 Punkte für mehr Sicherheit im Straßenverkehr" and "Programm für mehr Sicherheit im Straßenverkehr") in 1999 and 2001, respectively. These programmes are designed to ensure mobility under conditions of environmental protection and social equity. Human lives shall be better protected in road traffic and the economic damage caused by accidents (see Box 15) should be minimised.

Box 15

Priorities of traffic safety policy

- Improvement of the social behaviour in road traffic (e.g. reduction of aggressiveness)
- Protection of vulnerable persons
- Reduction of accident risks for young drivers
- Reduction of risks from heavy goods vehicles
- Improvement of safety on country roads

Federal Ministry of Transport, Building and Housing: Report on the prevention of accidents in road traffic, 2000/2001

5 LEISURE TIME AND RECREATION

Leisure time is the counterpart to working time. More than ever, it has become important today that leisure time is used for the purposes of self-creative activity, in addition to recreation and restoration of working fitness. The main objective of these activities consists in finding a compensation for unbalanced and uniform strain at work or school. One hundred years ago, people had to work for about 16 hours a day. In today's modern industrial society, the relation between working and leisure time has shifted in favour of the latter. In the late 1990s, the average working time of an adult in Germany was about 1 600 hours per year, against a leisure time of almost 2 500 hours, accounting for 18 and 28 %, respectively, of the total number of hours of a year (8 760).

Individual needs with regard to leisure time and recreation activities may vary considerably. Irrespective of age groups, they may be roughly divided into 'passive consumption' and 'active organisation'. There is a great variety of leisure time activities. In the following, our attention has been focussed mainly on visits to discos and bathing at natural beaches or river banks.

5.1 Music – the louder the better?

The love of music is independent of age. Generally, people would listen to it for relaxation and entertainment.

Among young people, listening to loud music has become quite popular since the beginning of the age of beat, pop and rock music when powerful amplifiers became generally available. They attend discos and big music events or listen to recorded music through headphones from HiFi sound systems or portable players (Walkman®, Discman®).

In occupational medicine, preventive examinations have revealed an increasing share of

adolescents with distinct hearing impairment. This has probably to be attributed to leisure time noise.

For this reason, the Federal Environmental Agency (UBA) not only deals with environmental noise (see Chapter 3.3, Where does the noise come from?) but also with leisure time noise and has commissioned or carried out a number of studies on this issue.

▼ Music styles preferred by young people

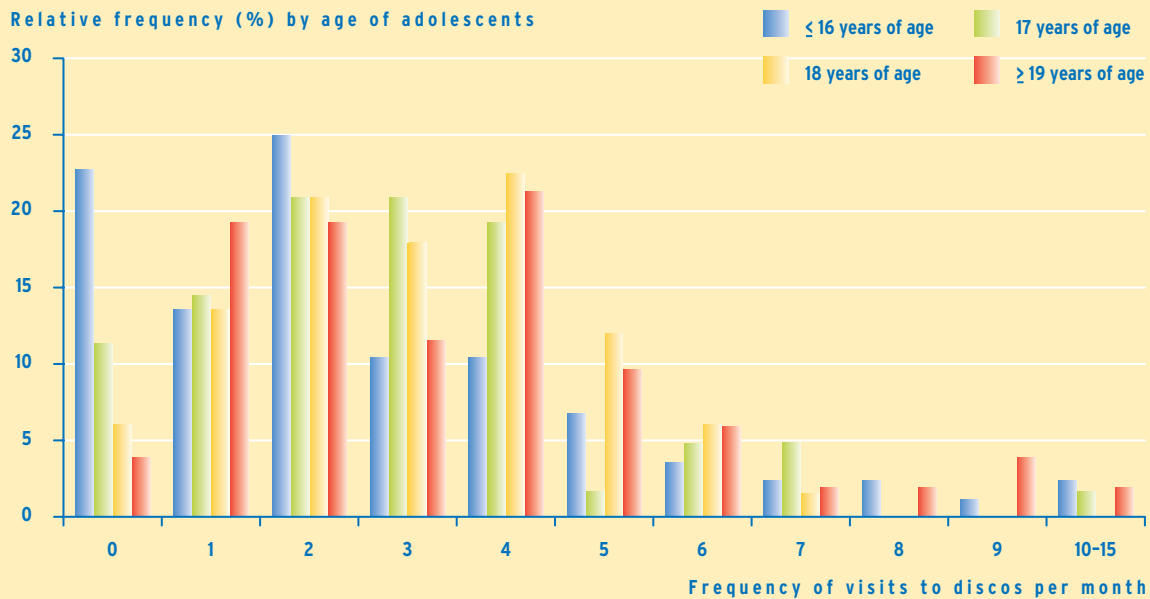
Inquiries among adolescents in German-speaking countries have revealed that on an average, young people start to visit discos at the age of 14–16 years. From 20 years of age, interest in the disco will wane. About 10 % of young people visit discos or other music events once or twice a week, approx. 5 % of those aged above 15, at least twice a week. On an average, they stay at discos for about three to four hours. 10–15 % of those interviewed, however, stayed even for six or more hours.

According to an inquiry among approx. 450 Berlin pupils in 1998, their preferred music genres were Hip Hop, Drum 'n' Bass and Trip Hop. It should also be taken into account that preferences for certain types of music are also influenced by fashion and trends in youth culture.



Figure 7

Source: Federal Environmental Agency, Sound-pressure levels in discos and at music events, 2000)



Reply to the question: How often per month, on an average, do you visit a disco?

25 % of the pupils loved extremely loud and very loud music. 30 % stated that communication at discos was possible by yelling only, if at all.

Headphones were used by 35 % of the adolescents aged 16–17 and 60 % of the adolescents aged 18–19 years according to the study. About one third of these pupils preferred extremely loud and very loud music. Somewhat more than 5 % of them would listen to music through headphones for at least four hours daily. Almost two thirds of those preferring extremely loud and very loud discos would also adjust their headphones to high sound levels when listening to music through these.

▼ It is too loud in here

Measurements of sound levels in discos, at rock concerts and in headphones revealed equivalent sound-pressure levels between 90 and 110 dB(A). On dance floors of discos, the levels measured were often around or even above 100 dB(A). Mostly, the volume would increase by 2 dB(A) per hour in the course of the night. At rock concerts and also in discos, considerably higher sound levels may be reached near loudspeakers.

▼ Noise may cause deafness

The human ear has its highest sensitivity at a frequency of 4 000 hertz (Hz). Audible frequencies range from approx. 16 (very low tones) to 20 000 Hz (very high tones). With increasing age, the upper hearing threshold decreases so that high-pitched sounds such as the chirping of crickets can no longer be heard.

Damage to the ear can be largely excluded at sound levels below 75 dB(A). Continuous sound levels above 80 dB(A) may result in a temporary shift of the hearing threshold within a few hours. The threshold of pain corresponds to approx. 130 dB(A).

Box 16

Noise-induced hearing impairment

It is defined as a noise-related reduction of the hearing capacity by more than 40 dB(A) at a frequency of 3 000 Hz.

G 20 Noise, Principles stipulated by the professional insurance bodies (German term: Berufsgenossenschaft) for preventive medical examinations) 1998



Bangs and explosions as well as continuous noise may result in temporary shifts of the hearing threshold or even permanent hearing loss. The development of hearing loss is decisively influenced by sound-pressure level, sound level rise time, duration of noise exposure and individual sensitivity of the inner ear. Often, excessive exposure to noise of the inner ear will result in tinnitus. Tinnitus experienced after excessive exposure to noise should be considered as a serious warning signal.

Not only continuous noise but also single noise events involving a high sound intensity (such as fireworks, toy pistols) may immediately result in permanent hearing impairment. Noise-induced inner ear damage will be irreversible.

Noise-induced hearing impairment will mainly affect the frequency range around 4 000 Hz. Although hearing aids may help people affected, they will constitute a considerable impairment in their quality of life. Also, the hearing dynamics will be restricted. Hearing of weak sounds will be impossible or poor, and strong sounds will cause discomfort (a phenomenon referred to as 'recruitment').

▼ Legal regulations?

For the protection against occupational noise-induced hearing impairment, wearing of ear protectors is required by a new EC Directive (2003/10/EC) for exposure action values of 85 dB(A) and

above. Recovery of the ear during leisure time will be adversely affected by visits to discos, listening to loud music and other noisy leisure time activities. Such combination of exposure to both occupational and leisure time noise will increase the risk of hearing impairment.

There are no adequate regulations for leisure time noise in Germany. In contrast, Switzerland has introduced a limit value for discos and big music events. It has been fixed at an equivalent sound-pressure level of 93 dB(A). In exceptional cases only, 100 dB(A) are permitted. France, for example, has issued a sound level standard for portable music players.

Studies of visits to discos by adolescents have revealed that about 10 % of these young people have to be considered as a risk group for the development of measurable hearing impairment.

If noise from headphones were included in such calculations, the share of persons at risk would probably be even higher.

▼ Education of the public

Adherence to music sound levels that are tolerable for the human ear can only be achieved by cooperation of all groups involved.

Appropriate health education is required both for disc jockeys and sound system technicians on the one hand and consumers of music, on the other. Such education could be performed for example in the context of school lessons in physics or biology. Appropriate teaching material has already been developed by the Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung). The most recent recommendations for a reduction of music sound levels were published in 2000 by the former Commission "Soziakusis" (societal hearing damage) of the UBA.

For reasons of health protection, a reduction of sound levels in discos, at concert events and in other situations involving sound exposure has to be demanded.

A number of inquiries conducted among adolescents and young adults have revealed that most people feel sound levels to be too high in such places anyway and would therefore welcome noise reduction measures. The lower level of ac-

ceptable sound levels seems to be slightly above 90 dB(A). Under such circumstances, a reduction of noise levels to ear-friendly values below 100 dB(A) should be acceptable also for managers of discos and organisers of music events.

CONTACT ADDRESSES

Umweltbundesamt
(Federal Environmental Agency)
Abt. Umwelthygiene
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

5.2 Everyday on the sunny side?

Without the sun, life on earth would be impossible. The optical radiation emitted by the sun, particularly its infrared (long-wave) fraction (approx. 42 %) heats the soil, the sea and the atmosphere and thus controls weather and climate. Visible radiation ('light', approx. 52 %) is the main supplier of the energy needed for plant growth.

Box 17

The spectrum of UV radiation emitted by the sun is subdivided into three wavelength ranges

UV-A (320–400 nm)
almost completely reaches the earth's surface

UV-B (280–320 nm)
is absorbed by atmospheric ozone to almost 90 %

UV-C (100–280 nm)
is completely absorbed in the atmosphere by oxygen and ozone.

1 nanometre (nm) corresponds to the 1000 millionth part (10^{-9}) of a metre

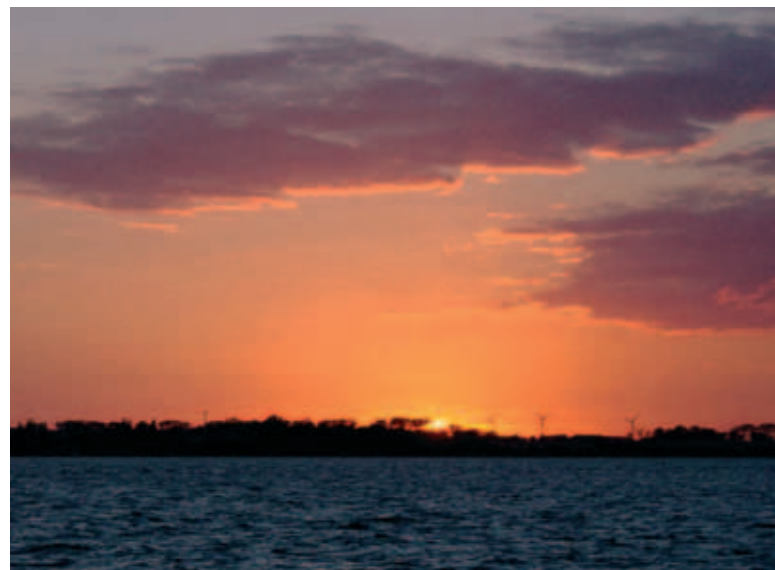
The sun also emits ultraviolet (UV) radiation (approx. 5 %). UV radiation comprises three wavelength ranges. Two of these reach the earth's surface (see Box 17).

Although we can neither see nor feel this radiation, it produces the strongest biological effects of the entire optical radiation. The UV-B fraction is the most effective part. Low UV irradiation is

required for the formation of vitamin D in the human skin. Vitamin D plays an important role in the metabolism in our bones (ossification). Likewise, UV irradiation is used in medicine to treat diseases of the skin such as psoriasis.

▼ Too much sun is harmful

Apart from these favourable effects, however, health risks from such radiation are predominant. It is seen with concern that during the last decades, public opinion has considered a tanned skin as 'beautiful' and 'healthy'. This has led to an excessive outdoor UV exposure and also to an additional artificial exposure from using solarium during leisure time and when people are on holiday.



Lakeside sunset.

Above all, solar irradiation produces damage to skin and eyes. Acute effects are sunburn (erythema, inflammatory redness of skin), keratitis and conjunctivitis. Chronic effects are premature ageing of skin, skin cancer and opacification of the lens of the eye (cataract).

Regarding squamous cell and basal cell carcinomas which are mostly found at skin sites having suffered chronic damage from exposure to light, there is an obvious dependency on the UV irradiation dose. Melanoma, which often develops at sites covered by clothes, is more frequently observed in persons having often suffered sunburn in their childhood. In Germany, among 100 000 persons (males and females), approx. 40 per year fall ill from squamous cell carcinoma, approx. 150, from basal cell carcinoma and approx. 8–10, from melanoma. Numbers of cases show a rising tendency.

Source: www.suvmonet.de

Figure 8



German solar UV measuring network:
Measuring sites operated in April 2004

▼ UV monitoring in Germany

High UV exposure may not only result in more cases of certain diseases in humans but also have damaging effects on growth and development of plants and animals. For this reason, UV radiation has become an important environmental parameter which has to be continuously monitored. Nowadays, UV measurements are performed worldwide.

These monitoring activities are meant to watch the relationship between reduced ozone levels in the stratosphere ('ozone hole') and the increase in ambient UV radiation linked to this phenomenon.

In Germany, UV monitoring began in 1993, at four measuring sites operated jointly by the Federal Office for Radiation Protection (BfS) and Federal Environmental Agency (UBA). Meanwhile, the network has been extended and now comprises another official station run by the German Federal Meteorological Service (Deutscher Wetterdienst) and five stations run by associated institutions, i.e. the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin), Kiel University, Bavarian Environmental Protection Agency (Landesamt für Umweltschutz Bayern) and the Lower Saxony State Agency for Ecology (Niedersächsisches Landesamt für Ökologie) (see Fig. 8).

Up to now, the UV measurements performed have not shown any significant increase of ambient UV-B radiation. This is due primarily to the quite variable weather conditions at our geographical latitude and also to the short period of monitoring which does not yet permit statements on trends.

▼ Which is the role of ozone?

In the last 30 years, a 10 % reduction of the total tropospheric and stratospheric ozone level has been observed by the German Federal Meteorological Service. Due to this reduction, UV-radiation is less absorbed, i.e. a larger share can hit the earth's surface. This may suggest an increase in UV-B radiation at ground level. 'Ozone killers' such as hydrochlorofluorocarbons (HCFCs), having been used for a long time in pressurised sprays and refrigerators are among the agents responsible for the reduction in atmospheric ozone. In Germany, production of HCFCs was discontinued in 1994. International agreements have led to a world-wide reduction of production

Box 18

Sensitivity of human skin to UV radiation varies from one individual to the other	
Skin type I	
Fair skin, freckles, reddish hair, blue eyes	Always sunburns, hardly any tanning even after repeated solar exposure
Skin type II	
Blond hair, grey, blue or green eyes	Nearly always sunburns, moderate tanning after repeated irradiation
Skin type III	
Light brown hair, grey or brown eyes	Moderately frequent sunburns, progressive tanning after repeated sun exposure
Skin type IV	
Dark hair, brown eyes	Rarely sunburns, rapid onset of tanning

and use of HCFCs. Since HCFCs and related products are not readily degradable and persist in the atmosphere for more than 100 years, they may pose problems even for future generations.

During the last three decades, there has been a massive reduction in the levels of air pollutants in Germany, in particular that of dust. This also means that it has become easier for UV radiation to penetrate the atmosphere.

▼ Education of the public

For a number of years already, both the BfS and the Commission on Radiological Protection (Strahlenschutzkommission, an independent advisory committee of the Federal Ministry for the Environment) have noted with concern a steep increase in the number of cases of skin cancer.

This increase has been attributed mainly to a higher UV exposure resulting from changed habits of sun-bathing and leisure activity.

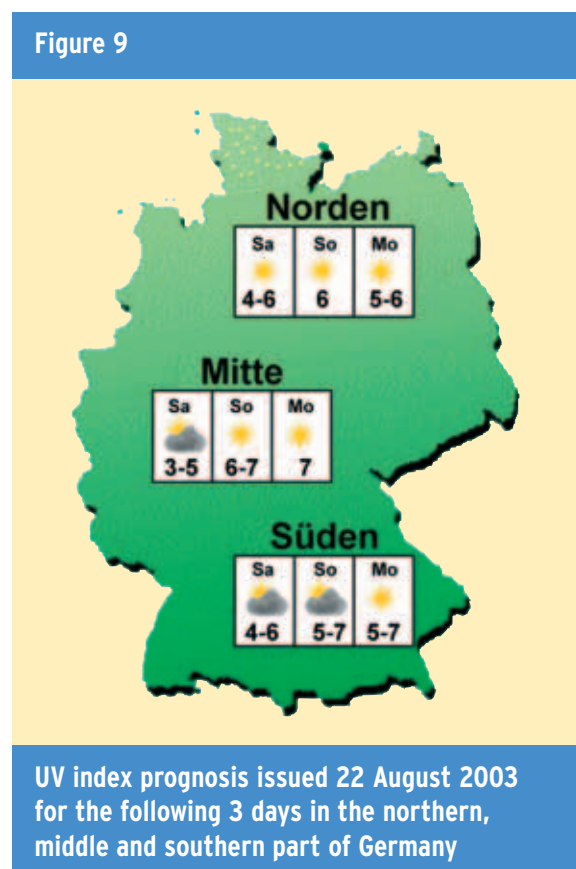
For more than 10 years, both the BfS and the Commission on Radiological Protection have been informing the public on the risks of solar UV radiation by leaflets and recommendations. In 1998 for example, the Commission on Radiological Protection revised their recommendations on the protection of humans against solar UV radiation. In these recommendations, risks and causes of skin cancer are explained. Furthermore they give recommendations about habituation of the skin to solar irradiation, protection against solar radiation and the maximum number of sun baths per year. Sunburn should be avoided at any time. This applies especially to children and adolescents.

▼ UV index published on the internet

For a number of years already, the BfS has published an UV index to inform the public about the current UV exposure in Germany. The UV index is a variable expressing the highest sunburn-

Source: Federal Office for Radiation Protection, 2003
www.bfs.de

Figure 9





Sensitivity to UV radiation varies by skin type. From left to right: Skin types I, II, III and IV (see also Box 18). Fair-skinned pale persons with reddish hair need more protection to avoid sunburn than dark ones.

producing radiation level of the respective day. By raising awareness among the public concerning the risks of excessive UV exposure, it serves the purposes of preventive health care and avoidance of disease.

Commonly, the UV index value for the summer period in Germany will reach a maximum of 8. In southern countries, higher values are observed.

This index is not applicable to artificial UV radiation. In the summer months, prognostic UV exposure values for the next three days in northern, central and southern Germany are published by the BfS (www.bfs.de). In addition, current values observed at the ten measuring sites are shown daily.

Individual protective measures are recommended if the UV index is higher than 5 (see Table 3).

Sun blockers should only be used where it is impossible to seek shadow or to wear suitable

clothing. They are offered with sun protection factors (SPF) differing in intensity and may effectively prevent sunburn if properly applied. The SPF corresponds to the factor by which the period of irradiation until the onset of sunburn is prolonged when the respective product is applied. If possible, the SPF should be the double of the UV index. However, the extent of protection against skin cancer provided by sun blockers is still unclear.

▼ A note on solaria

The biological effects of UV irradiation depend on the spectrum involved, irrespective of its natural or artificial origin. The damaging influence of solar UV irradiation will increase in the case of additional UV exposure by artificial UV sources like those used in solaria. For preventive reasons and in accordance with international recommendations, the Commission on Radiological Protection does not recommend a use of solaria for pur-

Source: Federal Office of Radiation Protection

Table 3: Skin type II - Protective measures

UV index	Exposure	Burns possible	Protective measures
8 and above	Very high	Within less than 20 minutes	Absolutely necessary
5-7	High	From 20 minutes	Necessary
2-4	Moderate	From 30 minutes	Recommended
0-1	Low	Unlikely	Not necessary

poses other than medical ones. If nevertheless people wish to visit solaria, the BfS recommends the use of certified establishments only. Only in certified solaria, the user is given a minimum standard of protection against excessive UV exposure. This helps to reduce the personal health risk of the user.

The essential criteria for certification consist in defined standards for equipment limiting UV radiation as well as uniform operating procedures regarding hygiene and occupational safety. Also, the professional qualification of the staff and the extent of information for and advice to customers are regulated.

CONTACT ADDRESSES

Bundesamt für Strahlenschutz
(Federal Office for Radiation Protection)
Postfach 10 01 49
38201 Salzgitter
Internet: www.bfs.de

Strahlenschutzkommission
(Commission on Radiological Protection)
Geschäftsstelle beim Bundesamt für
Strahlenschutz
Postfach 12 06 29
53048 Bonn
Internet: www.ssk.de

Umweltbundesamt
(Federal Environmental Agency)
Abt. Luft
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

5.3 Undisturbed pleasure on the beach

In the summer months, bathing at local beaches on the banks of rivers, lakes and the seaside, is most popular.

The physical activity involved promotes health in general and helps to control civilisation diseases such as cardiovascular diseases and such originating from a sedentary lifestyle.

▼ Can bathing lead to disease?

Bathing may involve health risks. The spectrum of possible accidents ranges from cuts and abrasions to drowning. Where beaches are watched, accidents by drowning are exceptions.

There may be illnesses involving fever, diarrhoea and vomiting where specific agents of disease are introduced into open waters by effluents from sewage works and mixed sewerage systems. Excreta of bathers may contain pathogens which

may involve a risk of disease above all where water bodies are stagnant.



Children at an unattended beach.



Another problem related to sewage discharge is caused by the introduction of nutrients, in particular of phosphorus and nitrogen compounds resulting in a mass growth of algae (eutrophication).

In particular, blue-green algae produce algal toxins and allergens. These algal products may cause acute disturbances of health such as conjunctivitis or skin rash and also have chronic effects (liver damage). In addition, water will become turbid which does not constitute just an aesthetic problem but may be an obstacle when trying to save the life of a drowning person.

▼ Evaluation of health risks

In accordance with Council Directive 76/160/EEC concerning the quality of bathing water dated 8 December 1975, the evaluation of health risks is based on so-called indicator organisms such as *Escherichia coli* (*E. coli*) and coliform bacteria. The bacterium, *E. coli*, is an indicator of faecal contamination. This bacterium which as a rule is harmless has its habitat in the human and animal intestine. It is transported by way of sewage into receiving waters. Directive 76/160/EEC stipulates that bathing water must not contain more than 2 000 *E. coli* in 100 mL water. The term 'coliforms' is used for bacteria which are capable of living also outside the intestine. In bathing waters, they may be present in concentrations up to 10 000 bacteria in 100 mL. Apart from these standards whose levels constitute imperative limits, the EC Directive on bathing water stipulates lower and thus more stringent values which should

be aimed at. The latter (100 *E. coli*/100 mL and 500 coliforms/100 mL) are referred to as guide values.

▼ Monitoring of beaches

Improved sewage treatment by communities and industry in Germany and in neighbouring countries has led to a considerable improvement of the biological quality of waters, in particular in the catchment areas of Germany's great rivers. This does not mean, however, that such water bodies are suitable for bathing from the viewpoint of hygiene. To keep the risk of infection as low as possible, official beaches in Germany are monitored by the federal Länder authorities. The pertinent Länder regulations are based on the Council Directive mentioned above. To avoid or reduce health problems from bathing water at natural bathing beaches, there should be the lowest possible amount of pathogens. The fixed concentration of defined indicator organisms should not be exceeded and the water should have a minimum visibility of 1 m.

Water samples will be examined 14 days before the beginning of the bathing season and examinations will be repeated fortnightly during the season. After the bathing season, the results are communicated to the Federal Environmental Agency (UBA) and the Federal Ministry for the Environment for reporting to the European Commission. The European Commission will classify all European bathing beaches by their quality.

In May of each year, the Annual Report on Bathing Water Quality is published, which contains the results for the bathing season of the preceding year. A more detailed version of this report is available from the homepage of the European Union (europa.eu.int/water/water-bathing/index_en.html).

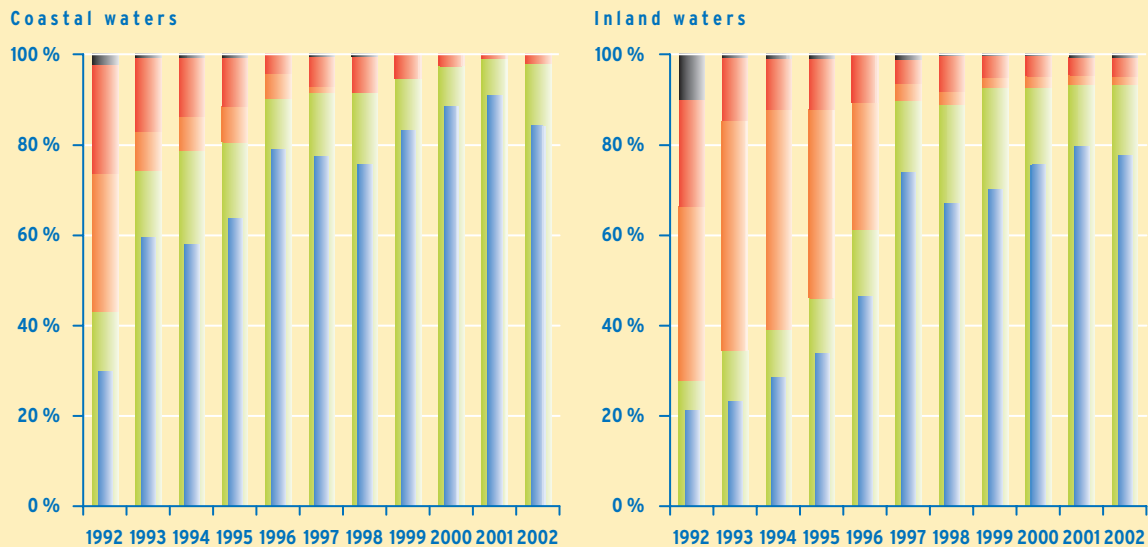
▼ Constant improvement of the quality of waters

The Report on the 2002 bathing season published in May 2003 confirms that there has been a constant improvement of the quality of bathing water in Germany.

Remediation measures were initiated after local authorities had established the causes for repeated failures to comply with the Directive. Hygienic

Figure 10

Source: European Commission: Bathing Water Quality (Bathing seasons 2000, 2002)



Quality of bathing waters in Germany 1992-2002

Green: imperative value complied with; blue: guide value complied with; red: imperative value not complied with; black: temporary ban on bathing; orange: number of examinations insufficient

monitoring of officially designated beaches at inland (1 587 measuring sites) and coastal (403 measuring sites) waters revealed that in 2002, bathing was banned at less than 2 % of the measuring sites. The Infection Protection Act (Infektionsschutzgesetz) (§ 40) stipulates that the UBA should develop concepts for prophylaxis, recognition and prevention of the spreading of water-borne diseases. Assistance is provided by an advisory committee on bathing water whose members include appointed representatives of Länder authorities and scientific institutions.

▼ More stringent standards are in preparation

When the standards of the 1976 Bathing Water Directive were fixed, it was assumed that adherence to these would not involve any essential health risks in particular because in those countries where similar standards were valid at that time, no conspicuous clusters of illnesses linked to bathing had been observed. Epidemiological studies on the risk of infection for bathers indicate, however, that the currently valid limits may be too high.

Thus, an increased number of illnesses was found to have occurred also after bathing in waters complying with EU standards. Illnesses consisted in mild diarrhoea persisting for some days which did not require treatment and ended with recovery. Severe courses of disease were not observed. A revised EC Directive is under preparation. For the respective draft, see the report on bathing water quality mentioned above.

CONTACT ADDRESSES

Umweltbundesamt
(Federal Environmental Agency)
Abt. Umwelthygiene
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

5.4 What about the mobile phone?



Using the mobile phone involves radiation of higher intensity.

For many adults it is unthinkable to live without their mobile phone. They want to be within reach at any time and anywhere, in the street, on the train, even in the theatre or cinema. For children and teens, this modern technical achievement has become part of their basic outfit. There is increasing concern that mobile phones and particularly transmitters of mobile telephone systems would pose a health risk.

Are such worries justified?



Using the cordless phone does not involve intensive radiation.

▼ A radiation source near the head

To enable mobile telecommunication over the entire territory of a country, radio transmitters (base stations) are set up for mobile telephone networks. Mobile telephone communication is achieved by electromagnetic fields. For this purpose, a mobile phone set is equipped with an antenna receiving and emitting high-frequency fields.

When you use a mobile telephone (see photograph), the source of radiation is close to your head. Therefore, the radiation to which your body is exposed by the telephone itself will generally be much more intensive than radiation from radio transmitters of mobile telephone systems in the neighbourhood. This is due to the fact that the intensity of the electromagnetic field (flux density) will drop approximately by the square of the distance, i.e. it will drop to 25 % when the distance doubles.

High-frequency fields are absorbed by parts of the human body. As a result, the temperature of body tissues increases. Health effects can occur when the temperature increase of the human body or certain tissues exceeds 1° C (thermal effect). For mobile telephones, thermal effects of such magnitude can be ruled out.

At present, we are facing a controversial public discussion about non-thermal effects of electromagnetic fields. For example, effects on sleep and response time were observed at intensities which occur during the operation of mobile telephones. It is, however, not possible at present to conclude if a health risk is associated with these effects.

The situation is different for cordless telephones for house and garden use which work at distances of up to 300 metres. They transmit voice signals from the normal telephone network to the receiver by radio. The power of the transmission output is low and the radiation level is clearly below internationally recommended limits.

▼ Limit values for mobile phones

To protect human health, basic standard values of the 'specific absorption rate' (SAR) have been agreed at international level (see Box 19).

Box 19

The standard **SAR** limit for mobile telephones is 2 watts per kilogramme for the human head (average as determined for 10 grammes of body tissue).

The SAR level expresses the high-frequency electric energy absorbed by the human body and the head, respectively. Suitable methods of measurement to prove compliance with the limit values have been laid down in international standards.

▼ Who checks on transmitters?

The operators of radio towers and transmitter masts are responsible for operation in accordance with standards. For each site, a corresponding certificate on its environmental safety ("Standortbescheinigung") is required. It is issued by the Regulatory Authority for Telecommunications and Post. Transmitters having an energy output of ten watts and more may be operated in Germany only if the valid standards are complied with. For this purpose, the Regulatory Authority will define individual safety distances for each site. Beyond this safety distance, possible health effects on humans (including pregnant women, children and sick persons) are not to be expected.

▼ Public participation

The Federal Office for Radiation Protection (BfS) regards it as necessary to inform the public about the setting up of base stations as well as about the technical characteristics of mobile telephones. The agreement between associations of communities and operators of mobile telephone networks (see Box 20) is considered a step forward in that direction.

▼ Possible interference with electronic devices

Already at radiation levels which are clearly below the threshold for possible health effects, mobile telephones may interfere with sensitive electronic devices.

- ▶ For example, cardiac pacemakers may be interfered with. For this reason, mobile telephones should not be carried close to the upper part of the body, near the implanted device.
- ▶ Persons wearing electronic hearing aids may perceive a 'humming' sound which can be avoided either by a larger distance to the source of the radio signal or by temporarily switching off the hearing aid.
- ▶ Bans on mobile telephones in hospitals should be observed. Medical technology, in particular electronic equipment used at intensive care units or in operating rooms may be affected. Such interference could result in life-threatening situations for patients.
- ▶ To avoid any influence on the electronic equipment of airplanes, mobile phones must be completely switched off during flights.

Use of mobile phones without a hands-free attachment when driving a car has been banned in Germany.

▼ Risk reduction

Some scientific publications have pointed to possible biological effects at levels below the currently used standards. It is unknown whether such effects may have any influence on human health.

According to what is known so far, it can be assumed that any possible health risk would be low. If it exists, however, such risk would affect a great number of persons because the new radio technologies are used everywhere.

For this reason, the BfS supports all measures to reduce exposure and makes recommendations addressing especially children and adolescents.

Box 20

Agreement on exchange of information and participation of communities in the expansion of mobile telephone networks

- ▶ Objective: Conflicts arising from the installation of new base stations shall be avoided and concerted arrangements reached.
- ▶ Commitment by operators: Communities will receive comprehensive information on envisaged projects and sites; alternative sites will be accepted where appropriate.



Better send an SMS message!

- ▶ Use your mobile phone only when a normal (stationary) phone is not available.
- ▶ Keep mobile phone conversations short, switch off mobile phones not needed at the moment.
- ▶ Keep distant from mobile phones. Where head sets are used for mobile telephone conversation, field effects will be clearly reduced because of a larger distance between head and antenna.
- ▶ Avoid conversations under bad receiving conditions because the mobile phone will automatically transmit signals with a higher power output.
- ▶ Pay attention to SAR levels stated for mobile phones. The SAR levels should be as far as possible below the limit of 2 watts per kilogramme.

In 2002, the Environmental Label Jury has presented criteria for low-radiation mobile phones. According to these, a mobile phone can be awarded the Blue Angel label if its SAR level does not exceed 0.6 watts per kilogramme. However, manufacturers are still quite hesitant to apply for this label (April 2004).

Consumers may, however, obtain information from the BFS about the SAR levels emitted by the mobile telephone types which are available on the German market. The results of regularly conducted inquiries are also published on the internet (www.bfs.de/elektro/hff/oekolabel.html).

CONTACT ADDRESS

Bundesamt für Strahlenschutz
(Federal Office for Radiation Protection)
Postfach 10 01 49
38201 Salzgitter
Internet: www.bfs.de

6 FOOD AND NUTRITION

Nutrition is an essential factor for health, well-being and a satisfactory life. Normally, we eat and drink every day. We cannot live without foods and beverages. Meals are also of socio-cultural importance.

However, it is the main purpose of food intake to ensure that the human body is supplied with energy and essential nutrient components. For this reason, a food intake that is in accordance with the body's needs is part of a healthy lifestyle.

Nevertheless, by eating foods we may take in pathogens and environmental pollutants. There are legal provisions to prevent this as far as possible.

6.1 Do we eat the right foods?

Source: Robert Koch Institute, German Nutrition Survey 1998

Foods	Women	Men
Cereals, bread, pasta	208	279
Sweets	40	49
Potatoes	105	139
Vegetables	247	244
Fruit	209	181
Dairy products	280	331
Eggs	20	25
Meat, sausage, poultry	125	199
Fish	17	21
Animal and vegetal fat	25	32
Beer, wine	76	347
Coffee, tea	501	554
Juices	148	163
Soft drinks	296	343
Drinking water	686	634

▼ Food - meeting the requirements

An adequate nutrition should provide a good balance of fats, carbohydrates and proteins (macronutrients, suppliers of energy), vitamins and minerals as well as sufficient amounts of dietary fibre and fluids.

An optimal nutrient balance is essential, especially for children and adolescents because they are still growing. Thus, Commission Directive 96/5/EC (1996) on supplementary food defines reference values for the content of proteins, fat, carbohydrates, vitamins and minerals in infant food products.



Low-fat dairy products should be preferred.



Cereal products contain also dietary fibre.

▼ We eat too much fat...

The types and amounts of food consumed by German adults have been comprehensively assessed in the German Nutrition Survey conducted by the Robert Koch Institute as part of the 1998 German National Health Interview and Examination Sur-

vey. The Nutrition Survey included approx. 4 000 adults aged 18–80 years. Some results are shown in Table 4.

Whereas overall daily energy intake approximately meets the average requirements, the proportions of macronutrients may still be improved (see Fig. 11).

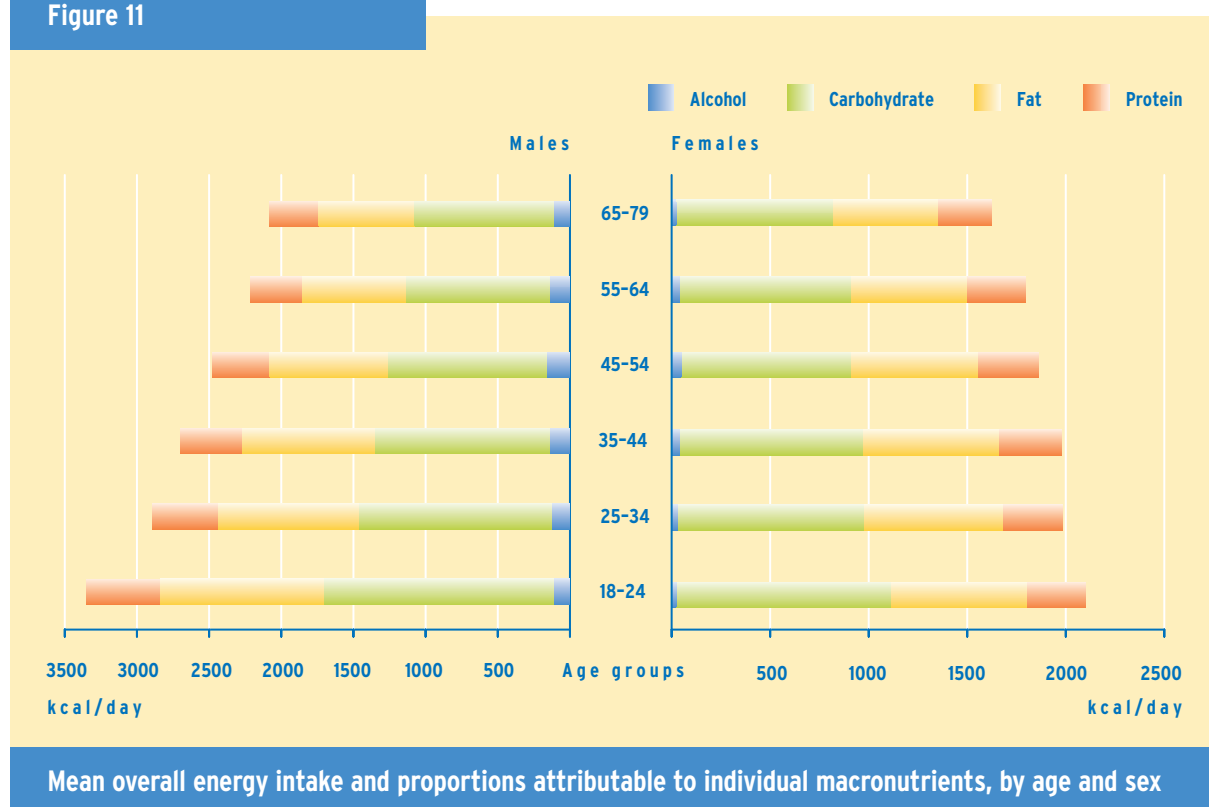
On average, fat accounts for approx. 33 % of caloric intake. This level is considerably lower than approx. ten years ago (40 %), but still does not comply with the recommendation to consume less than 30 % of caloric intake in the form of fats given by the German Nutrition Society (Deutsche Gesellschaft für Ernährung; see Box 21).

▼ ...and also too much protein

Energy intake from proteins is about 15–16 % which is still relatively high. In contrast to this, carbohydrate intake is relatively low. This refers in particular to polysaccharides and complex carbohydrates which are contained in vegetable products rich in fibre – such as vegetables and whole-grain bread. High consumption of monosaccharides like those contained in sweets should

Figure 11

Source: Robert Koch Institute, German Nutrition Survey 1998



Box 21

Recommended proportions of energy intake by macronutrients for people with light to moderate physical activity

Fat	less than 30 %
Carbohydrate	more than 60 %
Protein	8–10 %

German Nutrition Society, 2000

be avoided. Despite the relatively high share of bread, fruit and vegetables in their diet, most Germans do not eat enough fibre.

A considerable number of young women and elderly people have a low overall energy intake. Many elderly people also do not drink enough.

Generally, the supply with minerals, trace elements and most vitamins (in particular vitamin A and C), appears to be sufficient. As an exception, intake of vitamins D and E, folic acid, and in women, vitamins B1 and B2, calcium and iron do not always reach the levels recommended by the German Nutrition Society.

Vitamins and mineral supplements are taken by one fifth each of women and men at least once per week.

▼ Eat more fruit and vegetables

A healthy diet is characterised by a high share of fruit and vegetables. Still, many young people do not pay much attention to this. As one of the promoters of the international campaign '5 A Day', the German Nutrition Society recommends five servings of fresh fruit or vegetables a day or a total amount of 650 grammes (including potatoes). At present, 30 to 40 % of Germans comply with this recommendation, however only if fruit and vegetable juices are included in the calculation.

▼ Germans weigh too much

The consumption of considerable amounts of fat, protein and alcoholic beverages in combination with insufficient physical exercise may have



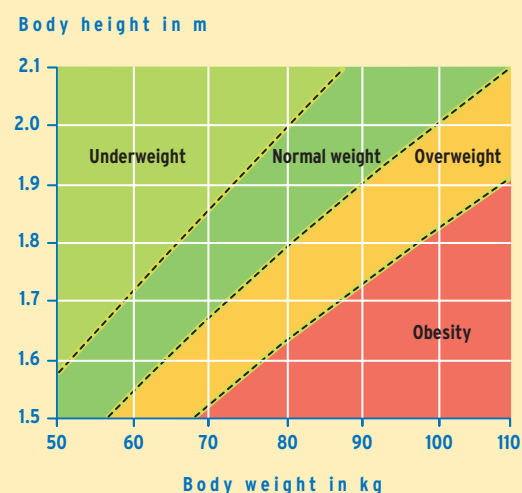
Vegetables are rich in vitamins, minerals and fibre.

led to the high prevalence of obesity in Germany, which on its turn may cause several chronic diseases.

Data on body weight and height which were collected in the German National Health Interview and Examination Survey 1998 show that a considerable proportion of middle-aged and

Source: Federal Ministry of Consumer Protection, Food and Agriculture;
www.verbraucherministerium.de

Figure 12



Draw a horizontal line through your height and a vertical one through your weight. At the intersection of both lines you will find the evaluation of your body weight, based on the body mass index

elderly Germans is overweight. More than 50 % of women and almost 70 % of men have a body mass index (BMI, see Fig. 12) of at least 25 and hence have to be considered as overweight. Approx. 20 % of men and women have a BMI of at least 30, which means they are obese (massively overweight).

▼ An unbalanced diet causes disease

What we eat has an essential influence on our health. Our diet may prevent disease or modify its course.

Dental caries, hypertension, type II diabetes, obesity, coronary heart disease and cancer are examples of nutrition-related disorders. The individual food components are also important for the functioning of the immune system. For this reason, food intake may influence the course of many communicable as well as non-communicable diseases. In recent years, it has become increasingly clear that genetic disposition and nutrition are co-factors in disease development. This applies,

for instance, to neural tube defects in children whose mothers have suffered from folic acid deficiency during pregnancy.

For further information regarding nutritional habits in Germany, you may consult a German book entitled “Was essen wir heute?” (What do we eat today?) which can be ordered free of charge from the Robert Koch Institute (Email: gbe@rki.de).

CONTACT ADDRESS

Robert Koch-Institut
Abt. Epidemiologie und
Gesundheitsberichterstattung
Seestr. 10
13353 Berlin
Germany
Internet: www.rki.de

6.2 Is our food safe enough?

Official food control by the federal Länder is based on the Foods and Other Commodities Act. Foods which do not comply with legal provisions are withdrawn from the market.

To ensure that microbiological and chemical examination of foods is performed according to uniform standards, several national and European reference laboratories have been established at the Federal Office of Consumer Protection and Food Safety (BVL) and the Federal Institute for Risk Assessment (BfR). At these laborato-



Bacteriological meat examination.

Box 22

The authorities responsible for protecting human health are interested in the following questions

- ▶ Does the food contain pathogens?
- ▶ Have maximum residue limits for pesticides and for contamination with heavy metals and other undesirable substances been complied with?
- ▶ Are composition and labelling of products in conformity with the Foods Act and regulations under this act?

ries, the technical conditions for supervisory measures are established and adapted to technical progress.

▼ Additional Food Monitoring

In addition to the official food control, a food monitoring scheme has been in operation since 1995. This scheme allows representative examinations to detect pollutants in foods marketed in Germany in order to permit an early recognition of possible risks from such substances.

Food monitoring is a governmental task which has been shared by the federal and the Länder authorities and is also defined in the Foods and Other Commodities Act. The Länder are responsible for sampling and examination of foods while organisation and reporting of the monitoring results are tasks of the BVL.

Each year, approx. 4 700 samples of about 20 different foods are examined for the presence of residues of pesticides, of persistent chlorinated hydrocarbons, of heavy metals, of nitrate and also of mycotoxins (toxic metabolites of moulds). To cover a range of foods as wide as possible, different foods are examined each year.

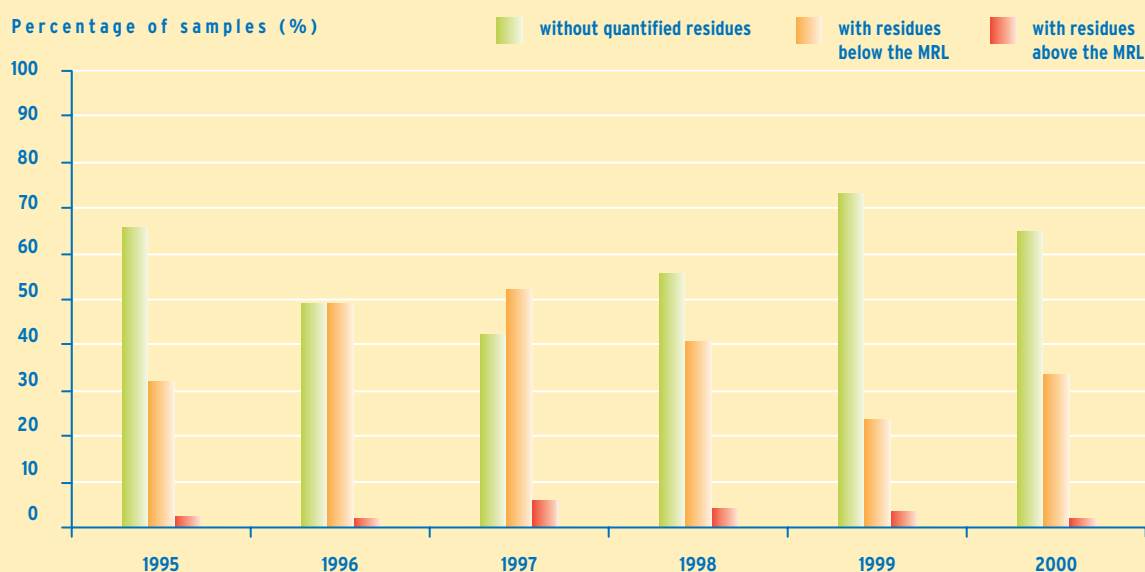
▼ Which are the substances of interest?

In Germany, pesticides must only be used for agriculture or market gardening if they are authorised. According to the Plant Protection Act, the BVL is responsible for the approval of such products. The Federal Biological Research Centre for Agriculture and Forestry (BBA), the BfR and the Federal Environmental Agency (UBA) take part in the approval procedure. If pesticides are used in accordance with their intended purpose and good agricultural practice, residue levels will be low and adverse effects on health and the environment are not to be expected.

Because of their massive use in the past, persistent chlorinated hydrocarbons such as DDT, PCBs and HCB (see list of abbreviations) are widespread in the environment so that they are counted among the environmental contaminants now. They accumulate in the food chain, above all in the fatty tissue of animals. Because of their adverse effects on health and the environment, their use in Germany has been banned or considerably restricted since many years. However, in cases where feeds are imported from countries where such bans do not exist and these substances are still used in the pro-

Figure 13

Source: Federal Office of Consumer Protection and Food Safety, Food Monitoring



Presence of pesticide residues in foods of vegetal origin

MRL, Maximum residue limit



Wild boar are also biological indicators.

duction of foods of animal origin, the presence of such substances cannot be ruled out.

In 1990, certain musk compounds (which were used as fragrances in cosmetics, detergents and toilet products) and bromocyclen (a veterinary drug) were found in trout by chance. The health significance of these substances is not yet clear.

Nitrate may be present in foods of vegetal origin as a natural component and also as a residue of fertilisers. Some vegetables such as lettuce, radish, or beetroot are known as nitrate accumulators. Nitrate as such has a low toxicity. However, in the human body, nitrate is converted to nitrite which in the presence of amines can form carcinogenic nitrosamines.

Box 23

What are ADI or TDI?

- **ADI** (Acceptable daily intake) or **TDI** (Tolerable daily intake) are doses in milligrammes of a chemical per kilogramme body weight.
- It is that amount of a substance which doesn't cause unacceptable harm according to the state of scientific knowledge even under lifelong daily intake.

Among heavy metals, lead, cadmium and mercury are of particular importance because they accumulate in certain organs and may produce disorders (e.g. cadmium in the kidney).

Especially foods rich in oil such as nuts and pistachios may contain aflatoxins if they are infested with moulds of the species *Aspergillus flavus*. Aflatoxins belong to the best known fungal poisons (mycotoxins). They are highly toxic and are considered as carcinogenic.

▼ Wildlife animals as indicators of environmental contamination

Wildlife animals are well suited as indicators of contamination in their habitat. Thus, samples of wild boar meat from the eastern Länder showed elevated DDT levels while in samples from the western Länder, there were mostly high PCB-180 concentrations found. In the former German Democratic Republic, DDT use was discontinued later than in the western Länder, while in the latter, larger amounts of PCBs were used.

Environmental chemicals of organochlorine type were frequently found in some wildlife fish species and other marine animals, e.g. in herring, eel and halibut. Musk xylene and bromocyclen were detected in 10–50 % of fish samples.

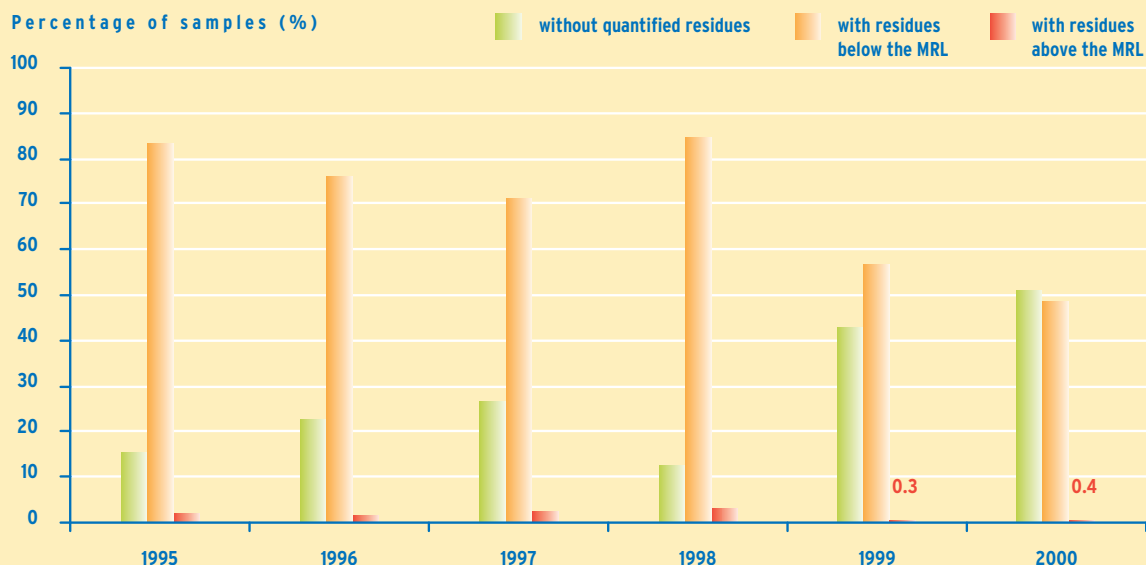
▼ Admissible maximum levels

There are limit values for the evaluation of residue and contaminant levels which are also referred to as maximum residue limits (MRLs). These limits have been fixed in a number of regulations under German and European law and must not be exceeded. They are based on the respective ADI and TDI values (see Box 23).

The guide values for heavy metals published by the former Federal Institute for Health Protection of Consumers and Veterinary Medicine have meanwhile been replaced by a legally binding regulation (Regulation (EC) No. 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in food). Under this Regulation, maximum levels for nitrate have been fixed for spinach and leaf lettuce only.

For baby and infant food, the German regulations on special diets apply which require not only the highest level of microbial safety but al-

Figure 14



Presence of residues of organochlorine compounds in foods of animal origin

MRL, Maximum residue limit

so the lowest limits for pesticides and nitrate. Thus, there is a general maximum residue level of 0.01 mg/kg for all pesticides and of 250 mg/kg for nitrate. In the future (after conversion into German law), some substances will be subject to the more stringent provisions of the European Commission Directives 2003/13/EC amending Directive 96/5/EC on processed cereal-based foods and baby foods for infants and young children, and 2003/14/EC amending Directive 91/321/EEC on infant formulae and follow-on formulae.

▼ Low level of contamination

The results of food monitoring over the 1995–2000 period have shown that with few exceptions, contamination of foods with undesirable substances is low.

Modern methods permit the detection of the residues of 120 or even more plant protection products in one single analytic run (see also Fig. 13). Important foods of plant origin such as cereals were almost completely free from residues of pesticides. The admissible maximum levels were exceeded only in a low number of cases. Only in some vegetables like lettuce, broccoli, courgette,

cucumber, savoy and some fruits like grapes, stone fruit and papaya, MRL-exceeding residues were found more frequently. High nitrate levels were found in lettuce. In pistachios from certain countries, aflatoxin concentrations exceeded the maximum levels frequently. As a consequence, pistachios are imported from areas with a low fungal contamination.

Infant formula and foods for young children for which particularly stringent standards exist were mostly free from residues and contaminants.

Foods of animal origin were examined for approx. 30 organochlorine substances (see also Fig. 14). These substances include the compounds already mentioned, DDT, PCBs and HCB as well as musk compounds and bromocyclen.

The contamination of milk, dairy products and meat (including fatty tissue) of animals for slaughter with these substances was low. This has also been due to intensive controls of feeding stuffs.

In general, contamination of samples of foods of vegetal and animal origin with heavy metals was inconspicuous.

CONTACT ADDRESSES

Bundesamt für Verbraucherschutz und
Lebensmittelsicherheit
(Federal Office of Consumer
Protection and Food Safety)
Diedersdorfer Weg 1
12277 Berlin
Internet: www.bvl.bund.de

Bundesinstitut für Risikobewertung
(Federal Institute for Risk Assessment)
Thielallee 88-92
14195 Berlin
www.bfr.bund.de

6.3 The water we drink

For most of us, fresh, clear and appetising water is available from the tap in as it seems unlimited supply. It is far more than just a food. We need water for personal hygiene, for doing the laundry and for the cleaning of all objects and surfaces coming into contact with foods. Thus, in everyday life, drinking water offers the most important, most economic, very effective and often the only means to prevent infectious diseases. There are legal provisions which ensure that the quality of drinking water in Germany meets both hygienic and aesthetic requirements (see Box 24).

The most important piece of legislation in this respect is the revised Drinking Water Ordinance, in force since 1 January 2003. It is based on the Eu-

ropean Council Directive 98/83/EC on the quality of water intended for human consumption. Compliance with the legal provisions along the way ending with the consumer's tap is controlled by the local health authorities.

Through its Advisory Committee on Drinking Water, the Federal Environmental Agency (UBA) has played an important decisive role in the revision of the Drinking Water Ordinance. It is one of the preferential tasks of the WHO Collaborating Centre for Research on Drinking-Water Hygiene also hosted by the UBA to assist all activities which contribute to an adequate supply of safe drinking water, both on the national and international levels.

▼ Where does the drinking water come from?

In Germany, groundwater (74 %), surface water (17 %) and other sources, e.g. bank filtrate (9 %) are used for the production of drinking water.



Designation of a water protection area.

Box 24

Basic requirements for drinking water

- ▶ Absence of pathogens
- ▶ Low bacterial counts
- ▶ Absence of properties likely to adversely affect health
- ▶ Appetising appearance (clear, colourless, cool, absence of odour and bad taste)

Based on the Federal Water Act, the federal L nder have designated water protection areas for drinking water production. Often, it will only be necessary to remove interfering iron and manganese from groundwater while surface waters which are more or less polluted by sewage require a more intensive treatment (see photograph).

▼ Protection of water resources

The quality objective of groundwater protection is to have groundwater that is largely free from man-made pollution. For this purpose, a strict application of the precautionary principle is of primary importance.

This means that as a principle, sewage treatment is to be given preference where water resources are to be protected. An important parameter in this context is the share of the population connected via sewerage to sewage treatment plants. In 1998, approx. 90 % of the population lived in dwellings connected to municipal sewage plants. However, an effective sewage treatment can only be achieved by biological treatment and specific removal of nutrients.

Although the total capacity of water resources is sufficient in Germany, there are areas with only



Filter system in water supply works: Removal of turbid matter with adherent microorganisms (among these, pathogens) and chemical contaminants.

small usable groundwater resources. Water supply in areas with a water shortage is ensured by long-distance pipelines from areas with surplus water resources.

▼ Can drinking water cause illness, too?

In the legal provisions on monitoring of drinking water, reference is made to so-called indicator or-

Source: Federal Environmental Agency, 2003

Table 5: Quality of drinking water from large water works in Germany 1999–2001

Parameter	Parametric value ¹	Total of measurements			Parametric value not met (category B)		
		1999	2000	2001	1999	2000	2001
Turbidity	1.5 FTU ²	78 459	81 990	79 461	95	103	105
Conductivity	2.000 mS/cm	75 923	79 006	76 944	0	1	0
PH value	6.5–9.5	57 270	65 391	54 622	38	137	34
Free chlorine	0.3 mg/L	47 906	50 773	39 167	11	39	24
Nitrate	50 mg/L	18 772	20 411	18 341	213	218	142
Coliforms	0 in 100 mL	188 376	191 389	202 396	1 278	1 100	1 272
E. coli	0 in 100 mL	188 293	191 525	202 434	468	347	208

¹ According to Drinking Water Ordinance 1990; ² formazin turbidity unit



ganisms. Thus, a presence of the bacterium, *Escherichia coli* (*E. coli*) will indicate faecal contamination while the presence of coliform bacteria (a group which includes *E. coli*) does not necessarily mean faecal contamination. Occasionally, there may be clusters of water-borne diarrhoea caused by a number of gastroenteritis viruses and protozoa such as *Cryptosporidium*, even if all legal provisions have been complied with.

If the water contains substances like heavy metals, nitrate, polycyclic aromatic hydrocarbons and organochlorine compounds in too high concentrations, health disorders may occur which are mostly of a chronic nature (see also chapter 6.2, Is our food safe enough?).

In some old houses there are still lead pipes. In these cases, drinking water will contain lead in elevated concentrations. Lead is stored in the bones from where it may spread over the entire body. The nervous system is particularly sensitive

Box 25

The Federal Environmental Agency recommends

- Before drawing water for drinking and cooking, let water run off the tap until its temperature becomes cooler. Such water has not been stagnant in pipes.
- Runoff water may be used for watering flowers or for cleaning.

to lead. Even in relatively low concentrations, lead impairs the development of intelligence in the unborn child, in infants, young children and schoolchildren. With the new Drinking Water Ordinance from 2003, the limit value for lead was reduced from 40 µg/L to 25 µg/L which became effective on 1 December 2003. A standard of 10 µg/L will be valid after 30 November 2013. Lead pipes should then belong to the past.

Meanwhile, copper is the material mainly used for pipes in Germany (60 %). In rare cases, an elevated copper concentration may cause liver damage in infants. When the water used for preparation of infant formula meets the minimum requirements set for copper and pH, it does not constitute a health risk for infants. This is the result of a study that had been commissioned by the UBA. Where water has a pH value below 7.0, copper must not be used for installations. This is the case with many private wells.

Responsible for the domestic distribution system is always the owner of the respective house. Even where all rules have been adhered to, an accumulation of substances may occur when water is stagnating in pipes and fittings for a longer period. In these cases, substances from the installation material may migrate and accumulate in the water or microbial growth may occur. Consumers can, however, protect themselves against such contamination if necessary (see Box 25).

▼ Water supplied by the water works is 'wholesome'

In 2001, more than 68 million inhabitants in Germany (approx. 84 %) were supplied with approx. 4 200 million m³ drinking water from municipal drinking water treatment plants. In Table 5, information on the quality of drinking water supplied by water works has been summarised. Generally, the quality of such drinking water in Germany is excellent. The proportion of cases where parametric values according to the Drinking Water Ordinance are not met (category B), is very low (less than 1 %). Only in the case of nitrate, 1.1 % of the samples analysed showed levels exceeding the limit value in 1999 and 2000.

The data for some parameters shown in Table 5 were taken from a report on drinking water quality which is prepared by Germany every three years and submitted to the European Commission. The EU requires that the report should in-

Table 6: Selected metals in drinking water sampled at domestic taps

Limit/guide value ¹		Per cent share of samples not complying with standards					
		Germany		western Länder		eastern Länder	
Element	[mg/L]	1990/92	1998	1990/91	1998	1991/92	1998
Arsenic	0.01	n.e.	0.1	n.e.	0	n.e.	0.1
Lead	0.04	2.2	0.9	0.8	0.7	8.1	1.8
Cadmium	0.005	0.3	0.1	0.1	0.1	0.7	0.2
Nickel	0.05	n.e.	4.8	n.e.	4.2	n.e.	7.5
Copper	3	0.6	0.9	0.7	0.9	0.5	0.8
Zinc	5	2	1.0	0.5	0.6	8	2.3

¹ in accordance with Drinking Water Ordinance of 1990; n.e., not examined

clude data on water supply systems serving more than 5 000 persons or delivering daily volumes of more than 1 000 m³ of drinking water to public supply networks. Figures given in the Table are based on data reported by the 16 Länder for the period 1999–2001. The results were, according to the Drinking Water Ordinance 1990 valid at that time, grouped into two categories A (limit value adhered to, not shown) and B (parametric values not met). It is not possible to draw conclusions about the amount of water supplied or the numbers of persons concerned.

▼ ...and what about water at the tap?

When arriving at the consumer's tap, drinking water may not always maintain the quality level it had when leaving the drinking water treatment plants. During transport, substances originating from the installation material may be taken up.

In the Environmental Survey conducted by the UBA in 1998, first draw samples of domestic drinking water sampled in the morning from taps in the homes of 4 800 adults were examined for arsenic, lead, cadmium, copper, nickel, zinc and other parameters (see Table 6). When comparing the results with those obtained in the Sur-

vey of 1990/92, lead levels were found to have dropped and copper levels to have risen, particularly in east Germany. This is mainly due to the exchange of lead pipes for pipes made of copper or iron/steel. In the 1998 Environmental Survey, also nickel levels were examined. It was found that stagnant water in fittings can be considerably contaminated with nickel.

When rating the analytic results for domestic drinking water by the parametric values of the Drinking Water Ordinance 1990 being valid at that time, it is seen that in Germany, domestic water samples did not always meet the Ordinance values prescribed.

CONTACT ADDRESSES

Umweltbundesamt
Abt. Umwelthygiene,
Abt. Trink- und Badebeckenwasserhygiene
or Zentraler Antwortdienst
PF 33 00 22
14191 Berlin
E-Mail: bk@umweltbundesamt.de
Internet: www.umweltbundesamt.de

6.4 Breastfeeding: Pros and cons

Breast milk is the best food for babies in the first months of their life. It contains all nutrient components needed for the infant's development: Proteins, lactose and unsaturated essential fatty acids as well as vitamins, minerals, enzymes and antibodies. The latter protect the infant against pathogens to which the mother had been exposed during illness or as a result of maternal vaccination. Apart from this, breastfeeding promotes the relationship between mother and child as well as the emotional and social development of the child.

However, breast milk may contain undesirable substances. This refers not only to caffeine, nicotine, or alcohol which can be avoided by a health-conscious behaviour of the mother but also to a number of substances incorporated by the mother, mostly in food, a long time before the birth of her baby and stored in the fatty tissue of her body (bioaccumulation; see chapter 6.2, Is our food safe enough?). In the course of the lactation period, these undesirable substances are mobilised and released into breast milk.

▼ Since 1980: Breast milk data base

Undesirable substances, residues and contaminants, may constitute a health risk for the infant.



For this reason, breast milk is analysed by the public health laboratories of the federal Länder. Since 1980, the results have been documented in the central data base on breast milk and dioxin in humans and evaluated by the Federal Institute for Risk Assessment (BfR).

▼ Organochlorine compounds are fat-soluble

Breast milk is examined for persistent organochlorine compounds. These include:

- ▶ Pesticides used in the past such as DDT, HCB, HCH isomers
- ▶ polychlorinated biphenyls (PCBs) and dioxins (an acronym for polychlorinated dibenzodioxins and dibenzofurans) and
- ▶ since 1992 also synthetic fragrances (musk compounds).

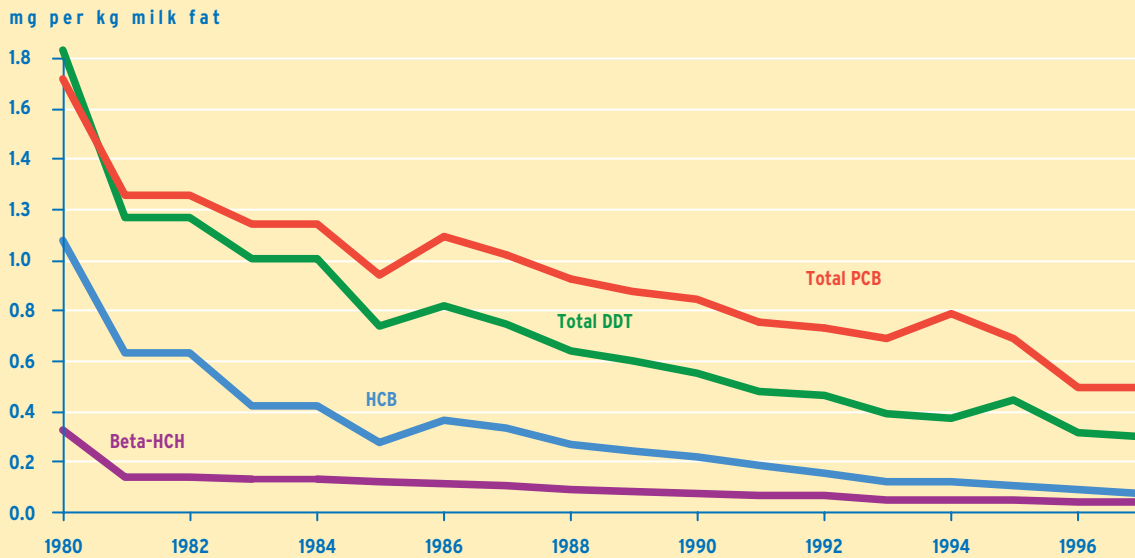
Persistent organochlorine compounds enter the human body preferentially through the consumption of foods of animal origin while fragrances take the dermal route when cosmetics are used.

Meanwhile, data on more than 40 000 breast milk samples have been collected so that reliable statements on national trends can be made. The regulations and bans of organochlorine pesticides (DDT, HCB, beta-HCH, dieldrin) and PCBs have resulted in a noticeable reduction of the contamination of breast milk (see Fig. 15). The levels of a number of substances like the insecticides lindane (gamma-HCH) and the banned dieldrin have decreased to the range of the detection limit.

Also in the case of dioxins, which form as undesirable by-products of combustion and certain chemical processes and had been a subject of discussion in the context of incineration plants, a retrograde development is seen (see Fig. 16). Since dioxins are also known to accumulate in the food chain, breast milk samples have also been examined for dioxins since the mid-eighties. An obvious reduction of dioxin levels has been observed since the early nineties. This is a welcome result of technical and regulatory measures to reduce the release of dioxins into the environment.

Figure 15

Source: Federal Institute for Risk Assessment



Mean levels of selected pesticides and PCB in breast milk in Germany, 1980–1997

▼ Are levels of xenobiotic substances too high?

Xenobiotic substances in breast milk are generally undesirable, in particular those which accumulate in fatty tissue or organs of the infant and thus can raise the body burden over the child's lifetime. For that reason, the National Breastfeeding Commission (Nationale Stillkommission) whose registered office is located at the BfR is closely following the situation. Residues found in breast milk are assessed for resulting health effects in infants.

When deriving the ADI/TDI (see box 26) values, not only sensitive subgroups of the population are considered but also a lifelong (i.e. over more than 70 years) daily intake.

However, a breastfeeding period of six months corresponds to less than 1 % of the average life expectancy.

The ADI/TDI value as such does not constitute an adequate basis for evaluation in this case. However, if the calculation reveals that the amounts of residues incorporated by the infant are within the range or below the ADI values, one can assume that a health risk is improbable. In Ger-

many, this appears to be the case e.g. for total DDT, dieldrin and gamma-HCH (lindane) in breast milk.

Regarding dioxins and PCBs, the situation is different. For these substances, the TDI value established by the WHO (see Box 27) for the breastfeeding period is exceeded at present. At the moment, a definite assessment of synthetic musk compounds is not yet possible. However, the amounts incorporated by a breast-fed infant are far below (by 4 logs) the amounts studied experimentally which did not produce effects in animals.

Box 26

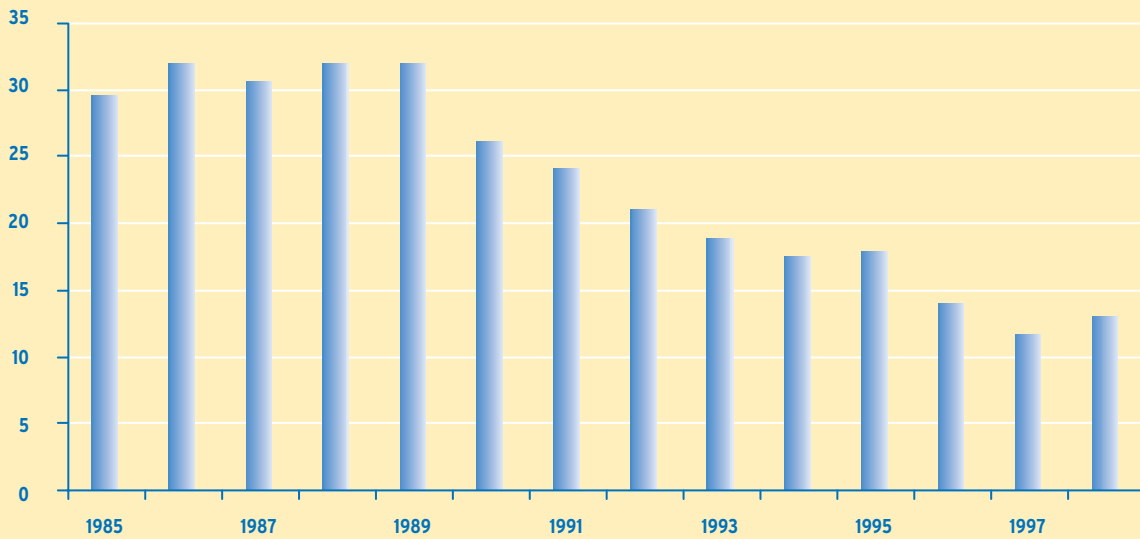
What are ADI and TDI?

- ▶ ADI (Acceptable Daily Intake) and TDI (Tolerable daily intake) are intake doses in milligrammes per kilogramme body weight and day.
- ▶ The ADI/TDI indicates the amount of an undesirable substance whose life-long daily intake is safe as judged by the present state of scientific knowledge.

Figure 16

Source: Federal Institute for Risk Assessment

ng I-TEQ per kg milk fat



Mean dioxin levels in breast milk in Germany 1985–1998

Box 27

Dioxins and PCBs

- ▶ TDI value for dioxins inclusive of dioxin-like PCBs = 1–4 pg WHO-TEQ per kg body weight and day (WHO, 1998)
- ▶ TEQ – Toxicity equivalent: Value used to estimate the total toxicity of mixtures of substances, which have a similar action mode as the well researched reference substance TCDD ('Seveso dioxin')
- ▶ The 17 different dioxins that are accumulated in human body fat are expressed in summarised form as international toxicity equivalents (I-TEQ).
- ▶ So far, I-TEQs only accounted for dioxins. To include dioxin-like PCBs, they may be converted to WHO-TEQs using a factor of 2–3 as an approximation.

1 pg = 1 picogramme, the millionth part of a microgramme

Nevertheless, because of the bioaccumulative characteristics, the German Association of Manufacturers of Body Cosmetics and Detergents (Industrieverband Körperpflege und Waschmittel – IKW) recommended to its members in 1994 that they should on a voluntary basis discontinue the use of musk xylene, as a precaution. The members followed that recommendation. As a consequence, the concentrations of musk xylene in breast milk became less.

▼ Yes – breastfeeding is still recommended

In recent years, various international and national expert panels have considered the problem of residues in breast milk and independently recommended breastfeeding without reservations.

As a result of the declining concentrations of organochlorine compounds in breast milk, the National Breastfeeding Commission and the Food and Nutrition Commission of the German Society for Paediatrics and Adolescent Medicine (Deutsche Gesellschaft für Kinderheilkunde und Jugendmedizin) have already recommended in 1995 complete breastfeeding until the 4th to 6th

month of life when feeding of solid food will start. A continuation of breastfeeding – aside the supplementary food – is not considered to involve health risks.

A leaflet recommending breastfeeding has been published in German as well as in English, French, Italian, Russian and Turkish; it can be obtained free of charge from the National Breastfeeding Commission.

CONTACT ADDRESSES

Bundesinstitut für Risikobewertung
(Federal Institute for Risk Assessment)
Thielallee 88-92,
14195 Berlin
Internet: www.bfr.bund.de

Geschäftsstelle der Nationalen Stillkommission
(National Breastfeeding Commission)
Bundesinstitut für Risikobewertung
Thielallee 88-92,
14195 Berlin
E-mail: stillkommission@bfr.bund.de

7 WHAT REMAINS TO BE DONE?

In this brochure we have been able to show that for many contaminants there has been a favourable development towards reduced exposure for humans and the environment. Thus, exposure to lead or sulphur dioxide has ceased to play a major role in Germany.

Instead, other problems have emerged. Predominant topics on the agenda of the Federal Environmental Agency (UBA) are the quality of indoor air in homes as well as exposure to noise and fine particles. The Federal Office for Radiation Protection (BfS) has considered problems such as health risks from mobile telephone systems and solar radiation. The Federal Office of Consumer Protection and Food Safety (BVL) is confronted again and again with problems raised by new unwanted substances in foods. On a national level, the Robert Koch Institute (RKI) is active in the collection of important representative data on the health of children and adolescents.

In the following, some examples of problems of current interest are presented. In some cases, a technical/scientific basis that would permit to give definite answers to open questions is still missing. In such fields, further research is necessary.

Once problems have been identified, it will be possible to take appropriate action. Measuring and observation combined with active and understandable information on risks, adequate behaviour and protective measures mean important steps to this end.

In many cases, it will not be possible to do without legal provisions and regulations protecting human health and also the environment. An intact environment is an essential prerequisite also for the health of coming generations. The objective consists in harmonising the protection of health and of the environment. At first glance this often seems to be almost impossible, and conflicting 'pro-and-con' situations seem so be unavoidable in many cases.

▼ Indoor air

The conflict arising from the Energy Conservation Regulations which became effective in 2002 is a striking example for this. The require-

ments of economic energy use in buildings on the one side and a good indoor air quality on the other must be harmonised as far as possible. There is no doubt that a better thermal insulation of buildings is meaningful which saves energy and assists climate protection. Likewise, it is obvious that perfect sealing of buildings and rooms makes an indoor/outdoor exchange of air more difficult or even prevents it. Concentrations of pollutants in indoor air will rise and a higher humidity may also result in the growth of moulds. Both aspects, energy conservation and indoor air quality, can be balanced only by simultaneously reducing emissions from materials used indoors and ensuring an adequate air exchange. This sounds simple and seems to work in low-energy and passive buildings. It is, however, still unclear at present how such principles can be followed when renovating existing buildings under energetic aspects. In the opinion of the UBA, there is still need for research on this subject.

▼ Undesirable substances in foods

Again and again, problems arise which have to do with foods. In 2002, it became known that acrylamide, a substance which has proved to be carcinogenic and mutagenic in animal experiments, may be present in roasted and deep-fried foods such as potato crisps, potato pancakes and crispbread. Acrylamide was in everybody's mouth, in the true sense of the word. Meanwhile, it has become known that this substance is produced when heating certain sugars (glucose, fructose) in the presence of the amino acid asparagine at temperatures above 120 °C. At present, research concentrates on the questions which factors essentially favour a formation of acrylamide and which is the role of raw materials or processing and preparation techniques in this context. It is the objective of such work to develop procedures for the production and preparation of foods which involve only a low formation of acrylamide.

Although the available data are still inadequate to assess the health risk of acrylamide for humans, a precautionary concept has been developed by the BVL to reduce acrylamide levels in foods. The federal Länder, the industries involved

and the Federal Ministry of Consumer Protection, Food and Agriculture have agreed on dynamic minimisation strategies.

▼ Mobile telephones

It has not yet been fully clarified whether exposure to electromagnetic fields produced by mobile telephone systems may affect human health. For this reason, the BfS has recommended individual precautionary measures to minimise influences of such electromagnetic fields.

▼ Excessive sun-bathing

In some cases, a limitation of known health risks by legal measures is almost out of question because possible risks are decisively dependent on individual behaviour patterns. To give an example: An excessive unprotected exposure to sunlight, particularly of very young children, favours a development of skin cancer due to the UV irradiation absorbed. Development of skin cancer (latency period) may take several decades. Only an extensive education of the population may help to prevent this disease. This requires long-term educational programmes. For a number of years already, campaigns have been conducted by the BfS which were specifically designed to appeal to adolescents. It has been the objective of such campaigns to influence the individual leisure behaviour so that excessive sunbathing without any protection becomes reduced. Again and again it has been noted that it is very difficult to make people aware of the need to alter their leisure time behaviour accordingly and to achieve such modified behaviour. But in this case the only way to reduce the health risk is education on this subject.

▼ Child and adolescent health

Representative surveys on the subject of child and adolescent health have been missing so far. For this reason, the RKI launched, in May 2003, the German National Health Interview and Examination Survey for Children and Adolescents. The aim is to obtain data about the health status of approx. 18 000 children and adolescents aged 0 – 17 years. This is the first time such a survey is carried out on the national level. The topics of this study include health status, physical and mental development, illnesses and injuries from accidents,

conditions of living, lifestyle, risk behaviour and vaccination status. To obtain the required data, children and adolescents participating in the study are subject to medical examination and are interviewed using a questionnaire. In addition to this, blood and urine analyses are offered.

Based on the study results, it will be possible to show the frequencies of diseases and health-relevant behaviour patterns as well as to identify existing health risks in children and adolescents. It is an objective of the study to develop concepts for the prevention of certain diseases and health disorders. There will also be a concrete benefit for the individual children and adolescents participating in the study. They will be informed about possible individual health risks such as hidden nutrient or vitamin deficiency, specific allergic sensitisation or vaccination gaps.

▼ Sensitivity of children

Is the response of children different from that of adults? The Federal Institute for Risk Assessment (BfR) tries to elucidate this question. This institute coordinates activities in the field of sensitivity of children to contaminants which are conducted jointly with the BfS, the RKI and the UBA. As a first step, the current situation regarding the consideration of children when establishing maximum levels will be reviewed. The second step will consist in a study of the factors modifying the exposure of children to contaminants as compared to the situation in adults. This will be examined for the inhalative, dermal and oral routes. For example, children may ingest contaminants by the oral route not only with food but also through 'mouthing', i.e. by putting objects into their mouths. In a third step, recommendations for the onward approach to derive maximum levels will be developed which may also include a description of necessary research work to be done.

▼ New challenges

The examples given in the present brochure give an idea of the complexity of the subject of environment and health. A lot has been done already to improve environmental conditions and thus the health of the population. Nevertheless, some things remain to be done.

These also include a modification of individual human behaviour patterns by e.g. cessation of

smoking, not using the car from time to time or to shop with awareness, i.e. by giving attention to the Blue Angel logo.

Although a number of contaminants are known, new ones still emerge and there are some which turn out to carry a risk for health and/or the environment only after an extended period of use.

Thus, long-term observations performed with the aid of improved techniques will detect risks which have been present already for a long time without being identified. Also an onward devel-

opment of production processes and changes in consumer behaviour may lead to new risks.

There is no sophisticated technology and no perfect monitoring system that would be capable of eliminating risks completely.

The objectives of our efforts should consist in an early recognition of risks and minimising them by suitable measures taken in due course – thus contributing to the maintenance and improvement of human health and the preservation of our environment, for ourselves and future generations.

8 CONTRIBUTORS

Siegfried Abelman
Umweltbundesamt

Dr. Wolfgang Babisch
Umweltbundesamt

Dr. Frank Bähre
Bundesamt für Verbraucherschutz
und Lebensmittelsicherheit

Dr. Siegfried Beilke
Umweltbundesamt

Christiane Böttcher-Tiedemann
Umweltbundesamt

Wolfgang Bräuniger
Umweltbundesamt

Dr. Jaqueline Burkhardt
Umweltbundesamt

Ute Dauert
Umweltbundesamt

Dr. Jutta Dürkop
Umweltbundesamt

Dr. Norbert Englert
Umweltbundesamt

Dr. Wolf-Dieter Garber
Umweltbundesamt

Dr. Gunnar Gohlisch
Umweltbundesamt

Dr. Axel Hahn
Bundesinstitut für Risikobewertung

Dr. Gernot Henseler
Bundesamt für Verbraucherschutz
und Lebensmittelsicherheit

Prof. Dr. Helmut Höring
Umweltbundesamt

Helmut Jahraus
Bundesamt für Strahlenschutz

Dr. Gerald Kirchner
Bundesamt für Strahlenschutz

Hubertus Klein
Bundesamt für Verbraucherschutz
und Lebensmittelsicherheit

Karin Lehnigk
Umweltbundesamt

Dr. Juan Lopez-Pila
Umweltbundesamt

Dr. Gert Mensink
Robert Koch-Institut

Dr. Heinz-Jörn Moriske
Umweltbundesamt

Dr. Hans-Guido Mücke
Umweltbundesamt

Dr. Wolfgang Plehn
Umweltbundesamt

Prof. Dr. Hildegard Przyrembel
Bundesinstitut für Risikobewertung

Dr. Annette Rauterberg-Wulff
Umweltbundesamt

Marianne Reppold
Umweltbundesamt

Dr. Elke Roskamp
Umweltbundesamt

Dr. Rolf Sartorius
Umweltbundesamt

Dr. Hedi Schreiber
Umweltbundesamt

Christine Schulz
Umweltbundesamt

Angela Seifert
Umweltbundesamt

Dr. Bernd Seifert
Umweltbundesamt

Dr. Wolfgang Straff
Umweltbundesamt

Michael Strogies
Umweltbundesamt

Dr. Regine Szewzyk
Umweltbundesamt

Dr. Bärbel Vieth
Bundesinstitut für Risikobewertung

Dr. Wolfgang Weiss
Bundesamt für Strahlenschutz

Dr. Heidemarie Wende
Umweltbundesamt

Dr. Horst Werner
Umweltbundesamt

Dr. Ute Wolf
Robert Koch-Institut

We wish to thank Andrea Bartel and Manfred Frank for their linguistic and editorial suggestions made and advice given during the preparation of this brochure.

9 FREQUENTLY USED TERMS AND ABBREVIATIONS

ADI	Acceptable Daily Intake, value for the amount of a contaminant which is considered to be harmless if ingested lifelong on a daily basis (the ADI value is used for substances that are – like pesticides – used intentionally).	DDT	Dichlorodiphenyltrichloroethane, a pesticide. The application in Germany is forbidden since 1972 (in the GDR, however, only since 1989). DDT is persistent in the environment and accumulates in the food chain.
BBA	Biologische Bundesanstalt für Land- und Forstwirtschaften, Bundesoberbehörde im Geschäftsbereich des → BMVEL; Federal Biological Research Centre for Agriculture and Forestry: Superior federal authority responsible to the → BMVEL	Dioxins	Short term for polychlorinated dibenzodioxins and -furans. These toxic compounds form unintentionally in the production process of other substances and during incomplete combustion; they reach the environment via exhaust fumes or wastewater, are persistent and accumulate in the food chain (see also → TCDD).
BfR	Bundesinstitut für Risikobewertung, Bundesoberbehörde im Geschäftsbereich des → BMVEL; Federal Institute for Risk Assessment: Superior federal authority responsible to the → BMVEL	Emission	Release of solid, liquid or gaseous substances or of noise from stationary or mobile sources, that are also denominated as emitters; emissions cause pollution of air, water and soil.
BfS	Bundesamt für Strahlenschutz, Bundesoberbehörde im Geschäftsbereich des → BMU; Federal Office for Radiation Protection: Superior federal authority responsible to the → BMU	EC	European Community, EC replaced the term EEC (European Economic Community)
BMGS	Bundesministerium für Gesundheit und Soziale Sicherung; Federal Ministry of Health and Social Security	EU	European Union
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit; Federal Ministry for the Environment, Nature Conservation and Nuclear Safety	Exposure	Coming into contact with → noxae (pollutants, noise, pathogens, irradiation), i.e. influences potentially harmful to health. This contact may vary in intensity and frequency.
BMVEL	Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft; Federal Ministry of Consumer Protection, Food and Agriculture	HCB	Hexachlorobenzene, its use as a plant protection product is forbidden in Germany since 1977. HCB is persistent in the environment and accumulates in the food chain.
BVL	Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, Bundesoberbehörde im Geschäftsbereich des → BMVEL; Federal Office of Consumer Protection and Food Safety: Superior federal authority responsible to the → BMVEL	HCH	Hexachlorocyclohexane, there are different isomers of which only gamma-HCH (lindane) shows insecticidal effects. Lindane is permitted in Germany with restrictions, e.g. for the treatment of head lice and scabies mites.

Immission	Influence of contaminants, noise, irradiation etc. acting on humans, animals, plants or objects. The extent of the destructive effects (immission damages) depends on the concentration and residence time at the place of exposure.	RKI	Robert Koch-Institut, Bundesoberbehörde im Geschäftsbereich des → BMGS; Robert Koch Institute: Superior federal authority responsible to the → BMGS
Limit value	Legally binding value that is not to be exceeded (in food law also called → maximum level). A limit value is defined by the legislator on the basis of scientific knowledge under consideration of social aspects, attainability etc.. New demands include the participation of the public at the process of risk regulation (risk assessment, risk evaluation, risk management).	SVOC	Semi-Volatile Organic Compound
Maximum level	Legally binding value for the residue of a plant protection product or other undesirable substances in foods. The value is not to be exceeded (see also → limit value).	TCDD	Tetrachlorodibenzo-p-dioxin, often used especially for 2,3,7,8-Tetrachlorodibenzo-p-dioxin. Indicator substance that is also the most poisonous dibenzo-p-dioxin congener. It was released at the disaster of Seveso in 1976 and is since then colloquially referred to as 'Seveso Dioxin'.
Noxa	Cause of disease or damage, that can be of biological, chemical or physical nature.	TDI	Tolerable Daily Intake, equivalent to the →ADI also for substances that are not used intentionally
PCB	Polychlorinated biphenyls, material used in the past for many purposes, banned in Germany since 1989. PCB is persistent in the environment and accumulates in the food chain.	UBA	Umweltbundesamt, Bundesoberbehörde im Geschäftsbereich des → BMU; Federal Environmental Agency: Superior federal authority responsible to the → BMU
PCP	Pentachlorophenol, wood preservative. Its application is forbidden in Germany since 1989.	VOC	Volatile Organic Compound
Risk	Likelihood of an event, i.e. of a disease. Mostly stated as the number of diseases per 10 000 or 100 000 individuals. To minimise environmental health risks → limit values and other environmental standards are set.	Precautionary principle	Principle emphasising the need of taking measures after having identified potentially dangerous effects from a phenomenon, product or process even if scientific evaluation does not yet allow the risk to be determined with sufficient certainty.
		WHO	World Health Organization

10 PICTURE CREDITS

Photographs for illustration of this brochure were kindly provided free of charge by the persons and institutions listed below.

Bavarian Environmental Protection Agency:
p. 31

Uwe Buscha, Berlin: p. 33

Der Grüne Punkt-Duales System Deutschland AG:
p. 9

Norbert Englert: front cover

Federal Biological Research Centre for Agriculture and Forestry: p. 16 top

Federal Institute for Risk Assessment: p. 54

Federal Office for Radiation Protection:
pp. 44, 48 top and bottom, 50

Axel Hahn, Federal Institute for Risk Assessment:
pp. 16 bottom, 17, 45

Sebastian Hahn, Berlin: pp. 13, 23, 24, 36, 41, 58

Clemens Hölter, Haan: p. 7

Monika Jung,, Großbeeren: p. 46

Heinz-Jörn Moriske, Federal Environmental Agency: p. 18 top and bottom

Robert Koch Institute p. 11 top and bottom

Stadtteilbüro für die Unterstadt Neunkirchen:
p. 8 top

Andreas Schwerin: p. 10

Hubert Stüber, Oberhausen: p. 37

Heike Voigt, Berlin: pp. 34, 38, 60

Wildpark Rolandseck: p. 56

Wort & Bild Verlag: p. 15

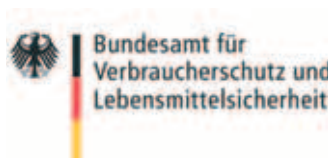
Copyright for the following photographs obtained from

Berliner Wasserbetriebe: p. 59

KOMAG, Berlin: pp. 12, 20, 29, 30, 32, 40, 51, 52, 53

Picture-alliance/dpa: pp. 26, 62

FOR YOUR NOTES



Contact:
Federal Environmental Agency
PO Box 33 00 22
14191 Berlin, Germany
Fax: ++49 30 89 03 22 85
Internet: www.umweltbundesamt.de
E-mail: uba@stk.de
Printed on 100 % used paper
© 2004 Umweltbundesamt

**Umwelt
Bundes
Amt** 
Für Mensch und Umwelt

This brochure is a contribution to the Action Programme
Environment and Health and its public relations activities.
This brochure is available free of charge.



Aktionsprogramm
Umwelt und Gesundheit
(APUG)