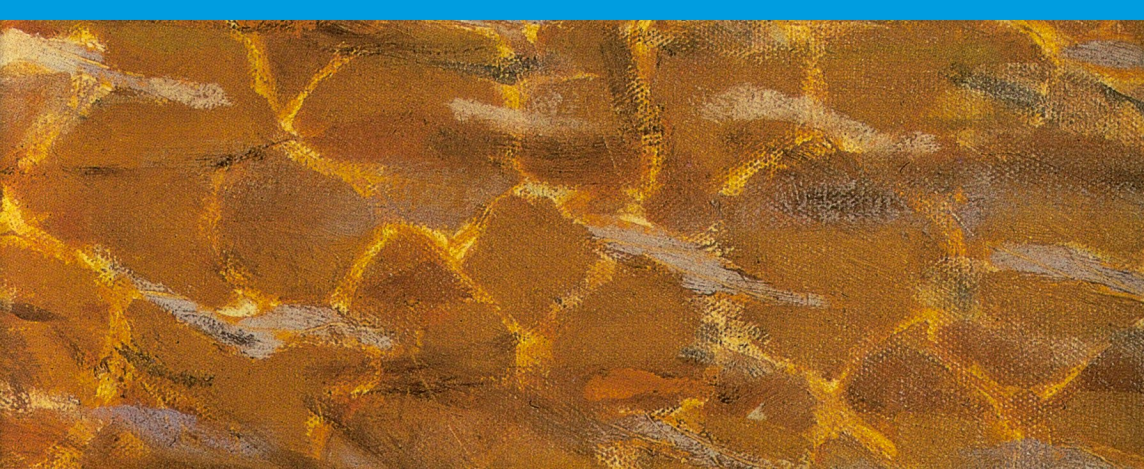
Environment for Sustainable Health Development

– an Action Plan for Sweden

SOU 1996:124 REPORT ON THE PROPOSALS PRESENTED BY THE COMMISSION ON ENVIRONMENTAL HEALTH



Environment for Sustainable Health Development

– an Action Plan for Sweden

SOU 1996:124 REPORT ON THE PROPOSALS PRESENTED BY THE COMMISSION ON ENVIRONMENTAL HEALTH

Swedish Official Reports Series
1996:124
Ministry of Health and Social Affairs

Environment for Sustainable Health Development

– an Action Plan for Sweden

Report on the proposals presented by
the Commission on Environmental Health
Stockholm 1996

This report is on sale in Stockholm at Fritzes Bookshop, which supplies Swedish official government reports and departmental series (SOU and Ds) and also, on behalf of the Central Services Office for the Ministries, arranges for them to be circulated to the competent parties for comments.

Address: Fritzes, Customer Services
SE-106 47 Stockholm
Sweden

Telefax: 08-690 91 91 (national)
+46 8 690 91 91 (international)

Telephone: 08-690 91 90 (national)
+46 8 690 91 90 (international)

Cover layout: Lena Karlsson
Cover illustration: Solnät (Sun net). Oil painting 1983.

gotab 17552, Stockholm 1996

ISBN 91-38-20389-8
ISSN 0375-250X

Foreword

The Government decided in April, 1995 to appoint a Commission under a special investigator for the purpose of preparing a national environmental health action plan for Sweden. The general purpose of the investigation was to identify environmental problems that represent health risks and to submit proposals for measures to reduce these risks. The investigator's terms of reference are set out in document Dir 1995:68.

The investigator was Prof. Christer Hogstedt, Deputy Director-General of the National Institute for Working Life and a chief physician with Stockholm County Council. Ass. Prof. Katarina Victorin, Institute of Environmental Medicine, was chief secretary. Martin Eriksson, Head of Section, National Board of Health and Welfare, and Dr. Titus Kyrklund, National Environmental Protection Agency were engaged as secretaries on a part-time basis. For some months, Ann Mari Skorpen, Ph.D., assisted the Commission's secretariat by collecting data and producing documentation, Sara Victorin, B.A., assisted with stylistic matters and editing and Ms. Barbro Nilsson assisted as clerical officer. The English translation was made by Robert Crofts.

The Commission's findings consist of a main report (SOU 1996:124) and two annexes: Health Risks and Organizations and Instruments in the Struggle against Environmental Ill-health. The facts presented in the main report are based on the material presented in the annexes, the text of which was the work of many people besides the investigator and the secretariat.

The Commission was assisted by an expert group consisting of the following members:

Mona Blomdin (until November, 1995), Maria Delvin (November, 1995–June, 1996) and Eva Sandberg (from June, 1996), Ministry of the Environment, Leif Busk, National Food Administration, Göran Enander, Älvsborg County Administrative Board, Ann-Sofie Eriksson (until January, 1996), Mona Åkerström (from January, 1996), Swedish Association of Local Authorities, Erik Jannerfeldt/Margareta Mårtensson, Swedish Employers' Confederation-Federation of Swedish Industries, Anders Jeppsson, Ministry of Labour, Enn Kivisäkk,

National Radiation Protection Institute, Michael Kramers, Ministry of Health and Social Affairs (until December, 1995), Sven-Åke Larsson, Federation of County Councils, Lars Lindau, National Environmental Protection Agency, Nils Gunnar Lindquist, National Chemicals Inspectorate, Laila Linnergren-Fleck, National Board of Health and Welfare, Göran Pershagen, Institute of Environmental Medicine, Pia Stork, Ministry of Transport and Communications, Inger Sävenstrand-Rådö, National Institute of Public Health and Kerstin Wennerstrand, Ministry of Industry and Commerce/Ministry of the Interior.

The Commission was also assisted by a scientific reference group and an officials' group in discussions on planning, analyses and proposals. The scientific reference group consisted of the following members:

Prof. Anders Ahlbom, Institute of Environmental Medicine, Prof. Olav Axelson, Department of Occupational and Environmental Medicine, Linköping University Hospital, Ass. Prof. Jörgen Bäckström, Association of Swedish Chemical Industries, Prof. Erik Dybing, National Public Health Institute, Norway, Ass. Prof. Carl-Gustav Elinder, Department of Nephrology, Huddinge Hospital, Prof. Bo Jansson, Department of Applied Environmental Research, Stockholm University, Prof. Max Kjellman, Children's Department, Linköping University Hospital, Prof. Tord Kjellström, Office of Global and Integrated Environmental Health, WHO, Geneva, Prof. Roland Möllby, Centre of Microbiology and Tumour Biology, Karolinska Institutet, Prof. Gunnar Nordberg, Department of Environmental Medicine, Umeå University, Prof. Staffan Skerfving, Department of Occupational and Environmental Medicine, Lund University, Dr. Jan Sundell, National Institute of Public Health and Prof. Leif Svanström, Department of Studies in Public Health, Karolinska Institutet.

The officials' group consisted of the following members:

Åke Larsson, Environmental Health Committee, City of Malmö, Kia Regnér, Environmental Health Committee, Österåker Municipality, Rolf Wickström, Environmental Planning and Building Committee, Kramfors Municipality, Carl-Lennart Åstedt, Environmental Health Committee, Uppsala Municipality, Karin Andersson, Environmental Urban Planning Committee, Nynäshamn Municipality, Bertil Fermstad, Environmental Health Committee, Mark Municipality, Göran Jansson, Environmental Protection Division, Kristianstad County Administrative Board, Jan Johansson, Environmental Protection Division, Östergötland County Administrative Board, Christian Blücher, Environmental Protection Division, Kalmar County Administrative Board,

Lars-Göran Jonsson, Environmental Protection Division, Jönköping County Administrative Board, Gunnar Önnevall, Environmental Protection Division, Västerbotten County Administrative Board, Lars Hagmar, Department of Occupational and Environmental Medicine, Lund University Hospital and Kjell Andersson, Department of Occupational and Environmental Medicine, Örebro Regional Hospital.

The report was presented to the Minister of Health and Social Affairs and the Minister of the Environment in October, 1996.

Christer Hogstedt

Katarina Victorin

Martin Eriksson

Titus Kyrklund

Contents

1	*Summary*		11
2	*Background*		17
2.1	Terms of reference		20
2.2	Environmental health objectives and measures		21
2.3	Design of the action plan and the report and implementation of the investigation		23
2.4	Sustainable health development		25
3	*Environmental health risks – a discussion and proposals for objectives and measures*		27
3.1	Outdoor air		27
	3.1.1	Health risks and priority substances	27
	3.1.2	Current national objectives	30
	3.1.3	Proposed objectives	31
	3.1.4	Emission sources and trends; discussion of appropriate action	34
	3.1.5	Proposed measures	38
3.2	Indoor air		40
	3.2.1	Health risks	40
	3.2.2	Current objectives	44
	3.2.3	Proposed objectives	44
	3.2.4	Discussion of the situation and previous measures	45
	3.2.5	Proposed measures	49
3.3	Water		50
	3.3.1	Health risks	50
	3.3.2	Existing objectives	54
	3.3.3	Proposed objectives	55
	3.3.4	Discussion of measures	55
	3.3.5	Proposed measures	56
3.4	Pollution in food		56
	3.4.1	Health risks	56
	3.4.2	Existing national objectives and objectives adopted by agencies	63
	3.4.3	Proposed objectives	65
	3.4.4	Discussion of appropriate measures	66

	3.4.5	Proposed measures	70
3.5		Polluted soil	70
3.6	Health risks associated with chemicals in households		71
3.7	Noise		73
	3.7.1	Noise nuisance	73
	3.7.2	Existing objectives	75
	3.7.3	Proposed objectives	75
	3.7.4	Discussion of the situation and previous measures	76
	3.7.5	Proposed measures	78
3.8	Ionizing and non-ionizing radiation and electric and magnetic fields		78
	3.8.1	Health effects	78
	3.8.2	Objectives	80
	3.8.3	Discussion	80
	3.8.4	Proposed measures	81
3.9	Injuries		81
	3.9.1	Existing objectives	83
	3.9.2	Proposed measures	83
3.10	Sectoral measures		84
	3.10.1	Transport	86
	3.10.2	Energy	89
	3.10.3	Industry	91
	3.10.4	The construction sector	93
	3.10.5	Agriculture	93
4	*International cooperation – discussion and proposals*		95
5	*The role of the public sector – discussions and proposals*		99
5.1	Government agencies		99
5.2	Local authorities		101
5.3	County councils		102
6	*Ways and means of reducing environmental health risks – discussion and proposals*		105
6.1	Agenda 21 and other declarations		105
6.2	Supervision and other health-promoting work		106
6.3	Environmental monitoring		106
6.4	Health monitoring		107
6.5	Instruments in industry		108
6.6	Environmental impact assessments		108
6.7	Planning		109
6.8	Grants and economic instruments		109
6.9	Research		110
6.10	Proposals		111
7	*National environmental health action plan*		113

7.1 Introduction 113
7.1.1 Objectives, methods and measures in environmental health activities 114
7.2 Guidelines for national environmental health activities . 116
7.2.1 The high level of health protection should be maintained 116
7.2.2 The precautionary principle should be applied to environmental health activities 116
7.2.3 Manufacturers must take the necessary precautions in order to prevent damage to health 117
7.2.4 International cooperation on environmental health requires high competence and expert participation 118
7.2.5 Labour market resources should be used for improvements in environmental health 118
7.2.6 Health impact assessments of major political decisions should be performed 119
7.2.7 Environmental health activities should be developed together with environmental and public health activities 119
7.2.8 The supervisory and research and information structures should be pluralistic 120
7.2.9 Research and education should be strengthened 121
7.2.10 The action plan should be followed up and environmental health monitoring strengthened 123
7.3 Environmental health risks – objectives and measures . 124
7.3.1 Outdoor air 124
7.3.2 Indoor air 127
7.3.3 Contamination of drinking water 129
7.3.4 Infections and pollution in food 130
7.3.5 Noise 132
7.3.6 Radiation 133
7.3.7 Injuries caused by accidents 135

1 Summary

Compared with many other countries, both Sweden's environment and its people are in good health. The classical sanitary risks were eliminated a long time ago. Our welfare system, our high level of education, our legislation and our comprehensive system of administrative supervision have contributed to this comparatively favourable situation. However, some measures have proved difficult to implement or finance in full. Moreover, pollution is spread from one country to another, new products are brought onto the market, scientific progress is constantly being made, and the impact on health of certain substances sometimes only becomes apparent after several decades. Consequently, several major environmental health problems remain to be addressed. The environment must be improved and we must see to it that we are equipped to deal with new risks.

Environment-related health risks occur in many different sectors and are dealt with by a variety of authorities and organizations. It is therefore essential to obtain an overall picture of this aspect of environmental and public health and agree on appropriate objectives. These were the primary tasks of the Commission on Environmental Health. By signing the "Declaration on Action for Environment and Health in Europe", which was adopted by the European ministers of health and the environment at a meeting in Helsinki in 1994, Sweden has undertaken to present, by 1997, a national action plan designed to reduce environmental health risks.

The Commission's task was thus to present a coherent national action plan, similar to those to be presented by other European countries, with the above objective in view. In accordance with the Commission's terms of reference, the draft plan only covers chemical, physical and, to some extent, biological risks, as well as injuries, other than industrial injuries, caused by accidents. The report summarizes the research on which the report is based, and this is followed up by proposals on environmental and health quality objectives and indicative measures appropriate to various environmental factors and sectors. In addition, there is a brief description of diseases that may be caused by environmental factors and of the risk analysis method used. In conclusion, the proposed action plan is presented.

These proposals, the structure of which differs somewhat from the presentation of the background material, outline the main analyses and measures. Ten general guidelines are proposed for the task of reducing environmental health risks, after which the health-related environmental factors are addressed with objectives and the appropriate types of measures that can be applied to achieve these objectives.

The Commission's task may be summed up in three crucial questions:

- What are the most significant environment-related health risks?
- What resources and instruments exist to prevent and eliminate these risks?
- What more can be done without recourse to new financial resources?

When all the background material for the report had been prepared, a workshop was held at which the Commission's experts and members of two reference groups discussed the quality of the information and classified the health risks associated with various environmental factors. The gravity, extent and anticipated future significance of their effects on health were considered. On the basis of these discussions I have identified the following five key problem areas:

- *Asthma and respiratory disorders,* which are on the increase and can lead to lifelong suffering or even death. Although the causes are not fully understood, it is clear that pollution in indoor and outdoor environments plays a large part.
- *Lung cancer,* which claims many hundreds of victims every year, resulting from polluted air, radon and environmental tobacco smoke.
- *Malignant melanomas* (skin tumours), which are spreading at an alarming rate due, in particular, to excessive exposure to sun.
- *Accidents and injuries,* which still cause many deaths and disabilities despite the success of preventive measures in the last few decades.
- *Accumulation of persistent substances* in the body and the food chain, which may affect future generations, although the processes involved are not fully understood. There is thought to be a risk of potential impact, on immunological mechanisms, hormone systems, reproduction and foetal development.

In addition to these there are many health problems which, while not life-threatening, affect large numbers of people, in particular, *annoyance reactions caused by noise* and *gastrointestinal* problems caused by contaminated food and water.

Substantial resources are devoted to the purpose of reducing environmental health risks, e.g. for measures implemented by the sectors concerned, industry, local and central authorities, county administrative boards and county councils, universities and research foundations, as well as from voluntary work done by patients' associations and Agenda 21 groups.

The key to preventing environmental health risks is to define and address health concerns in all the relevant sectors and to facilitate the implementation of the various systems and principles on which environmental activities are based, i.e. international cooperation, producer responsibility, community planning, life cycle analyses, quality assurance, the precautionary principle and the substitution principle, environmental legislation and its enforcement, environmental impact assessments, environmental monitoring, research, and education and training. Health concerns must be accorded a central role even where other major environmental issues emerge. Addressing the priority health problems identified by the Commission will require a combination of many different instruments. Some measures will be costly, while others will rely for their success on personal initiatives.

The Commission has not considered the need for structural changes, since public health is generally only one of the responsibilities of the authorities concerned. However, it does propose that better use be made of the research and development resources in the field of environmental medicine, a closer cooperation between research on industrial medicine and on environmental medicine and the implementation of a permanent environmental health programme by the National Institute of Public Health utilizing its existing operations.

In addition, *the following guidelines* are proposed in the context of national environmental health activities:

* The high level of health protection should be maintained, despite cutbacks in the private and public sectors, to avoid a deterioration of public health which would require even more costly measures.
* Since international cooperation is essential in order to reduce transboundary pollution, take action to combat depletion of the ozone layer and adopt rules, including trade rules, that are conducive to health protection, such cooperation requires expert knowledge of high quality.
* Producers should take the necessary measures to prevent health risks in connection with the production process and throughout the life cycles of their plants and the goods they produce.
* Health impact assessments should be carried out prior to strategic policy decisions.

* Research and risk analysis should be given higher priority, in particular as regards interaction between environmental factors, lifestyles, and work and living conditions and the long-term impact on health of persistent substances.
* Local and regional environmental and health workers need access to national sources of information and support for networks.
* Since environmental health risks are the responsibility of several sectors, supervision, research and educational activities should be pluralistic, while at the same time coordinated, efficient and effective.
* Better use should be made, through closer regional cooperation, of the resources allocated to environmental medicine.
* Environmental health monitoring should be improved and used for the purpose of continuous analyses, in particular, of implementation of the proposed action plan.

In addition to these guidelines, a number of objectives and measures are proposed with a view to reducing health problems caused by air pollution, indoor environments, contaminated drinking water and food, noise, radiation and injuries due to accidents.

The general health objectives are formulated with a view to eventual elimination of all health problems that can be prevented. The environmental quality objectives are expressed in terms of acceptable exposure, mainly on the basis of medical data and the existing documentation and conventions.

Estimates have also been made of *the cost* of measures proposed for certain specific areas. As a rule, the cost estimates only relate to measures designed to improve environmental quality, without reference to the health benefits. These estimates are not very precise, and no estimates have been made of the cost of not implementing preventive measures. Cost-benefit analysis of measures designed to improve environmental health is an area that is in urgent need of further development.

Many of the necessary improvements can be made in connection with new investment, reconstruction, increased knowledge and reallocations. Funds allocated under employment programmes can be used for health-related environmental improvement. Some measures can be financed by charges, others will have to be paid for by the individual. Some objectives can be attained speedily, while others may take decades, either because they require concerted international action, because the cost of rapid changes would be too high or because of the slow degradation of certain substances in the food chain.

The draft proposals will be submitted to the Government for further consideration and may subsequently be presented to the Parliament. It

is important that the plan should be *evaluated* with respect to guidelines, objectives and suggested measures; such an evaluation might be carried out after a period of five years. A revised plan might take into account new research findings, an evaluation of the integration of health issues into public and private sector planning and quality systems and the experience gained of coordination between the environmental and health sectors. Furthermore, research on the connection between environmental factors and the living conditions should by that time have reached a point where the findings can be integrated into a revised plan.

The plan of action proposed by the Commission is intended to heighten awareness of the impact on health of various environmental factors, to promote long-term planning measures that will maintain and further improve the high level of health in this country, to achieve improvements in neglected areas and to enhance knowledge both of suspected risks and of the effects of the measures taken. The plan should help to mobilize resources in the interests of a sound *environment for sustainable health development.*

2 Background

Compared with many other countries, both Sweden's environment and its people are in good health. We have for many years attached great importance to measures designed to prevent ill-health and reduce exposure to environmental health risks. Environmental health committees were appointed in the 19th century to prepare measures against cholera, tuberculosis and other infectious diseases which are mostly caused by defects in the physical environment. Measures designed to improve the water supply and sewerage systems, housing hygiene, diet and education, as well as a general improvement in living standards, contributed decisively to reducing the prevalence of these diseases. In recent decades measures have also been taken to deal with the major sources of industrial pollution, and accident prevention efforts have been successful in many sectors.

Consequently, the risk factors in the physical environment of today are somewhat different. The increase in road traffic, both in Europe and in Sweden, and heating with fossil fuels and wood have given rise to air pollution that has both short- and long-term effects. To an increasing extent, construction materials contain various additives, and since housing is now better insulated, this means that we are exposed to a number of different chemical substances indoors. The relative importance of the many small diffuse emissions has increased. Some of these pollutants accumulate in the environment, plants and animals, and are subsequently taken up by the food and liquids that we eat and drink. The effects may appear only after several decades. Food poisoning and other environment-related infectious diseases are still a significant problem. New risks will arise on account of new chemicals, new technology, changing microorganisms and new risk categories.

The impact on health of many of these pollutants is insufficiently known. Often, exposure to a single pollutant is not sufficiently great for its impact on health to be determined, while the overall effect of many different risk factors is crucial. Sometimes, external risk factors interrelate with lifestyle factors, e.g. radon gas with tobacco smoke. Therefore, different measures must often be combined in order to reduce a certain effect on health.

Today, some of the most widely discussed health effects that are associated with exposure in the environment are the risk of developing cancer and respiratory disorders. The connection is well-documented for several factors. In other cases a connection is suspected with varying degrees of probability which must be investigated.

Consideration must not only be given to effects in the form of illness. The nuisance caused by noise and smell is not as serious as cancer and allergies, but many people are exposed to it and it may seriously affect their well-being.

We also know far too little about the substances to which people are actually exposed in the general environment. Although a certain amount of environmental monitoring has taken place for a long time, it has mostly been directed at the environment as such and human uptake has not been given special study. Measurements of individuals are necessary in order to make it possible to determine the connection between people's state of health and the actual quantities of substances absorbed by them through the air, food or the skin.

Although environmental activities have always focused on human health, the health aspect has not always been at the centre of environmental policy.

The work of preventing and reducing environmental health risks - referred to in this report as environmental health activities - extends from economic policy and legislation to health education and can be broken down into the following types of measures:

- general health policy measures
- development-integrated activities, i.e. health aspects integrated into product development or area planning
- regulatory measures, i.e. legislation etc.
- institutionalization of activities, e.g. environmental health protection committees, public health secretariats, Agenda 21 groups
- information and educational activities
- activities undertaken by action groups.

The Commission on Environmental Health has examined and attempted to take into account all these different types of measures in its analysis and in the proposals it has submitted.

There is no framework uniting all the activities designed to prevent and eliminate environmental health risks. Each sector (transport, industry, energy, agriculture, trade etc.) is responsible for ensuring that its activities and products do not cause problems in terms of health and well-being. Several ministries and government agencies, as well as the county administrative boards, are responsible for the preventing and reduction of environmental health risks. At the local level, health and

environmental protection is the responsibility of the local authorities. The health services also play an important part, for example as regards environmental medicine. Furthermore, every individual is responsible for the area in which he or she has influence.

It should be possible to use existing resources more efficiently if those involved can agree on common objectives, measures and forms of cooperation. An important objective of this action plan is to summarize our knowledge about ill-health caused by environmental factors and the instruments that are available to prevent such ill-health so as to make it possible to define the problems and thus facilitate joint action. A national consensus on an action plan to combat the major environmental health risks should also stimulate local and regional action.

A good example of successful environmental health activities is the increasing attention paid to allergies and hypersensitivity. The increase in asthma and respiratory disorders was noticed in the mid-80s, so that today most people are aware of it. A combination of thorough investigations carried out in close collaboration between researchers and the relevant authorities, good informative coverage by the media, local and regional support, support for networks, the allocation of funds by central government, increased resources for research and individual, massive campaigns have effectively placed the "allergy issue" on the agenda in Sweden.

Agenda 21 activities and the success achieved in reducing the number of accidents in various sectors are other examples of successful environmental health activities based on other combinations of instruments but characterized also by interaction between the international, national, regional and local levels, the private and public sectors, research, information and voluntary work. These examples indicate that there is every reason to be optimistic about the chances of mobilizing preventive environmental health activities in Sweden.

The task of elaborating an environmental health action plan is also part of a process originally initiated by the WHO's European office. In 1984, the European WHO Member States adopted the health programme "Health for All by the Year 2000", several of the 38 objectives of which related to environmental health risks. In 1989, the first WHO Conference on Environment and Health took place in Frankfurt. There the European Charter on Environment and Health was adopted unanimously by the ministers of the environment and health of the Member States in the European region.

In June, 1994 the European ministers of the environment and health met again and adopted a Declaration on Action for Environment and Health in Europe. Under this declaration, each country undertakes by 1997 to have prepared a national environmental health action plan. The

action plan is to be based on each country's needs and to be elaborated jointly by the ministries of the environment and health. The plan is not only to focus on health risks but also to take stock of and assess the structures and the instruments needed for this task.

The third WHO Conference on Environment and Health is to take place in London in 1999 and its purpose is to follow up the national and international activities initiated by the Helsinki Declaration.

2.1 Terms of reference

The Commission on Environmental Health was instructed to concentrate on the health effects of factors in the physical environment. The physical environment in this context means physical, chemical and certain biological factors in outdoor and indoor environments. This concept is, however, very broad. It was therefore necessary to impose certain restrictions, most of which were set forth in the terms of reference.

One of the restrictions was to exclude matters relating to the work environment and certain lifestyle issues (alcohol, tobacco, diet, drugs, hygienic and cosmetic products) from the investigation. The transmission of infection between people and between animals and people is likewise excluded. The transmission of infection through water and food is, however, included.

The reason for excluding the work environment is that this has already been thoroughly investigated and that supervision, research and development in this area have been well organized by the Ministry of Labour. Where the work environment coincides with a public environment, e.g. schools and day nurseries and nursery schools, these are included in the investigation.

The reason for excluding lifestyle factors is that these factors are not normally regard as a part of the physical environment. The use of alcohol, tobacco and drugs is basically a social issue. However, where risks in the physical environment interact with lifestyle issues, e.g. the connection between radon and smoking, these have been dealt with. Cosmetics and sanitary articles were also excluded as being lifestyle factors.

Matters relating to medicines and medical products were not included, since these are carefully controlled and are not normally regarded as environmental factors.

Social and psychological matters were also excluded, since this study might otherwise have become a study of public health, which was

not the intention. Psychosocial effects of disturbances in the physical environment were included in the study, but not matters to do with unemployment, social networks, harassment etc.

The purpose of the action plan is to give a comprehensive picture of objectives and indicative measures designed to improve environmental health, but not to elaborate detailed plans on how each objective should be achieved. Detailed plans already exist for some areas and for others they can be drafted by the sectors and authorities concerned, but this falls outside the scope of the investigation, which concentrated on the field as a whole.

2.2 Environmental health objectives and measures

"Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature."

(Opening paragraph of the Rio Declaration)

The Rio Declaration and Agenda 21 were adopted by the United Nations Conference on Environment and Development, which was attended by 150 heads of state, in 1992. These documents represent an important step forward by emphasizing, at the international and national levels, the need to allocate greater resources to the solution of environmental and development problems.

Agenda 21 notes that there is a close link between people's health and development, and one chapter is devoted to human health. Several objectives aimed at reducing the health risks caused by environmental factors relate to air pollution in urban areas and indoors, water pollution, pesticides, residential districts, noise, radiation and industrial and energy production.

The Rio Declaration, Agenda 21, the Health for All programme and the European Charter on Environment and Health lay down general principles that should serve as a guide in the formulation of the objectives at various levels and should be consistent with these objectives.

The Riksdag (the Swedish parliament) has adopted a great number of objectives for environmental measures in Sweden, both objectives of a general nature and specific objectives in various areas. Many of the adopted objectives are based on the Government Bill *A Good Environ-*

ment to Live in (1990/91:90), which sets forth the following general goals:

- protection of human health
- conservation of biological diversity
- wise management of natural resources with a view to long-term use
- protection of natural and agricultural landscapes.

The Riksdag has also adopted certain environmental objectives specifically linked to health, and these are dealt with in chapters 3 and 6 in connection with various kinds of exposure. As regards national public health objectives, the Government presented a public health bill to the Riksdag in 1991. This emphasized that public health work must be based on three principles: local commitment, knowledge and intersectoral cooperation.

In December, 1995 the Government appointed a parliamentary committee to draft proposals on national public health objectives. These objectives are to serve as a guide in activities aimed at promoting public health and preventing ill-health and the premature and avoidable impairment of functions, and sickness and death.

There is a potential for conflict between measures that are designed to prevent certain types of ill-health but may risk worsening others. For example, better ventilation in all types of housing inevitably leads to an increase in energy consumption, and none of the commonest types of energy is environmentally benign in all respects. An increased use of bicycles would reduce vehicle exhausts, but on the other hand increase the risk of accidents unless measures were also taken to prevent those risks. An increased recycling of waste can give rise to new risks of infection where garbage is stored near housing for any length of time. It is therefore important to consider the overall effects in attempts to improve environmental health, as in all activities directed at improvement. In many cases, further research in the field of environmental medicine is needed to determine which measures are most important and which factors interact or conflict with each other.

2.3 Design of the action plan and the report and implementation of the investigation

The Commission's main task was to elaborate a national environmental health action plan. The action plan is designed to be goal-, problem- and action-oriented, monitorable, relatively brief and useful in global contexts. The proposals have been designed in such a way as to make it possible to present them to the Riksdag following circulation to interested parties and any modifications that may be necessary.

As a first step, an inventory and description were prepared of environmental health risks, as well as of the authorities and the legislation, policies and instruments that exist to prevent and eliminate these risks. The report concentrates on what we regard as priority issues.

A risk assessment seminar arranged by the Commission in February, 1996 was of great importance in deciding priorities.

There are many different kinds of objectives, for example general objectives, objectives relating to processes, structures, production, results, effects, quality etc. In designing an environmental health programme it is natural to regard good health as the effect of achieving the objectives and a low level of exposure, which ensures protection against ill-health, as the result to aim for. Since the desired health and exposure targets (environmental quality objectives) lie far ahead in the future and may require international cooperation, it is sometimes appropriate to set initial objectives to be achieved in a limited time in order to make it possible to evaluate the progress of improvement. Thus the formulation of objectives in an action plan differs from the method used by organizations and authorities, which is usually more operation-oriented.

All the objectives and indicative measures are discussed rather fully in chapters 3 to 6. In addition, several proposals presented in the main report cannot appropriately be included in a forward-looking, national action plan for international use. This applies, for example, to measures that have already been adopted and are being implemented, or measures relating to specific authorities etc. Therefore, the number of proposals discussed in chapters 3 to 6 is greater than that in chapter 7. The difference is due to the nature of the action plan and not to the Commission's assessment of the relative importance of the proposals and measures.

A number of measures are dealt with in different parts of the report. This is because we have addressed issues both in connection with the

discussion of environmental factors and with the description of the different sectors' importance with regard to environmental health problems. In accordance with the terms of reference, the action plan is based on a review of the health effects of various environmental factors. It was natural to relate objectives and measures to these factors. On the other hand, most of the measures will be implemented in different social and industrial sectors, and for this reason a section on important measures to be implemented in different sectors is included (section 3.10).

In chapters 3 to 6 measures are proposed which in some cases are addressed to individual authorities, but in the section on sectoral measures no such specification is generally made. Many kinds of cooperation that are relevant to environmental health risks are under way in various sectors. The formulations in the national action plan are of a fundamental nature and we have avoided naming individual authorities as far as possible.

The terms of reference included a request for the preparation of cost/benefit analyses of the environmental measures needed to save life, reduce harmful exposure or reduce the number of victims.

Experience has shown that the cost estimates vary greatly, due to the fact that calculations of the health effects of various measures involve great uncertainty and that the financial calculations can be made in many ways and are based on varying assumptions. In assessing the specific costs of the proposed measures, account must be taken of the extent to which the parties concerned are in a position to finance them.

The analyses seldom include calculation of the costs of omitting to take preventive action. Such analyses are difficult to make in the absence of any agreed valuation of the price of suffering and death at various ages. In quantifying health effects in monetary terms the concepts used are "statistical life", people's willingness to pay for improvements or for reducing production losses, the cost of health care etc. No scale of priorities or valuation of life in monetary terms is free frrom value judgments.

In assessing cost/benefit analyses it is important to remember that investments in improved health often coincide with investments for other reasons. As a matter of principle, costs should be charged to those who cause the harmful exposure.

Useful cost/benefit analyses of environmental health measures represent an area that is in urgent need of development, even though the purpose of the proposed measures is not primarily to reduce production losses or future health care costs, but to prevent ill-health and improve public health and well-being.

2.4 Sustainable health development

In its report "Our Common Future" the World Commission on Environment and Development (the "Brundtland Commission") coined the term "sustainable development", which it defined as "development ... that ... meets the needs of the present without compromising the ability of future generations to meet their own needs." In its national Health for All strategy (1991) the former Swedish Public Health Group referred to sustainable development in terms of health policy. This means development which in the long term promotes people's chances of living a healthy life. In Sweden too, inequalities between different social groups must be reduced if we are to succeed in achieving sustainable development.

The Commission has not analysed the prevalence of environment-related ill-health in various social groups or differences between men and women. Such data are not available and the investigation as a whole was based on known facts, since no resources were available for research projects. There are no longer any slums in Sweden, and therefore the differences in health between the various social groups that are attributable to the environment are smaller than in many other countries. However, it may be assumed that people with only basic education and small personal resources are less able to absorb the information that is needed in order to reduce many environmental health problems. Smoking is a common habit among women with basic education, and their children are therefore likely to be affected by passive smoking to a greater extent than other children. The children of low-resource parents are more prone to accidents than other children. Those who have no choice tend to live in substandard housing with poor sound insulation and few recreational facilities. A lack of financial resources increases the risk of an inadequate diet. It may therefore be assumed that there are imbalances as regards environment-related ill-health that are due to both occupational and social risk factors.

The way society protects and provides for its children is a measure of its degree of civilization and development potential. Children should be the first to benefit from mankind's successes and the last to suffer from its failures. An under-stimulating outdoor environment, rundown housing estates and inadequate school buildings do not provide a favourable setting for the young or offer them the best conditions in which to grow up and develop. The fact that children are more sensitive than adults justifies taking children, to an increasing extent, as the norm in determining limit values for substances in the environment and products.

The increasing accumulation of persistent toxic substances that are suspected of affecting reproduction and foetal development, as well as an increase in respiratory disorders and malignant skin tumours, are examples of threats to health development. What is needed is a coherent programme for healthy development, which creates a favourable climate for better consideration of health effects in planning and quality systems, citizens' commitment, increased knowledge, long-term planning for the maintenance of efficient systems, coordinated activities, adequate margins of safety, a better environment and sustainable development. We have therefore called this report and the proposed environmental health action plan *Environment for Sustainable Health Development*.

3 Environmental health risks – a discussion and proposals for objectives and measures

At a risk assessment seminar arranged by the Commission on Environmental Health various environmental factors were classified according to their impact on health. These classifications form the basis of the prioritization of problems presented in this chapter. The main purpose is to discuss priority environmental health problems in relation to national environmental objectives. The existing objectives are analysed, new environmental health objectives proposed, measures that are being implemented or have been proposed are described and discussed with reference to the results achieved and any shortcomings. Lastly, the Commission's own proposals are presented. The proposals set forth in sections 3.2–3.9 relate to pollution and associated phenomena, while section 3.10 deals with the measures we consider important in various sectors.

3.1 Outdoor air

3.1.1 Health risks and priority substances

Global air pollution

Two major global environmental threats are the emissions of carbon dioxide due to the combustion of fossil fuels, which are responsible for the "greenhouse effect", and emissions of chlorofluorocarbons (CFCs), which accelerate the depletion of the protective ozone layer in the stratosphere. In this connection, the total emissions from the entire planet are crucial to the effects.

The increase in mean temperatures that may result from emissions of *carbon dioxide* may in some parts of the world involve serious consequences for human environments due to desertification and the flooding of low-lying areas. The Riksdag has decided that emissions of

carbon dioxide from fossil fuels in Sweden must be stabilized at the 1990 baseline level by the year 2000, after which they must fall. One factor of great importance after the year 2005 is whether and how nuclear energy is phased out. Sweden accounts for only a few per mille of global carbon dioxide emissions.

Following a ban and phase-out programmes, the Swedish use of *freons (CFCs)* has been greatly reduced, and the national target of phasing out all use of CFCs by the end of 1994 appears, by and large, to have been achieved. However, hydrochlorofluorocarbons (HCFCs), which are less damaging to the ozone layer, are still used. A depleted ozone layer lets through a much greater proportion of the sun's harmful UV rays. This may increase the risk of skin cancer, inter alia. According to the National Environmental Protection Agency, depletion of the ozone layer is likely to increase up to the end of this century, after which it should level out and then gradually decrease. Objectives and measures in these areas will not be discussed here, since these environmental problems are priority issues both at the national and international levels. Instead, we have elected to concentrate on air pollution that is likely to directly affect people's health.

Regional and local air pollution

All air pollution is distributed in the atmosphere without regard to national boundaries. The health risks caused by air pollution are, however, above all a problem in densely populated areas, where local sources of pollution are much more important than nationwide depositions. A major source of pollution in urban areas is motor traffic. This applies in particular to nitrogen dioxide, since traffic accounts for approx. 80–90% of the total quantities in urban areas.

Ozone is produced in large-scale chemical processes in the atmosphere from nitrogen oxides and hydrocarbons, and most of the atmospheric ozone in Sweden emanates from foreign sources. Unlike the other air pollutants discussed in this section, atmospheric ozone levels are lower in urban areas than in rural areas.

The air pollutants that are assumed to have the most serious effects on the airways are nitrogen dioxide, ozone and particulates. *Nitrogen dioxide* affects the function of the lungs, and the effect that is noticeable at the lowest concentrations is an increase in bronchial reactivity, which affects asthma sufferers in particular. Nitrogen dioxide therefore aggravates the symptoms in connection with inhalation of cold air, pollen and other allergens or in connection with physical effort, which may, especially when repeated, be of clinical significance to asthma sufferers. High levels during short periods have the greatest effects in

this connection. It is also interesting to note that Swedish investigations have indicated a correlation between nitrogen dioxide levels in various urban areas and the existence of respiratory disorders and symptoms and lower respiratory infections in children, even where the levels are below the limit values.

The effects of *ozone* are somewhat similar to those of nitrogen dioxide. The effect on the function of the lungs is, however, associated primarily with conditions such as coughing and respiratory distress, and inflammations are a typical component of the effects. Epidemiological studies indicate a correlation between increased levels of ozone and respiratory disorders, impaired lung function and increased hospitalization for asthma and other respiratory disorders.

Airborne *particulates* are of varying origin and chemical composition. The most important from the point of view of health are respirable particulates (e.g. measured as PM10). Several epidemiological studies, in particular in the USA, have indicated quantitative correlations between respirable particulates, without any marked thresholds, and various effects on the airways and even increased mortality. Particulates probably also have an impact on health in Sweden. They are thought to be responsible for increased hospitalization and also increased mortality among elderly and sick people.

Preliminary attempts to quantify the effects of ozone and particulates indicate that they may cause several hundred cases of hospitalization for respiratory disorders every year, and significantly more cases with mild effects, such as an impaired state of health among asthma sufferers. No quantitative studies have been carried out for nitrogen dioxide owing to a comparative lack of epidemiological data.

Carcinogenic air pollution is mainly caused by combustion, and emissions are higher in inverse proportion to the combustive efficiency. The largest sources are the combustion of wood and road traffic (including mobile machinery). Both polycyclic aromatic hydrocarbons (*PAHs*) and gaseous hydrocarbons such as *ethylene, butadiene and benzene* are important. PAHs are primarily associated with the risk of lung cancer, and benzene with leukaemia. On the basis of epidemiological and other data it has been estimated that air pollution in urban areas is responsible for approx. 100 cases of lung cancer per year in Sweden and 100–1 000 cases of cancer altogether. No new data have emerged to contradict these estimates. However, the data are very uncertain.

The levels of *sulphur dioxide* in urban areas have decreased substantially as a result of the reduction in the sulphur content in oil and the widespread use of district heating systems. The levels of *carbon monoxide* have fallen as a result of the increased use of

catalytic converters in cars. Today, the health risks associated with these substances are considered small.

The levels of *aldehydes* and *organic solvents* are seldom measured, and it is therefore impossible to identify any trends. The health risks in these cases are nevertheless considered low compared with the priority risks discussed above.

Priority pollutants

Causing irritation in the airways:	ozone, nitrogen dioxide, particulates (PM10)
Carcinogenic:	polyaromatic hydrocarbons (PAHs), certain volatile hydrocarbons

3.1.2 Current national objectives

In 1990 the Riksdag adopted the following general objectives with respect to air pollution:

- the air quality in urban areas should be improved so as to eliminate the remaining risks to human health due to emissions from traffic, industry and energy production plants;
- depositions of sulphur and nitrogen oxides should be limited to levels that do not harm nature or human health;
- depositions of volatile organic compounds should be limited to levels that do not harm nature or human health;

and the following time-related targets:

- by the year 2000 the levels of carbon oxides, nitrogen dioxide, sulphur dioxide, soot and particles should be lower than the guideline values prepared by the National Environmental Protection Agency. (Limit values for nitrogen dioxide, soot and particles are given in section 3.1.3);
- emissions of carcinogenic substances should be reduced by 90% in urban areas to bring the long-term health effects down to an acceptable level. An appropriate initial objective would be to halve emissions by 2005;

- nitrogen dioxide emissions should be reduced by 30% by 1995 with 1980 as the baseline;
- emissions of volatile organic compounds should be reduced by 50% by 2000 (baseline 1988).

As can be seen, no specific targets were set for ozone levels, but reduction of emissions of nitrogen oxides and volatile organic compounds (VOCs) help to reduce the production of atmospheric ozone.

3.1.3 Proposed objectives

Air pollution out of doors affects everybody. Since nobody can escape from such pollution, the limit and guideline values should be set in such a way as to protect both children and elderly people, as well as those with an impaired lung function, from negative effects.

The overall objective should be to extend the rules that now apply to urban areas to air pollution everywhere, including ozone in rural areas. The objective should also be formulated in more general terms, so as to cover emissions from private activities such as the burning of wood. Therefore, our proposed overall objective is:

> Air quality should be improved so as to eliminate the remaining risks to human health caused by emissions from traffic, industry, energy production plants or other activities.

It should be possible to specify this general objective as an environmental quality goal by specifying levels of indicator substances at which it is considered that no health risks exist. The objective already adopted, i.e. that levels should be lower than the National Environmental Protection Agency's limit values by the year 2000, should therefore be made more stringent for nitrogen dioxide and particles, and new objectives should be set for ozone and carcinogenic substances. It may be appropriate to use the proposed guideline values or "low-risk levels" prepared by the Institute of Environmental Medicine for the National Environmental Protection Agency. These guideline values are set in such a way as to protect both the general public and sensitive groups. However, the possibility of effects occurring cannot be excluded, since sensitive new epidemiological and other studies tend to detect effects at lower levels than previously. Risk assessment should therefore be revised at regular intervals as and when new data are established.

As regards airborne *particulates,* limit values (98th percentile[1]) of 40 μg/m³ (winter mean) and 90 μg/m³ (24-hour mean) are applied to soot. In addition, the National Environmental Protection Agency has laid down "guideline values" for total suspended particulates (TSPs) and respirable particulates (PM10) of 50 μg/m³ (winter mean) and 110 μg/m³ (24-hour mean), the PM10 value being applicable to street environments. In 1992 the Institute of Environmental Medicine proposed a winter mean PM10 value of 20 μg/m³ and a 24-hour mean value of 100 μg/m³. Following presentation of this proposal, however, new epidemiological studies have indicated that it may be appropriate to lower these recommended values. We therefore propose that the Institute of Environmental Medicine be instructed to carry out a new risk assessment, but that the values recommended in 1992 be used until further notice. Unfortunately, few measurements of PM10 levels are made in urban areas, but the recommended values are probably seldom exceeded. Systematic measurements are recommended.

The current limit value for *nitrogen dioxide* is an hourly mean of 110 μg/m³ (98th percentile). The Institute of Environmental Medicine recommends a 24-hour mean of 100 μg/m³ (99th percentile[2]), which corresponds to a 98th percentile value of approx. 90 μg/m³. This limit may be exceeded in streets with busy traffic, but levels have been falling for some years. It should be possible to achieve the target by 2005.

No limit has been set for *ozone*, but the Institute of Environmental Medicine recently recommended an hourly mean of 80 μg/m³. This level is exceeded many times a year in southern Sweden and must therefore be considered a longer-term objective than the others.

The Institute of Environmental Medicine has also prepared low-risk levels for the National Environmental Protection Agency with respect to certain *carcinogens*. These levels are equivalent to a theoretical excess lifetime cancer risk of 1 in 100 000 ($1 \cdot 10^{-5}$). The National Environmental Protection Agency has not adopted these levels as official guideline values, but they have been used in conjunction with environmental protection assessments etc. Despite the uncertainty associated with estimates of cancer risks at low doses, we nevertheless recommend the use of a low-risk level (corresponding to a lifetime

[1] May be exceeded for 2% of the number of hours measured (175 hours per year).

[2] May be exceeded for 1% of the number of hours measured (88 hours per year).

cancer risk of $1 \cdot 10^{-5}$) for some selected indicator substances as an environmental quality target for carcinogenic air pollutants.

Benzene, ethylene, butadiene and benzo(a)pyrene are substances which might be considered. The first three are indicators of gaseous hydrocarbons produced by combustion, and benzene is also related to motor traffic since it occurs in petrol and can be volatilized in connection with fuelling etc. Ethylene and butadiene are also relevant because their content in exhausts is likely to increase if the composition of fuel is altered in order to reduce emissions of benzene. The Institute of Environmental Medicine has specified low-risk levels for these three substances. Benzo(a)pyrene is used as an indicator of carcinogenic PAHs, which are produced during incomplete combustion. In the ambient atmosphere they normally only occur in particulates to which they are adsorbed. The WHO has published a risk estimate for benzo(a)pyrene that can easily be converted to a low-risk level. Benzene is the only one of these substances that is regularly measured, and there are no measurement data at all on butadiene. Benzene levels are approx. 2–8 times higher than the Institute of Environmental Medicine's low-risk level, but there has been a falling trend in the three winters during which they have been measured under the Environmental Research Institute's URBAN measurement programme in various Swedish towns. The levels of ethylene and butadiene are assumed generally to exceed the Institute of Environmental Medicine's low-risk levels in urban areas. Measurements of PAHs in Stockholm indicate that benzo(a)pyrene levels in busy streets are approx. 20 times higher than the low-risk level. The Riksdag's long-term target of a 90% reduction of emissions of carcinogens probably means that the low-risk levels for these substances will usually not be exceeded.

We recommend that *benzene* and *benzo(a)pyrene*, in particular, should be used as indicator substances for carcinogenic air pollutants, but also recommend that *ethylene* should be included if measurement is considered technically feasible. Analysis methods and trial measurements should be prepared for butadiene as a basis for subsequent decisions.

A category of substances that may be of interest as indicators in connection with environmental objectives and monitoring is aldehydes, formaldehyde in particular. Aldehydes smell unpleasant and irritate the mucous membranes in the eyes, nose and throat, as well as being carcinogenic in high concentrations. Aldehydes are produced both in conjunction with combustion and the breakdown of various hydrocarbons in the atmosphere. Furthermore, emissions of aldehydes from traffic will increase if motor alcohols are more widely used than is the case today. We recommend that measurements be carried out.

This description indicates that many categories of substances should be included in environmental health monitoring programmes, in addition to the substances for which limit values have already been established and which are measured more or less regularly in urban areas. This has also been suggested earlier in the Institute of Environmental Medicine's proposals for environmental health monitoring, which recommend ambient measurements of sulphur dioxide, nitrogen dioxide, particulates (TSPs and PM10), carbon monoxide, ozone, ethylene, propylene, benzene, formaldehyde, acetaldehyde, PAHs (benzo(a)pyrene in particular) and mutagenic activity (Ames test).

We recommend the following additions to the time-related targets for air pollutants adopted by the Riksdag (see section 3.1.2) (new criteria should be prepared for respirable particulates):

- The present situation as regards air pollution must not be allowed to deteriorate.
- By 2005 nitrogen dioxide levels should not exceed an hourly mean of 100 $\mu g/m^3$.
- In the long term, ozone levels should not exceed an hourly mean of 80 $\mu g/m^3$.
- By 2010 the long-term mean levels of ethylene, benzene and benzo(a)pyrene should not exceed 1, 1 and 0.0001 $\mu g/m^3$, respectively.

If the targets for ethylene, benzene and benzopyrene are attained, the levels of other organic compounds will probably also be low, since those substances also act as indicators of other compounds from the same source, e.g. car exhausts and other combustion sources. This objective is consistent with the long-term objective of a 90% reduction of emissions of carcinogens. Whether the national objective of reducing emissions by 50% by the year 2005 will ensure that the recommended levels will not be exceeded is impossible to tell in the absence of inventories of emissions and levels of these carcinogens.

3.1.4 Emission sources and trends; discussion of appropriate action

Emissions from industry have decreased sharply during the last few decades due to application of the requirement, under the Environment Protection Act, that permission is only to be granted for plants using the best available treatment technology. Emissions from power and

heating plants have also decreased as a result of this legislation. The Act is, however, only applicable to stationary plants. It has been much more difficult to deal with emissions from traffic, since this requires amendment of the legislation, as well as coordination with European legislation.

Nitrogen oxides

In 1992, emissions of nitrogen oxides from transport accounted for more than 80% of total emissions, and therefore measures in the transport sector are crucial to the effectiveness of the adopted measures overall. The exhaust standards for passenger cars imposed in 1989 reduced the limit values for nitrogen oxides by approx. 70%. New cars equipped with catalytic converters also generate substantially lower emissions than older cars. The exhaust standards for light trucks were made more stringent for 1992 models onwards and for heavy vehicles for 1993 models. Starting with 1993 models there is now also an environmental classification system which may reduce emissions still further. So far, the new stringent requirements and the classification system have not had an appreciable impact due to the simultaneous increase in traffic. No measures have been taken to reduce emissions in air and sea transport, and the emissions in these sectors have increased in proportion to the traffic. According to a report from the National Environmental Protection Agency (number 4532, 1996), emissions from road traffic decreased by 9% between 1980 and 1994, while emissions from other means of transport and mobile machinery increased.

Emissions of nitrogen oxides from energy production have decreased since 1980, partly as a result of a plentiful supply of electricity from hydro power and nuclear power, which has reduced the need of combustion. Improving combustion technology can reduce emissions somewhat and in some large district and industrial heating plants a start has been made in recent years on catalytic or chemical reduction of nitrogen oxides in flue gases, with or without ammonia. The imposition of a nitrogen dioxide charge in 1992 accelerated this development. National Environmental Protection Agency report number 4532, 1996, indicates a reduction in emissions from energy production by 55% and from industrial processes by 29% between 1980 and 1995. The total reduction during this period was 15%, which is considerably lower than the declared target of 30%.

The National Environmental Protection Agency has estimated that for 1991 more than one million people in Sweden were exposed to nitrogen dioxide levels that exceeded the Institute of Environmental

Medicine's recommended limit values. However, urban levels have decreased in the last few years. According to the Environmental Research Institute's URBAN measurement programme, the winter mean has fallen by approx. 25% between 1986/87 and 1994/95. The falling trend in recent years may, however, have been exaggerated by mild, windy winters. The decrease should mean that the number of "overexposed" people has dropped to a few hundred thousand.

With a view to reducing emissions of nitrogen oxides the National Environmental Protection Agency report 4532 proposes the following measures, in particular with respect to transport and mobile machinery:

- implementation of coming EU standards for mobile machinery and national measures to accelerate the introduction of machines with better exhaust performance;
- imposition of more stringent exhaust standards for new cars from 2000 (EU 2000 standards) and a further development of the environmental classification system.

Measures designed to reduce emissions of nitrogen oxides are also proposed for shipping and aviation, but these will not greatly affect the levels in urban areas.

Volatile organic compounds (VOCs)

VOCs include light hydrocarbons, as well as organic solvents, and e.g. aldehydes. Often, no distinction is made between VOCs and hydrocarbons.

The National Environmental Protection Agency has published a study of the sources of and trends in emissions of hydrocarbons (report number 4532, 1996).

Transport and mobile machinery account for over 40% of total emissions (excluding methane), energy production for over 30% and industrial processes for most of the remainder.

In the transport sector, road traffic accounted for 73% of hydrocarbon emissions in 1992, 84% of which was from cars. Emissions from cars have decreased following the increasing use of catalytic converters and vapour trap systems. It is envisaged that the classification of vehicles will reduce emissions still further. Between 1988 and 1994, emissions of hydrocarbons from transport and mobile machinery dropped by 23%.

Hydrocarbon emissions from the energy sector are dominated by small-scale wood-fired heating units (domestic boilers) and have only decreased by 3% between 1988 and 1994.

As regards emissions from industry, the largest proportion is accounted for by the forest industry (natural terpenes). Other major sources are manufacturing, paper and pulp, refineries and the wood varnish industry. Emissions of solvents have decreased in most sectors, as have hydrocarbon emissions from refineries, mostly due to more stringent requirements for the granting of permits.

The goal of a 50% reduction of emissions of VOCs between 1988 and 2000 will not, according to the National Environmental Protection Agency's report, be achieved in full. Forecasts indicate a reduction of 40% due to the measures already adopted. Apart from the measures adopted with respect to traffic, measures are recommended in particular for small-scale wood-fired heating and certain industrial processes.

Ozone

As mentioned above, atmospheric ozone is a result of photochemical reactions between nitrogen oxides and hydrocarbons. In summer, levels of over 120 $\mu g/m^3$ are common in southern and central Sweden, which may be compared with the long-term target recommended by the Commission, i.e. 80 $\mu g/m^3$ (hourly mean). On warm summer days levels sometimes exceed 180 $\mu g/m^3$ in southern Sweden. The levels on the continent are even higher. Ozone levels in Sweden are mostly the result of transboundary transport of pollutants. Levels are increasing by approx. 3% per year.

The ozone levels in Sweden can only be reduced by measures taken in Europe as a whole, and negotiations are in progress on a protocol within the framework of the ECE Convention on Long-range Transboundary Pollution. An agreement based on critical loads will probably be concluded and it is likely to include commitments and measures up to the year 2010. In the EU too, strategies are being discussed for the reduction of ozone levels in Europe. If the target of 80 $\mu g/m^3$ is to be achieved, very substantial reductions in the emissions of hydrocarbons and nitrogen oxides throughout Europe are essential.

Carcinogens

The carcinogenic light and heavy hydrocarbons, exemplified by ethylene, benzene and the PAH compound benzo(a)pyrene, are mainly a problem in urban areas, where small-scale wood-fired boilers, road traffic and mobile machinery are the principle sources. Measures to reduce emissions of light hydrocarbons have been described above. As regards PAH, emissions from traffic and domestic heating are esti-

mated to have been reduced by 35% between 1980 and 1987, mostly due to reduced emissions of particulates (National Environmental Protection Agency, report number 4366, 1994). In view of our incomplete knowledge of the contribution made by different sources, it will not be possible to evaluate achievement of the goal of halving emissions of carcinogens in urban areas by 2005. In a later report (number 4563, 1996), it is concluded that emissions of PAHs from traffic and wood-fired boilers had not been reduced during the period 1987–1995.

Very little measurement data are available on PAHs. However, the Stockholm Environmental Department has carried out measurements in Hornsgatan (a street with busy traffic) for a number of years. These measurements do not indicate any reduction.

3.1.5 Proposed measures

Although a great deal has been done to reduce emissions of air pollutants, and the air in urban areas is now generally better, the levels of certain pollutants are still so high that they can affect health. This applies in particular to our priority categories of substances: nitrogen dioxide, ozone, particulates and carcinogenic hydrocarbons (certain volatile hydrocarbons and PAHs). However, we know too little about the occurrence of the latter substances, since they are seldom measured and systematic monitoring does not take place. More radical measures are necessary, in particular as regards emissions from traffic and small-scale wood-fired heating.

Various proposals on how to reduce emissions from road traffic have been discussed. These are dealt with in section 3.10.1 on transport. We support the proposals made in various studies of emissions from traffic, but wish to point out that a priority area from the point of view of health is carcinogenic pollutants. Emissions of soot and PAHs are much higher from diesel vehicles than from petrol-driven vehicles, especially compared with cars equipped with catalytic converters, and must be reduced if emissions of carcinogens in urban areas as a whole are to be reduced. Therefore, emission standards that affect emissions of PAHs must be made more stringent for heavy traffic, including mobile machinery.

Apart from general measures such as reduced emissions from road traffic, we also wish to mention positive measures such as improved public transport and an increase in cycle paths in urban areas, increased use of electric vehicles, more car parks outside the city centers etc. See also section 3.10.1 on transport.

Attention must also be given to two-stroke engines and other small engines, e.g. mopeds, mowers, boat engines and snow scooters, which probably emit large amounts of PAHs and light hydrocarbons. The use of electrically operated tools, mowers etc. should be encouraged.

It is estimated that small-scale wood-fired boilers account for at least half of the emissions of PAHs and mutagenic substances that are attributable to combustion. These emissions must be reduced. Even approved boilers emit large amounts of PAHs, tar and mutagenic substances (as well as aldehydes and other irritating substances), and it is therefore essential for health reasons to impose more stringent environmental standards for wood-fired boilers and stoves (see also section 3.10.2 on energy). The burning of garden waste outdoors should be banned in urban areas, since it causes substantial local air pollution that is irritating to sensitive people.

Although emissions from industrial processes and electricity production has been substantially reduced, stringent environmental requirements applying the principle of best available technologies should remain in force (see also section 3.10.3 on industry).

Assessment of the health risks associated with air pollution depends on systematic, long-term monitoring of the air quality in urban areas, especially those with high pollution levels. Taking account of geographical differences and trends over time requires representative measurements of background levels in urban air. However, such measurements may need to be complemented by measurements at points where pollution is particularly high. Measurements at street level should also be included, as well as measurements of the carcinogens ethylene, benzene and benzo(a)pyrene (or other more stable PAH compounds or PAH profiles). It is appropriate that the costs of these measurements be shared so as to involve not only local authorities, but also central government and the traffic sector.

Monitoring of air quality should also cover measurements of respirable particles, PM10. The National Environmental Protection Agency should see to it that new criteria are produced for respirable particles to form the basis of a new limit value.

We propose the following measures (in addition to those mentioned in section 3.10):

- Efforts within the framework of the EU and international air pollution conventions to achieve substantial reductions of emissions of nitrogen oxides and VOCs in Europe with a view to reducing ozone levels.
- Manufacturers, users and relevant authorities should take steps to reduce emissions of PAHs and carcinogenic hydrocarbons from diesel vehicles, including mobile machinery, wood-fired boilers and small engines.
- Local authorities should inform the public of the health risks and nuisance caused by wood-fired boilers and wood burning, and should have the legal possibilities to permanently ban the burning of garden waste in certain areas. (See section 3.10.2 on small-scale wood-fired heating).
- The National Environmental Protection Agency and the local authorities should take steps to improve the systematic monitoring of air quality in urban areas, including the measurement of carcinogens.

3.2 Indoor air

3.2.1 Health risks

In recent decades air quality in non-industrial indoor environments has received increasing attention. Radon, tobacco smoke, formaldehyde and dust mites are examples of exposure factors that affect health.

Hypersensitivity reactions also include non-specific irritation symptoms known as Sick Building Syndrome (SBS). This term refers to various symptoms or disorders caused by buildings, e.g. irritation in the eyes, nose and throat, a feeling of dryness of the skin and mucous membranes, skin redness and rashes, and tiredness, which affect the health of increasing numbers of people. Such symptoms are not unusual in the population as a whole but they are more marked among those who live in sick buildings. The symptoms may disappear once a person leaves the building but return when he returns to it.

Today, more than one-third of Swedish children suffer either from asthma, allergic nasal catarrh or atopic eczema. Last year, approx. 6–8% of children were estimated to be suffering from asthmatic complaints. It is estimated that indoor environments are responsible for 20–33% of asthma and/or lower respiratory tract illness in small

children due to their parents' smoking, 6–26% due to furred animals at home and 12–17% due to defective ventilation.

The changes in the indoor climate in housing, nurseries, schools and offices have been related to SBS, but they are also suspected of being responsible for the increase in allergies. Substantial changes have taken place in these environments during the last few decades. The air change rate is lower due to increased insulation for the purpose of saving energy, without regard to the need for ventilation to compensate for this. Buildings are not cleaned and aired as often as before, and construction materials, furnishings, cleaning chemicals etc. emit organic substances that are not aired out properly where ventilation is inadequate. Inadequate maintenance, care and operation of ventilation systems and the change from boiler heating to electric and district heating systems (which reduce the "chimney effect" in ventilation ducts with natural draught) are other factors affecting ventilation.

The increase in allergies is noticeable mainly among children, and therefore children's environments, i.e. homes, nurseries and schools, are of particular importance in connection with primary prevention. Small children's environments are particularly important in view of their underdeveloped immune systems and the proven correlation between early exposure and later allergic diseases.

60 000–80 000 children are allergic to furred animals and about 500–2 000 people are hospitalized every year because of exposure to furred animals.

Indoor air consists of air from outside containing pollutants from traffic, soil, vegetation and industry. During transport through the input air system some of the external air pollutants are separated but at the same time the air may be polluted by particles, fibres and substances from components such as filters, internal insulation and accumulated dirt in ventilation ducts etc. Any dampness in the system may encourage the growth of bacteria and mildew, which may pollute the input air. Indoors, further pollutants are added by people, animals, activities such as smoking, cleaning and cooking, and additional humidity from showers and laundry. Further pollution is added by open fires, construction materials and furnishings, office equipment, hobby and cleaning articles, microbes etc. The situation is complicated further by the fact that pollutants can be absorbed and emitted from surfaces, chemical conversion occurs in indoor air and particles are deposited on and are swept up from floors and other surfaces during various activities.

The users' behaviour is crucial to the quality of the indoor air, e.g. the frequency with which they clean and air, the number of people in relation to the surface area, their smoking habits, the heating system and activities that are carried on in the building.

A Swedish survey (ELIB – Norlén, Andersson 1993) indicates that the number of problems and symptoms experienced by those who live in tenement buildings is consistently greater than for those who live in detached houses, despite the fact that the ventilation in the latter is generally less efficient. The commonest complaints expressed by those living in tenement buildings were dry air, dust and dirt, draughts, "bad" air and noise. The most common symptom was tiredness, followed by nose problems and headaches.

In 1994, the National Board of Health and Welfare reviewed the local authorities' supervision of defects in indoor environments in schools and nurseries. The local authorities stated that the chief problems were defective ventilation, inadequate cleaning, inadequate maintenance and damp and mildew due to leaks or structural defects.

In 1992, compulsory ventilation checks were introduced (although these do not apply to detached houses with natural draught or extract air ventilation). Many ventilation systems have been checked and repaired where necessary. However, it is estimated that half of the country's schools and nurseries still have defective ventilation.

The correlation between indoor environmental factors and asthma in children is strongest for tobacco smoke, early exposure indoors to pets, defective ventilation, dust mites and "damp buildings". The most important primary prevention factors are therefore the mother's smoking, particularly during pregnancy and breast-feeding, early exposure to furred animals and damp, usually inadequately ventilated housing.

There is plenty of information on the occurrence of allergens from *mites* and *pets* in dwellings, schools and offices. A number of studies have indicated a substantial occurrence of allergens even in environments where there are no animals or mites. Allergens from furred animals are carried by people from their homes to schools and offices, so that the content in these environments is sufficient to maintain hypersensitivity in the airways. The cleaning of schools and offices is a significant factor in this connection. It has been shown that improved cleaning can lower the prevalence of SBS symptoms.

On the other hand, we know far too little about the prevalence of individual, or categories of, *chemical air pollutants, particulates* or *microbially induced substances*. The difficulty of measuring and identifying such substances is so great that at present measurements can only be recommended for research purposes, but not for routine studies.

High *radon* levels in housing and other premises is considered to represent one of the major indoor health risks, particularly in combination with smoking. Radon levels in 70 000–120 000 detached houses and 20 000–80 000 apartments exceed the National Board of Health

and Welfare guideline values for health hazards (a radon gas content of 400 Bq/m^3 of air). In 1993, it was estimated that 35,000 of these units had been identified and 15 000 repaired. Since then more buildings have been identified and repaired, but the statistics are uncertain on account of measures that have been taken without the authorities' knowledge. However, there is still a great deal to be done when it comes to reducing exposure to radon. The National Board of Housing, Planning and Building's limit value for radon gas is 200 Bq/m^3 in new buildings.

About 400–900 cases of lung cancer per year in Sweden (out of a total of approx. 2 700) are probably related to radon in housing. There is a pronounced synergism between exposure to radon and smoking. Most of the victims are smokers, but non-smokers run a higher risk than otherwise. There is every reason to promote measures to reduce the two major risk factors for lung cancer, i.e. smoking and radon in housing.

Tobacco smoke is a very significant risk factor in indoor environments, not only as regards the increase in allergies but also as a cause of cancer and cardiovascular disease. Exposure to tobacco smoke combined with housing affected by damp has been shown to cause a marked increase in asthma and allergies among children. According to a study carried out in 1994, 20% of the inhabitants of Stockholm county state that they are exposed to tobacco smoke at home every day.

It is estimated that 20–30% of juvenile asthma is caused by passive smoking. About 40–80 people a year are assumed to contract lung cancer as a result of tobacco smoke. The fact that exposure to tobacco smoke is a cause of increased cardiovascular disease has a significant effect on public health. The data are less certain in this respect, but they indicate that several hundred deaths every year are connected with tobacco smoke.

It is difficult adequately to describe and estimate the population's exposure to the many substances that occur in indoor environments. The best description of the climate in Sweden's housing is the ELIB survey carried out in 1993, which showed that:

- between 400 000 and 500 000 Swedes consider themselves sufficiently affected by the indoor climate to show symptoms;
- air change rates are low, particularly in detached houses, and do not meet the National Board of Housing, Planning and Building's standard for new buildings and the National Board of Health and Welfare guideline values for health hazards (0.35 litres per second per square metre of floor surface, or 0.5 air changes per hour) in four of five detached houses and in about half of all tenement buildings;

- the radon content exceeds the National Board of Health and Welfare limit value (a radon gas content of 400 Bq/m^3 of air). This means that 200 000–400 000 people live in homes where the radon content exceeds the limit value;
- allergy sufferers and people who live in new, large tenement buildings are most affected by an unhealthy indoor climate;
- the commonest complaints are dry and/or stuffy air, dust and dirt, draughts and noise;
- 10% of all housing has damage caused by damp (on roofs and in attics, apartments and basements) that should be repaired immediately.

Priority problems

Radon, tobacco smoke and sick buildings (damp, inadequately ventilated housing, especially detached houses, schools and nurseries).

3.2.2 Current objectives

No national objectives have been set for indoor environments.

In 1993, the National Radiation Protection Institute presented proposals to the Government on the need of more active measures to combat radon in housing and certain kinds of workplaces. According to these proposals, 80% of buildings with a radon gas content exceeding 400 Bq/m^3 (the present limit value under the Health Protection Act) should be repaired within the next ten years and in the long term the average for housing in Sweden should not exceed 50 Bq/m^3 (as compared with the present average of 100 Bq/m^3).

3.2.3 Proposed objectives

General objectives

No-one should need to risk sickness or symptoms caused by defective indoor environments.

Environmental quality objectives

- Defective ventilation in housing, schools and nurseries should be repaired.
- All housing, schools and nurseries where radon gas levels exceed the guideline values for health hazards (400 Bq/m^3 of air) should be repaired by 2010. Eventually, mean radon gas levels in housing should not exceed 50 Bq/m^3.
- Nobody should be exposed to tobacco smoke against their will.

3.2.4 Discussion of the situation and previous measures

Ventilation

Since there is still great uncertainty about the health effects of the hundreds of different chemical substances that are known to occur in indoor air, steps to improve the ventilation are considered especially urgent.

In 1994/95 the Government allocated approx. 1 billion kronor in grants for various investments designed to repair damage and defects on account of damp and low air quality in housing and premises used by children.

Compulsory ventilation checks, which however do not apply to detached houses with natural draught and extract air ventilation only, were introduced in 1992. In 1996 the National Board of Housing, Planning and Building followed up the compulsory ventilation checks. The system has not been very effective. Checks have also shown that many ventilation systems are defective, often due to lack of maintenance.

In 1993, the Structural Defects Act (1993:320) came into force to ensure better consumer protection in connection with the construction of tenement buildings. The Act is designed to protect the health of residents when structural defects are detected and to allow defects to be repaired quickly without long disputes even where no-one can be held responsible for the costs. The structural defect insurance is valid for ten years from the final inspection of the building.

In 1989, a guarantee was introduced for detached houses for the purpose of repairing structural and material defects that are detected and reported not later than ten years after final inspection.

However, improving ventilation conflicts with the need to save energy. Ensuring that detached houses and apartments are ventilated in conformity with the building standards and guideline values laid down by the Health Protection Act (both provide for 0.35 litres per second per square metre of floor surface, or 0.5 air changes per hour) would require an additional energy supply of approx. 6 TWh, unless heat is recovered to a greater extent. However, it has been estimated that it is possible to increase the level of ventilation to that laid down in the National Board of Housing, Planning and Building's building standards and the National Board of Health and Welfare's general recommendations without any increase in energy consumption by means of heat recovery. Such an improvement in the ventilation situation is estimated to require investments of 62 billion kronor, in addition to an increase in maintenance costs of approx. 3 billion kronor per year.

Studies of the physical work environment in Swedish schools show that by far the most common complaint concerns air. Other common complaints relate to noise, lighting and maintenance. Damp and mildew problems occurs in a quarter of all schools. Only one local authority out of four complies with the provisions of the Health Protection Act.

Many of the current problems affecting indoor environments not only relate to the buildings themselves, but also to their use and maintenance. There is a need for more information about the importance of airing and cleaning and not smoking indoors at home, particularly where there are children. Cleaning in schools is often inadequate and must be improved.

Radon

The National Board of Housing, Planning and Building has received 20 million kronor for 1995/96 for grants to house-owners who wish to reduce the radon content in their houses. A house-owner can receive a grant that pays half the cost up to a limit of 15 000 kronor.

However, despite the grant house-owners have not shown very great interest in doing anything about high radon levels. This may be because they have not received proper information about the grant and because of the difficulty of convincing people of the need to reduce risks, since there is a tendency not to take relatively small and long-term risks seriously. Another factor may be concern that the value of the house may fall, as well as a general reluctance to see the home as a health risk.

Identifying and repairing all housing affected by levels over 400 Bq/m^3 will cost about 3 billion kronor according to estimates made for the Commission by the National Radiation Protection Institute in 1996. The costs are divided equally between measurements and technical

installations. The cost of the latter would average 16 000 kronor per house.

It may be questioned whether it is appropriate to require people to deal with radon in their houses by law. More must be done to increase house-owners' motivation. The sale or purchase of a house may be a suitable occasion to require that radon levels be measured. Compulsory ventilation checks represent another opportunity, although they do not cover the houses where the radon problem is greatest, i.e. detached houses without a mechanical ventilation system. Exposure to radon will decrease as new housing is built. Most houses nowadays are built without cellars, have well-ventilated foundations and mechanical ventilation. The extra cost of building "radon-proof" houses is relatively low.

Although the National Board of Health and Welfare was authorized by the Government to halve the radon guideline value for health hazards in 1990, it is still very high in relation to health protection on account of assessments of what may be regarded as reasonable costs.

It is of the utmost importance that levels of exposure to radon should be reduced. To start with, measures should be taken in buildings where the content exceeds the limit value. A very large number of buildings, especially detached houses, remain to be dealt with. Consideration should be given to the need to lower the limit values still further when further progress has been made in dealing with houses where the radon content exceeds the limit value.

Construction materials

Both the EU construction products directive and Swedish legislation stipulate that buildings that are erected or modified must fulfil a number of essential requirements. These relate to protection with regard to hygiene, health and the environment and protection against noise. Similar requirements apply to construction products and materials.

Construction materials emit chemical substances. Our knowledge of the health effects of most of the substances emitted by these materials is incomplete. By selecting low-emission materials and providing adequate ventilation, health problems can be avoided. Damp can cause such emissions to increase. The most well-known emission problems, formaldehyde from chipboard and emissions from surfacing filler containing casein, are both clearly associated with damp.

The floor industry provides, on its own initiative, product profiles of the content of and emissions from floor materials.

In the Commission's view, the owner of the building should as far as possible select materials that have been tested and for which product

profiles of the content and emissions of potentially hazardous substances have been issued. Such product profiles should cover emissions occurring in connection with use of the materials, in particular the effects of contact with damp.

The National Board of Housing, Planning and Building has been instructed by the Government to prepare a system of quality declarations of buildings that allow comparisons to be made between different types of housing as regards factors that may affect health. A report is to be published in March, 1998. The Commission considers that these declarations should cover ventilation, construction materials, radon and noise.

Improved education and training for key groups, such as architects, local authority administrators in the field of construction, building owners, house-owners etc., is also necessary.

The cuts in staff employed in local authorities and county administrative boards, and the increasing workload in other areas, have made it more difficult to address health protection issues. The local authorities' supervisory responsibility with respect to inadequate indoor environments needs to be extended, as does the county administrative boards' supervision of measures designed to improve indoor environments in their respective counties. In many local authorities and county administrative boards this would require greater resources or a reallocation of priorities.

The significance of the indoor environment for health, both in general and with respect to specific substances, is still insufficiently understood. There is a need of intensified research on health aspects, the chemistry of construction materials and construction techniques and close collaboration between these research areas.

3.2.5 Proposed measures

- Building owners should only use construction materials, including paint, that have been tested and for which product profiles of the content and emissions of potentially hazardous substances have been issued.
- All buildings should be built to be radon-proof.
- A system of declarations for buildings should be introduced covering factors that can affect health, e.g. ventilation, radon, noise and sound insulation.
- An information campaign on the importance of the indoor environment for health, directed at residents, landlords, and relevant authorities in cooperation with local authorities, should be launched by 1999.
- Ventilation should be improved and damage caused by damp repaired in housing, schools and nurseries by upgrading existing ventilation systems so that they operate as intended.
- Incentive grants should continue to be given to the construction industry in order to promote employment and improve indoor environments.
- Investment should be made in the development of technologies for energy-efficient ventilation.
- The current efforts to prevent children from being exposed to tobacco smoke should be intensified by the National Institute of Public Health together with the other parties concerned.
- The National Radiation Protection Institute should be instructed, in cooperation with other authorities, to continue its efforts to motivate house-owners to measure and deal with radon problems.
- High radon levels should not qualify house-owners for lower property taxes.
- Radon profiles in conjunction with the sale/purchase of properties should be introduced without delay.
- Local authorities should be given more resources for supervision and information activities in order to promote measures to eliminate risks in indoor environments, including smoking.
- Development of research on the importance of the indoor environment for health, both in general and with respect to specific substances, should be a high priority. Coordinated multidisciplinary research in the fields of medicine, chemistry, microbiology and structural engineering is the most urgent need.

3.3 Water

3.3.1 Health risks

In comparison with the rest of Europe, Sweden's water supply situation is very satisfactory, since we have many lakes and relatively unpolluted groundwater. Wastewater from towns and the leakage of nutrients from agricultural land can, however, give rise to eutrophication of lakes and bays. The resultant health effects are associated with the massive appearance of toxin-producing algae in connection with *algal bloom*. Dogs and cattle that have drunk such water have on occasion been poisoned. Algal bloom can also cause problems in connection with the production of drinking water and the accumulation of toxins, for example in mussels. Wastewater contains a great many viruses and bacteria and can involve the *risk of infection in connection with bathing* in places near the point of effluent. No specific study has been made of cases of illness caused by contact with bathing water.

The largest cities use surface water as a source of *drinking water* following treatment and chlorination. Altogether, 50% of those who are connected to a municipal source of water are supplied from surface water catchments, 25% by surface water that has passed through gravel ridges (artificial infiltration) and 25% by groundwater. There are about 1 800 groundwater catchments (1 400 of which supply less than 1 000 people and only 160 more than 4 000 people). Normally, groundwater is neither treated nor chlorinated. In addition, there are probably about 400 000 private wells for permanent residents, half of which are drilled wells, and 200 000–400 000 wells in permanent recreation accommodation. The greatest threats to the quality of groundwater as a source of drinking water are, apart from defects in the construction of the well, acidification, leakage of nutrients from agricultural land and proximity to refuse dumps, polluted industrial land and infiltration from drains. Salt water infiltration may be a problem in coastal areas. The risk of water catchments being polluted by diesel fuel or other chemicals in connection with road accidents must be considered when planning water catchments and road routes.

There are frequent reports of *infection via drinking water*. About 2–10 outbreaks occur every year and on average 3 000 people suffer from gastrointestinal diseases caused by bacteria, viruses or parasites. Most of these outbreaks occur in small communities with not more than 16 000 subscribers and are usually due to technical defects, faulty connections etc. as a result of which wastewater infiltrates the drinking water system. Individual wells are also exposed to the risk of infection

through adjacent infiltration ditches for sewerage etc. No system exists for the registration of such infections, but according to the National Food Administration 3–4 incidents are reported every year, although the number of people involved is small.

A special case of transmission of infection via water is Legionnaires' disease in cases where the bacterium *Legionella* has established itself in the hot water pipes and subsequently caused pneumonia through the formation of aerosols in shower rooms or ventilation systems. 25–50 cases of Legionnaires' disease are reported every year in Sweden. The actual number of cases is probably much higher.

There has been much discussion of the risks of *disinfecting drinking water* since it was discovered that undesirable by-products result from chlorination through reaction with humus in the water. The first such substances that were noticed were trihalomethanes, especially chloroform, which has proved to be carcinogenic in animal experiments. Extremely mutagenic substances have also been detected, although the chemistry in such cases has only be partially analysed. Several epidemiological studies have established connections between chlorination and cancer of the urinary tract and the intestines, but the International Agency for Research on Cancer (IARC) has not found the evidence sufficient to classify chlorinated drinking water as carcinogenic for humans. Since many by-products are produced by disinfection, it is difficult to estimate the cancer risks, but on the basis of the selection of substances <1 case per year is probably caused by chlorination in Sweden. In order to minimize the production of chlorination by-products it is essential to treat the water so as to effectively remove organic substances prior to chlorination. In assessing the risks of chlorination or other disinfection, account must also be taken of the risks of inadequate disinfection. The benefits of desinfections far outweights the potential cancer risks.

Pipes of various materials that come into contact with drinking water are at present not properly checked, since no rules have been laid down about type approval and the testing of pipe materials with respect to the leaching out of chemical substances into water. Therefore there are not sufficient data for a risk assessment. Probably, however, the risk of health effects from leached substances is very small. A substantial proportion of the pipes in buildings are of *copper*. Apart from its effect on the taste of the water and the problem of discolouring, reports indicate that increased copper levels in drinking water (approx. 1 mg/l) may cause diarrhoea in small children, although this has not been proved.

A number of epidemiological studies have been carried out, also in Sweden, that show a correlation between the incidence of cardiovascular disease and *soft water* (water with a low content of calcium

and magnesium). Surface water is soft, while groundwater contains more minerals, including calcium and magnesium. Magnesium has been proposed as a protective factor for cardiovascular disease. However, it has not been possible to draw any reliable conclusions about the relevance of drinking water.

The effects of depositions of acid air pollutants have been rather severe, since there are many exposed areas in Sweden where the soil has insufficient buffer capacity, especially in the southwest. As a result, many lakes are acidified, and even surface groundwater has been affected in certain areas. *Acid groundwater* causes the leaching out of aluminium from the surrounding earth, but also of cadmium and other mobile metals. Acid water also aggravates corrosion in copper pipes. The cadmium intake due to acid groundwater is normally very small compared with the food intake, so cadmium will be discussed in the section on food (3.4).

A nationwide study of the *aluminium levels* in shallow wells shows that about 20% of these wells had levels that exceeded the technical limit value of 0.5 mg/l and 10% had levels higher than 1 mg/l. Generally speaking, however, the intake through food is higher than that through water. Absorption from the gastrointestinal tract is low, although it may be higher from water than from food. Any risks associated with an increased intake of aluminium are due to the fact that patients with a severely impaired kidney function have suffered serious attacks of dementia when dialysis fluid containing aluminium has been used. However, in such cases the aluminium goes directly into the blood. Several epidemiological studies have focused on the correlation between the aluminium content of drinking water and the prevalence of dementia. Some of these studies indicate an extra risk at levels of about 0.1 mg/l, but inadequate methodologies make it impossible to draw any conclusions about the causal connections.

The problem of increased *methylmercury content* in fish in Swedish lakes is related to acidification. The associated health risks are described in section 3.4.

Fluorides exist naturally in the Earth's crust, and high levels can occur in wells drilled in rock. Fluorides are accumulated in dental enamel during childhood, but even at the level which is considered the optimum for caries prevention (1–1.2 mg/l) enamel fluorosis can appear in the form of white spots on the teeth, which become discoloured at high levels. At levels exceeding the limit value for drinking water, 6 mg/l, there is a risk of osteofluorosis, which can cause bone injuries through new bone formation. The problem of high levels of fluorides should not be ignored. About 50 000 wells drilled in rock are estimated to have levels higher than the limit value for "fit for drinking with reservations" – 1.3 mg/l – and 1 200 wells have levels exceeding

6 mg/l. However, in this part of the world very few cases of osteofluorosis have been described.

Arsenic also occurs naturally in the bedrock, and in some areas the content in the groundwater is higher than normal. The risk associated with arsenic in drinking water is that it can cause skin cancer. The limit value for water that is unfit for drinking is 0.05 µg/l and for "fit for drinking with reservations" 0.01 µg/l. The lifetime risk of skin cancer at the latter level is estimated by the WHO at $6 \cdot 10^{-4}$. This level was exceeded in 10% and 17%, respectively, of the wells surveyed in two studies in this field. The percentage of wells with such high levels is considerably lower for the country as a whole, and arsenic is estimated to cause 0.3–3 cases of cancer per year.

The radioactive gas *radon* occurs naturally in wells drilled in rock in areas where the bedrock is rich in uranium. The radioactivity in such wells is usually 10–1 000 Bq/l, but levels as high as 10 000–50 000 Bq/l do occur. The National Food Administration's recommended limit value for drinking water is 1 000 Bq/l and 500 Bq/l for "water fit for drinking with reservations". Theoretical calculations done by the National Radiation Protection Institute indicate that radon in water may cause 35–75 cases of cancer per year in Sweden, 10–20 of which are caused by the water itself and the remainder by respiration of radon gas emitted by the water.

High levels of *nitrates* are common in wells in agricultural areas due to the use of manure and artificial fertilizer. The National Food Administration's limit value (10 mg/l of nitric nitrogen, equivalent to 44 mg/l of nitrate) is estimated to be exceeded at least once a year in 10 000 dug wells and 2 000 drilled wells. The limit value relates mainly to the risk of the conversion of nitrates into nitrites in the body, which can cause methaemoglobinaemia in infants, which leads to an oxygen deficit. Another significant factor is the risk of carcinogenic nitrosamines in the gastrointestinal tract. No quantitative estimates of these risks are available, but it is assumed that the number of cases of this disease is very low. Vegetables are another significant source of intake of nitrates.

The problem of *pesticide* residues in drinking water is considered very small in Sweden. Only in a very small number of the wells that were examined were any pesticide residues detected. The greatest risk occurs where the source of the water supply is a dug well in agricultural land or surrounded, for example, by a courtyard where herbicides are or were used, even many years ago.

Summary

To sum up, the risk of polluted drinking water is considered to be moderate, and the transmission of infection is the biggest problem. Since a number of outbreaks of waterborne infection occur every year, often caused by a combination of technical faults and the human factor, better safety thinking is needed. A small risk of cancer is associated with chlorination, and this must be balanced against microbial risks. Attention should be paid to the risks to drinking water from lakes where algal bloom occurs.

Abnormally high nitrate levels in wells in agricultural areas show, however, that groundwater can be affected by external pollution, especially soluble substances. Therefore, it is important to ensure adequate protection of groundwater catchments. This applies in particular to private wells, where supervision and protection may be insufficient at present. Some naturally occurring substances such as fluorides, aluminium, arsenic and radon may occur at abnormally high levels. Radon is considered the greatest of these risks. Research on the uptake and effects of aluminium is important in order to establish whether it involves any risk of Alzheimer's disease or not.

Priority problems

Transmission of infection via drinking water; radon

3.3.2 Existing objectives

- Waterborne releases of nitrogen due to human activity should be halved between 1985 and 1995.
- The existence of pollutants should not restrict the use of water from lakes and watercourses and groundwater as sources of water supply.

Apart from the above objectives, which have been adopted by the Riksdag, the National Food Administration has recommended general requirements ensuring that no pollutants with adverse effects on health should affect the quality of drinking water. The proportion of analysed drinking water samples considered unfit or "fit with reservations" should be reduced by 10% during the period 1995/96–1998.

3.3.3 Proposed objectives

No-one should need to risk sickness caused by water from public or private sources of water supply.

3.3.4 Discussion of measures

In 1995, 100 million kronor was allocated to measures in the water supply and sewerage sector within the framework of labour market measures. The scope of the labour market measures should be extended. In addition, all local authorities should prepare long-term plans for renewal of the water supply and sewerage system.

The design of municipal waterworks must be improved from the point of view of safety in order to prevent new outbreaks of infection. Apart from technical measures, it is extremely important that the staff should be trained in water treatment techniques with special reference to health protection. Where necessary, such training should be improved.

In some cases, municipal water catchments are not located in protected areas, although this is very important. Supervision of private wells is inadequate; in particular, a very large number of wells are infiltrated, at least for a part of the year, by such high nitrate levels from the surrounding agricultural land that the water is considered unfit for drinking.

To encourage private owners of wells to take measures to reduce high fluoride and radon levels, government grants should be paid on the lines of the grants payable for radon in indoor air. The cost of reducing abnormally high fluoride levels in 20 000 wells is estimated at 200 million kronor, and the cost of reducing radon levels in 15 000 wells at 300 million kronor.

3.3.5 Proposed measures

- Local authorities should improve training and technical resources in order to reduce the risk of infection from waterworks and water distribution systems.
- Local authorities should prepare long-term plans for maintenance, renovation and replacement of water supply and sewerage installations.
- Local authorities should inform owners of wells in areas where high levels of radon and fluorides are suspected in the well water of the possibility of installing radon or fluoride separators. Government grants should be paid on the lines of the grants payable for radon.
- Local authorities should inform owners of wells about factors that may affect the quality of water and the measures that can be taken to prevent pollution.

3.4 Pollution in food

3.4.1 Health risks

Many dietary factors affect health and the prevalence of disease. For example, unsuitable dietary habits, e.g. a high consumption of saturated fats and low consumption of fibres, are considered to be one of the most important causes of cardiovascular disease and cancer. A diet that contains a large amount of fruit, vegetables and cereals and a smaller proportion of fats is recommended by nutrition experts. Intake via food is perhaps the most important exposure path for substances that are harmful to health and for sources of infection.

This section deals with the health risks presented by pollutants in food. The transmission of infections is discussed first, and this is followed by a discussion of natural toxins and fungal toxins, permissible additives, pollutants that individuals themselves can partly avoid (nitrosamines, PAHs, mutagens in the surface of fried meat) and, lastly, pollutants that are mostly beyond our control (heavy metals and persistent organic compounds).

Infection can be transmitted by food for various reasons. Defective food hygiene, e.g. incorrect cooling and refrigeration, insufficient heating and low standards of personal hygiene are probably a more

common cause than food that is polluted from the start. The statistics indicate that about 30 outbreaks of such infections occur every year. The number of people affected is about 2 000–3 000. However, the data are very uncertain, and one study estimated that the number may be as high as 500 000.

One area that has been very little studied is *natural toxins* that are present in the plants used for food production. These have developed in the course of evolution as a protection against pests and are now the focus of interest in plant breeding. An example of such a toxin is solanine in potatoes. *Fungal toxins* are also produced in nature and can affect food in conditions where mould fungi grow. An example is aflatoxins, which mainly occur in imported food such as peanuts and figs. Aflatoxins are strong carcinogens. They can pollute milk if feed containing aflatoxins is fed to cows. Little is known of intakes, but aflatoxins may be assumed to cause 1–10 cases of cancer per year in Sweden. Ochratoxin A occurs mostly in domestic products such as cereals, pulses and pork. Ochratoxin A causes kidney and liver damage in laboratory animals and tumours in kidneys, and some epidemiological studies also indicate a connection between a high intake of ochratoxin A and chronic liver damage in humans. Ochratoxin A is very common among Swedes in blood serum at low levels. The recommended daily intake of these toxins is probably exceeded quite often. There are also many other, less familiar fungal toxins.

Three areas that are well-regulated in Swedish legislation are *food additives*, *pesticide residues* and *residues of veterinary preparations*. The latter are assumed to present a very small risk to people in Sweden. As regards *food additives*, colorants have attracted the greatest interest, in particular from the point of view of allergies. According to a British study, 0.01–0.2% of the population, children in particular, are hypersensitive to additives in general. If this is applicable in Sweden too, it would mean that 1 000–20 000 people are hypersensitive. It is estimated that 3 200 people in Sweden are hypersensitive to azo colorants. Aggravated symptoms may affect this group if food containing azo colorants is once again imported after 1999 as a result of Sweden's membership of the EU.

Three categories of pollutants connected with the treatment and preparation of food are nitrosamines, mutagens in the surface of fried meat (heterocyclic aromatic amines) and PAHs.

Nitrosamines are produced in reactions between amines and nitrates or nitrogen oxides, and are therefore to be found in meat products that have been treated with nitrates, smoked and dried food and beer. They can also be produced in the body. Nitrosamines are carcinogenic, and the average intake of volatile nitrosamines is estimated to cause about one case of cancer per year in Sweden.

Mutagens are produced when meat is fried. At high temperatures and with a long frying time the content of these substances increases sharply. These mutagens are extremely active in bacterial test systems and are also carcinogenic in various animals. The risk to humans has been estimated on an experimental basis at 10–100 cases of cancer per year.

Polyaromatic hydrocarbons (PAHs) are produced by incomplete combustion and are, as a group, carcinogenic. The highest levels are found in the following three types of food: grilled and smoked meat and fish products, leaf vegetables grown in areas with high levels of air pollution and mussels grown in polluted water. The largest intake of PAHs via food is on average from cereal products and fats. The data are insufficient for a quantitative estimate of the cancer risk of PAHs, but they may cause 10–100 cases of cancer per year.

Of the pollutants that can be absorbed by humans through food, the ones that are persistent and can be bio-accumulated in the food chain are the most important, since they can cause abnormally high intakes, for example through fish. Some metals and chlorinated organic compounds have attracted most attention. The emission and distribution paths for many of these compounds are not fully understood, and reference is therefore made to "diffuse distribution".

Polychlorinated dioxins and dibenzofuranes (generally known as *dioxins*) are a group of substances with very high acute toxicity, especially tetrachlorodibenzodioxin (TCDD). Many studies have therefore been made, both of their acute toxicity and other specific toxic effects. The toxicity of the various compounds is usually related to that of TCDD in terms of "TCDD equivalents". These substances are formed in trace quantities during various manufacturing and combustion processes. In Sweden emissions of dioxins from waste incineration have fallen sharply since the introduction of more stringent emission standards and flue gas treatment at the end of the 1980s. Chlorine bleaching of paper and chlorine-alkali plants used to be a significant source of releases into water. Dioxins are soluble in fat, and exposure occurs via milk fat, but also via consumption of fat fish from the Baltic Sea or other polluted waters. For those who eat a great deal of fat fish from the Baltic Sea this may be the predominant source. Measurements of dioxins in mother's milk indicate that exposure has been reduced since the 1970s.

Risk assessments of dioxins are based on experimental data from animal experiments with TCDD, since the limited human data that exist are not considered sufficient for quantitative risk assessments. The critical effects are cancer and effects on the immune system and reproduction. The highest tolerable intake is stated to be 5 picograms per kg of body weight per day, which is a factor of 200 under the lowest

level at which effects have been observed in laboratory animals (1 μg=10^3 nanograms=10^6 picograms). Recent data from animal experiments indicate high sensitivity in foetuses, principally in the form of effects on the sexual development of the adult animal. In 1995, a Nordic expert group arrived at the conclusion, however, that it was appropriate to retain the previous risk assessment (1988).

Polychlorinated biphenyls, PCBs, were previously widely used as heat media, plasticizers, colour additives, flame retardants, transformer oil etc. Recently, it has been noticed that as much as 25% of the caulking compound in some buildings consists of PCBs, which may involve a risk of diffusion when such buildings are destroyed. The use of PCBs was banned in Sweden in 1985, but abnormally high levels are still found in environmental samples. As is the case for dioxins, the largest intake is from the consumption of milk fat and fat fish from the Baltic Sea.

The documented animal experiments have used various commercial mixtures of PCBs. Due to breakdown and exchange in nature, these differ from the mixtures to which humans are exposed. Therefore, risk assessments of PCBs are complicated. The critical effects identified in animal experiments are cancer, immunotoxicity and effects on development and behaviour. A Nordic risk assessment of PCBs made in 1992 concluded that the data were not sufficient for a quantitative risk assessment. However, the effects on behaviour were discussed separately, since hyperactivity and impaired learning have been reported in young rhesus monkeys exposed at the foetal stage and during breast-feeding. Similar behavioural effects have been reported in the case of children whose mothers were exposed to PCBs by eating fish from Lake Michigan. The lowest level of slight neurotoxic effects on children is estimated to result from an intake in the region of 0.014–0.9 μg per kg of body weight per day by their mothers during the pre- or postnatal stage. This may be compared with the average intake, which is estimated to be 0.05 μg per kg of body weight per day. Those who eat a large quantity of fish may have considerably higher intakes. Thus, the intake is of the same magnitude as one would expect to cause subtle effects in children exposed at the foetal stage and during breast-feeding.

Some PCB compounds also induce effects similar to those caused by chlorinated dioxins and dibenzofuranes. If the toxicity is expressed in TCDD equivalents, the contribution from the PCBs in fish and mother's milk samples is of the same size or larger than that from dioxins. If the total toxicity of all dioxin-type pollutants is considered, this means that the consumption of fish from certain polluted areas may cause an intake that exceeds the recommended tolerable daily intake of 5 picograms of TCDD equivalents per kg of body weight. The average

intake has been estimated at 2 picograms per kg of body weight for adults. The National Food Administration has therefore issued dietary recommendations to the effect that women of fertile age should not eat fat fish (herring, salmon) from the Baltic Sea more than once a month. The recommendation for men is not more than once a week.

People are exposed also to other persistent chlorinated and brominated pollutants that have been less carefully studied. Examples of such substances are chlorinated terpenes, which were formerly used as pesticides (*Toxaphene*) but due to their persistence and their accumulating properties are now spread all over the earth. Several studies have shown that chlorinated substances with a high molecular weight are present in the fat of marine mammals and fish both in areas that are affected by industry and those that are not. Only a very small part of all the extractable organic chlorine in fish consists of known pollutants such as dioxins and PCBs. Recently published studies indicate, however, that a large quantity consist of *chlorinated fatty acids*. Like dioxins and PCBs, these chlorinated fatty acids are absorbed through the intestine and pass the placenta barrier and are discharged via breast milk. Their acute toxicity is, however, very low. Apart from this, very little is known about the toxic effects, and it is impossible to make a risk assessment of the health effects.

Brominated flame retardants (polybrominated diphenyl ethers, tetrabromobisphenol A, brominated biphenyls etc.) are widely used in the treatment of materials and products, e.g. textiles, computers and TV sets, a variety of plastic products and construction materials. The toxic effects of these substances are not fully understood, and it is therefore not possible to make any risk assessments. Their occurrence and persistence in the environment is, however, a warning signal of potential health risks.

Their long-term potential health risks have caused concern about the occurrence in the environment of organic *pollutants with effects similar to those of hormones*, particularly effects similar to those of the female sex hormone oestrogen. The chemicals that have displayed oestrogen-like effects in various tests are of different types, e.g. certain chlorinated organic compounds, alkylphenols (detergents) and phthalates (plasticizers). Many substances with similar effects also occur naturally. The discussion of potential risks associated with hormone-influencing pollutants is based on the following factors:

- Treatment during pregnancy with high doses of oestrogen can cause serious effects in children later on in life, e.g. deformed sexual organs, and cancer and reproductive disturbances in girls.
- A number of observations in nature indicate that pollutants with oestrogen-like effects may affect the sexual differentiation of

various animals. There are reports that birds, fish and crocodiles in polluted areas suffer from a feminizing syndrome which causes disturbance of the development of male sexual characteristics, the presence of female sexual organs in males, changes in the sexual hormone balance and effects on reproductive behaviour.

- The incidence of diseases or disorders possibly associated with disturbance of the hormone balance has increased in the western world during the last few decades, e.g. a possible deterioration of sperm quality, testicle cancer and deformities in the urogenital organs among men and breast cancer among women.

However, no connection has been established between the effects on humans and exposure to these pollutants. Nor is it clear whether the effects on sexual differentiation that have been observed in animals as a result of exposure to pollutants also occur in humans.

The risks associated with toxic heavy metals to which people may be exposed through food are considered to be highest in the case of lead, cadmium and mercury. Arsenic, aluminium and copper were discussed in the preceding section on pollutants in water.

Lead has been used in large quantities as an additive in petrol and occurs both as an air pollutant and in depositions on growing crops. Since the introduction of unleaded petrol, levels in the air have fallen substantially. Other sources of lead intake, such as lead brazing in tins, have also been reduced. The lead content in the blood of the Swedish population has also fallen since the 1980s and is now generally well below the levels that represent a health risk, 100 µg/l of blood. This is estimated to be the lowest level at which subtle effects in the central nervous system can occur in children in the form of effects on behaviour, learning problems and impaired intellectual ability.

The problems that remain are related to the fact that the ongoing acidification of soil and water may cause an increase in the lead content of water in dug wells and that the soil in urban areas is polluted with lead, as a result of which there is a risk that children can take up lead when playing outside. A study of the lead content in blood among children in the Stockholm region showed a maximum content of 77 µg/l (a median value of 27 µg/l in Sundbyberg and 28 µg/l in Södermalm).

The use of *cadmium* has decreased in various sectors since the ban on cadmium for certain purposes. However, in other sectors, e.g. chargeable batteries, its use is on the increase. The largest emissions occur from the metal industry, the combustion of fossil fuels and the use of phosphorous fertilizers. As a result of the latter use and airborne depositions, cadmium content of agricultural land is estimated to have risen by approx. 0.2% per year. The use of digested sludge also

contributes to the increase in cadmium levels, although, as in the case of artificial fertilizers, there is a maximum permitted level.

Cadmium is absorbed by the roots of plants, and for non-smokers the largest cadmium intake is normally from cereals, in particular wheat, and vegetables. For smokers the largest intake is from tobacco. Shellfish, liver, kidneys and some mushrooms have a particularly high content of cadmium. The health risks associated with cadmium are due to its accumulation in the kidneys, where it has a very long half-life. Kidney damage is also the critical effect.

The normal daily dietary intake of cadmium in Sweden is under the maximum recommended by the WHO (1 µg/kg of body weight per day, i.e. 60–70 µg), but is nevertheless of the same order as the median intake of the population of Belgium (15 µg per day), where 1% of the population is estimated to have an impaired kidney function. The safety margin is therefore much smaller than was previously believed.

The fish in many Swedish lakes have a high content of *methylmercury* as a result of previous emissions from chlorine alkali plants, pulp mills etc. The ongoing acidification makes the situation worse. Airborne depositions mainly derive from foreign sources. The mercury content in pike in about 40 000 lakes is estimated to exceed 0.5 mg/kg of fresh weight, and 1.0 mg/kg, which was the previous limit for blacklisting, in more than 10 000 lakes.

The critical effect of methylmercury is damage to the central nervous system. The risk is greatest for the growing foetus, and slight brain damage may be caused where the mercury level in the mother corresponds to approx. 10–20 mg/kg in the hair. This damage takes the form of impaired psychomotor and neurological functions in children prior to school age, which has been established in test results. The maximum tolerable weekly intake recommended by the WHO, 0.2 mg of methylmercury, corresponds to a content in the hair of approx. 6 mg/kg for adults. However, this intake does not provide sufficient protection for pregnant women. A study of mercury content in the hair of pregnant Swedish women showed that the highest level found was 2.5 mg/kg.

The limit value for fish that is marketed is 1.0 mg/kg for pike, perch, pike-perch, burbot, eel and halibut, and 0.5 mg/kg for other fish. Since many people catch fish for their own consumption and the mercury levels are high in freshwater fish, the National Food Administration has issued dietary recommendations according to which women who are pregnant or breast-feeding, or who are planning to have a child soon, should refrain from eating the above species altogether.

To sum up, food is of crucial importance to exposure to pollutants, in particular persistent substances and substances that can be accumulated in the food chain. Up to now, chlorinated organic compounds such

as dioxins and PCBs and heavy metals such as lead, cadmium and mercury have attracted most attention. Far too little is known about emissions, distribution paths, exposure and the effects on humans of persistent organic substances. Research must be carried out in this area. The suspected effects are subtle, e.g. effects on the immune system, the nervous system, reproduction and foetal development. There is a lack of appropriate animal experiment models for many of these effects. The effects of pollutants on the hormone system is an area where we know far too little, at the same time as the potential risks are serious. Thus there is every reason to try to determine these potential risks.

There is adequate regulation and supervision of additives in food, and the associated health risks are therefore much smaller than in the case of pollutants. A high level of protection must be maintained and unnecessary additives avoided. A problem that has again attracted attention in connection with the recycling of various materials is the risk of migration of undesirable substances from packaging to food.

Many potential health problems associated with pollutants in foods, e.g. bacteria, PAHs, fungal toxins and mutagens in the surface of fried meat, can partly be attributed to handling problems. The National Food Administration has issued handling recommendations in order to minimize the risks. The occurrence of "natural" toxins in food is not an environmental problem per se, but more research is needed in this area.

Priority problems

- Methylmercury in freshwater fish
- Dioxins, PCBs and other chlorinated pollutants in animal products, in particular fat fish from the Baltic Sea
- Cadmium in agricultural land (absorbed by wheat)
- Diffuse distribution of persistent organic substances in the environment
- Chemicals with hormonal effects – need of research
- Transmission of infection via food

3.4.2 Existing national objectives and objectives adopted by agencies

A number of objectives adopted by the Riksdag concern the environmental effects caused by metals or organic environmental toxins. Other objectives have been proposed by the Government in bills or by the

National Environmental Protection Agency. Some of these are referred to below.

The following general objectives have been adopted by the Riksdag:

- Emissions of persistent organic substances should be reduced to such an extent that, by the end of this century, they no longer harm the environment. Priority is given to measures designed to reduce emissions of chlorinated organic compounds from the forest industry. In the long term, persistent organic substances that are environmentally harmful must not occur in the environment.
- The flows and uses of chemicals that are hazardous to health and the environment should be reduced. Flows that nevertheless contain harmful chemicals should be enclosed as far as possible. The use of the most harmful substances should be phased out.
- More efficient collection of end-of-life products containing mercury should be achieved within the framework of an action plan.

The only objective adopted by the Riksdag that was related to a time frame is the following:

- Emissions of mercury, cadmium and lead must be reduced by 70% between 1985 and 1995. Emissions of other important metals must be halved during the same period.

The National Environmental Protection Agency has proposed objectives relating to metals and organic substances. The following are of particular relevance to health:

- It must be possible for mammals and humans to eat fish and shellfish without any risks to health (organic environmental pollutants, cadmium, mercury).
- It must be possible to use cereals, leaf vegetables etc. for food or as basic materials for food without any risks to health.
- The mercury content of fish must eventually not exceed 0.5 mg/kg of fresh weight.
- The cadmium content of wheat kernels must not exceed 0.1 mg/kg of dry kernels.
- The introduction of cadmium to agricultural land, including that from atmospheric depositions, must not exceed removal.

The Government and the Riksdag have instructed the National Food Administration to take measures to ensure food security. This means that food must not contain pollutants in quantities that may be harmful

to human health. The limit values established by the National Food Administration are not to be regarded as environmental objectives. Many other factors are taken into account. If limit values are set at levels that do not ensure protection for all population groups, the National Food Administration complements its recommendations with special dietary advice for special groups. Examples of this are dietary advice to pregnant women regarding freshwater fish in view of the risk of foetal damage being caused by methylmercury. According to its plan of operations for 1995/95 the National Food Administration is to attain the following objectives and take the following measures:

- Action to reduce the risk of infections and poisoning caused by food
- Action to reduce the number of cases of hypersensitive reactions to food.

3.4.3 Proposed objectives

General objectives

- All food should be sufficiently free from pollutants to obviate the need for dietary recommendations.
- No-one should run the risk of being infected by food.

Environmental quality objectives

The general objective as regards methylmercury, cadmium and dioxin-type substances might be expressed in terms of target levels. The National Environmental Protection Agency's environmental objective for *mercury* in fish, 0.5 mg/kg, is, however, not sufficiently low to eliminate the need for dietary recommendations. On the other hand, targets must not be set so low as to be lower than the background level, 0.2 mg/kg. Given this level, 1 kg of fish per week (140 g/day) may be consumed by non-pregnant adults without exceeding the tolerable intake (0.2 mg of methylmercury/week). However, for pregnant women the need of dietary recommendations remains, even if levels in freshwater fish fall to 0.2 mg/kg, since no safe exposure level has yet been established for foetuses. For pregnant women, unlimited consumption of fish containing 0.2 mg/kg of mercury might mean 2–4 times higher exposure to mercury compared with today.

The National Environmental Protection Agency's target for the *cadmium* content of wheat kernels – 0.1 mg/kg – is higher than the average level in Sweden. Since it is important for health reasons to keep the intake of cadmium as low as possible, current levels should be lowered.

As regards *dioxin-type substances*, it is difficult to set a health-related target for the content in fish. We have decided on a level approximately corresponding to that for cod, but about 5–20 times lower than the levels in herring. At this level – 1 ng/kg in fish – the intake even for large consumers should not exceed the recommended maximum tolerable intake of 35 pg/kg of body weight per week, or 2 ng/week for a woman weighing 60 kg. No more than half of the tolerable intake should be derived from fish, since other sources contribute to the total intake, e.g. milk fat. A weekly intake of 1 ng of TCDD equivalents corresponds to consumption of 140 g of fish per day (1 kg per week) if the level is 1 ng per kg. (1 mg (milligram)=10^3 µg (micrograms)=10^6 ng (nanograms)=10^9 pg (picograms)).

- The mercury content in fish caught in Swedish waters must not exceed the background level of 0.2 mg/kg of fresh weight (long-term objective).
- The cadmium content in cereals must not increase from present levels and should eventually drop. The cadmium content of wheat kernels must not exceed 0.1 mg/kg of dry weight.
- The content of dioxin-type chlorinated substances in fish must not exceed 1 ng/kg of fresh weight expressed as TCDD equivalents (long-term objective).
- Infections transmitted by food should be minimized.

3.4.4 Discussion of appropriate measures

The toxic metals and persistent organic substances that are distributed in nature and are now found in fish, crops or milk products, for example, are obvious examples of the need to take measures at the source to prevent diffusion and potential enrichment in nature. Chemical and product control are appropriate instruments. Chemical control must include preparedness for the identification of new problematic chemicals at an early stage. The use of over 90 substances and categories of substances is prohibited or restricted in Sweden. There are restriction plans for several of these substances, e.g. mercury, lead, cadmium and brominated flame retardants. The diffuse distribution of chemicals through products makes it necessary to establish efficient waste disposal systems. International conventions are

necessary on distribution via products and large-scale distribution via air and water. It is therefore essential that these issues are addressed in an appropriate manner to ensure international acceptance of the vital need to take necessary action.

At the fourth Baltic Sea Conference in June, 1995 the ministers of the environment agreed on continuous reductions of releases of hazardous chemical substances to the North Sea with a view to complete elimination within one generation (25 years). The final objective is to achieve levels close to zero for anthropogenic substances. The Swedish Minister of the Environment has stated, with reference to the objectives adopted in the Baltic Sea Declaration, that the ultimate political objective should be to phase out all hazardous substances by 2020, starting with the most hazardous substances.

Sweden's emissions of metals into the atmosphere and water have fallen sharply in the last 10–20 years. This has mostly been achieved by measures at point sources, in particular industrial plants. Emissions of lead to air, which substantially derive from motor traffic, have been reduced by the use of petrol with a lower lead content and, subsequently, unleaded petrol (as of July 1, 1995 only unleaded petrol is on sale). The use of mercury has also been reduced substantially in recent years. The use of cadmium in batteries has increased, while its use has been reduced in other applications.

According to the National Environmental Protection Agency, continued national efforts to reduce the environmental impact of metals should be concentrated, inter alia, on:

- implementing the phase-out programmes for mercury, lead and cadmium and reducing the cadmium content in artificial fertilizer, lime and sludge;
- improving the take-back and final disposal of end-of-life products containing mercury, lead and cadmium;
- examining and where necessary sanitizing waste dumps and polluted areas;
- taking action to reduce acidification.

Foreign sources account for 70% on average of depositions of metals in Sweden. In some cases the contribution from outside Sweden is as much as 90% in southern Sweden. The chief source of cadmium and mercury emissions into the atmosphere is large-scale coal combustion in Europe. Agreements between several countries in Northern Europe provide for a reduction of emissions into water and air of most heavy metals by 50% during the period 1985/87–1995 (Oslo, Paris and Helsinki Conventions). In 1990, the North Sea Conference set a target of 70% for mercury, lead and cadmium. Apart from the general

reduction targets, these agreements contain a number of measures primarily directed at the use and emissions of mercury and cadmium.

The National Environmental Protection Agency's recommendation that the mercury content of fish should not exceed 0.5 mg/kg calls for an 80% reduction in present (1990) emissions of mercury into the atmosphere. Even if the targets set in the abovementioned conventions are achieved by all the parties, the target of 0.5 mg/kg will not be attained. Therefore, the target of 0.2 mg/kg proposed by the Commission for health reasons must be regarded as a very long-term objective. The mercury content of fish will not, according to current forecasts, fall, but may even rise during the next few decades.

The National Environmental Protection Agency's recommendation that the cadmium content of wheat kernels should not exceed 0.1 mg/kg would necessitate a virtual halving of present regional emissions to agricultural land via atmospheric depositions, artificial fertilizer, lime and sludge. At present, atmospheric depositions account for approx. 50% of total emissions to agricultural land. Nor is the target laid down in the conventions for cadmium sufficient to achieve a halving of emissions to agricultural land.

Measures designed to reduce the use and emissions of persistent organic substances are being taken at both national and international levels. Emissions of dioxins and other chlorinated organic compounds from the pulp industry and waste incineration have been reduced substantially. DDT was banned as long ago as 1975, PCBs in 1979 and lindane in 1989. On the other hand, the use of brominated flame retardants is on the increase.

As regards pesticides, in 1986 the Government instructed the National Board of Agriculture, the National Environmental Protection Agency and the National Chemicals Inspectorate to prepare an action plan in order to reduce the health and environmental risks associated with the use of pesticides in agriculture, forestry and horticulture. The "halving programme" has led to a substantial reduction in the use of pesticides. As a result of reviews of existing pesticides every five years, 45 active substances in pesticides have been banned or withdrawn in Sweden since 1986. Several of these substances were banned or withdrawn on account of their persistence.

At the international level, work is in progress within the framework of the Paris and Helsinki Conventions and the North Sea Conference (Esbjerg Declaration) on a reduction of emissions into water and air of several pesticides and other organic environmental pollutants. A protocol is currently being negotiated within the framework of the ECE Convention on Long-range Transboundary Pollution with a view to reducing emissions of persistent organic substances and heavy metals into the air.

The EU's programmes for risk assessment and risk management of new and existing substances are important forums for the adoption of risk-reducing measures for chemicals. The prior notification programme is well established within the EU. Although the programme has not yet been evaluated in detail, it seems to have led to much better documentation of new products from the point of view of health and the environment than was the case for most older products. The programme for existing substances is still at the introductory phase. Under this programme, enterprises must implement risk-reducing measures on the basis of documentation of health and environmental risks. So far, about 40 substances have been investigated and risk assessments and discussions of risk management with respect to these substances are now under way.

Many of the substances that are banned in industrialized countries are still used on a large scale in developing countries, e.g. DDT. These substances are transported on a global scale. A global convention on persistent organic pollutants is being discussed within the UN Chemical Forum. Negotiations are likely to start in 1997.

According to the National Environmental Protection Agency, future environmental health activities should focus on:

- strengthening Sweden's efforts in international bodies
- preventing the marketing of new persistent chlorinated organic compounds
- substituting less hazardous chemicals for hazardous ones
- further reducing emissions from point sources
- improving the handling and final disposal of products, construction materials etc. that contain persistent chlorinated organic compounds.

We wish to emphasize the importance of the efforts being made at the national level. Internationally, the work being done in the EU, OECD and the international marine and air pollution conventions is particularly important. The work in progress on transboundary transport of mercury and cadmium and persistent organic environmental toxins should be intensified. Greater importance should be attached to human health as a critical measure.

The problems and uncertainties connected with organic pollutants are, however, much greater than they are for metals, since this is a very large group of substances, the use and properties of which are only partly understood. There is a lack of knowledge both of the occurrence, distribution, exposure and health effects of many organic chemicals. This applies also to the alternatives to the chemicals that have been identified as problematic. Research in these areas is therefore impor-

tant. Potential health risks associated with pollutants that have hormonal effects have attracted special attention recently and coordinated research efforts are needed to enable a better assessment of the risks.

It is important that the restrictive policy on pesticides and veterinary preparations should remain in place now that Sweden is a member of the EU. Sweden should urge more stringent Community legislation in areas where this is justified for reasons of health or the environment. This applies also to additives such as colorants, e.g. azo colorants, to which many people are hypersensitive and which are banned in Sweden, but which are now liable to enter the country again, involving the risk of rashes for thousands of people.

3.4.5 Proposed measures

- Sweden should make active efforts in the EU and international conventions to bring about more radical reduction measures for heavy metals, especially mercury and cadmium, and persistent organic substances distributed via the air, water or products.
- Work in international forums to reduce the cadmium content in artificial fertilizer.
- The chemical industry should produce alternatives to halogenated persistent chemicals that are biodegradable and involve less health risks.
- Research on substances with hormonal effects is an urgent priority.
- The National Food Administration should improve and expand the information given to households, restaurants etc. in order to reduce the risk of transmitting infections.
- Proof of appropriate education in food hygiene should be a condition for the granting of permission to handle food on a commercial basis.

3.5 Polluted soil

The problem of polluted land areas has attracted increasing attention in recent years. These areas are often associated with abandoned industrial activity in the days when wastewater was released directly into nearby watercourses and waste was dumped or buried close to the plant. Up to

the entry into force of the Environmental Protection Act in 1969, effluents were only treated to a limited extent. A National Environmental Protection Agency report (number 4454, 1995) estimates the total number of such plants at 7 000, i.e. mostly closed industrial plants, but also mines, refuse dumps etc. The long-term objective is to identify, examine and classify all these plants and take the necessary measures. The objective of the action plan is to examine the 200 top priority areas within the next five years and to take the necessary remedial action with respect to half of those considered to be in need of treatment. The total resources needed for the five-year period is estimated at 4.5 billion kronor.

People can be directly exposed to chemical substances that pollute land and water through the mouth, skin contact or respiration of emitted vapour or suspended particles. Indirect exposure through vegetables or fish from polluted areas, for example, must also be taken into account. Small children are a risk group, since they can take in soil while playing outside. The average soil intake among small children has been estimated at 0.1–0.2 grams per day, but children who are particularly inclined to put things in their mouths may take in much more. It is very difficult to estimate the exposure and health risks associated with polluted soil. Guidelines are currently being prepared on the risks both to people and the environment, and these will include recommended values for about 30 substances.

The Government has so far allocated 75 million kronor within the framework of labour market measures for treatment of polluted land.

The Commission does not propose any objectives or measures of its own in this area, but refers to the work in progress at the National Environmental Protection Agency.

3.6 Health risks associated with chemicals in households

The public can be directly exposed to chemicals when handling chemical products or products containing chemical additives. The greatest risk of health effects associated with the handling of chemicals is the risk of acute poisoning (accidents involving children, in particular, see also section 3.9), irritation of the eyes and allergies. Households' use of chemicals can also contribute to the distribution of persistent and hazardous substances in the environment. These substances may subsequently constitute health problems, since they can turn up in food, but also in water and indoor and outdoor air. Such

secondary exposure resulting from the use of chemicals affects not only the user himself but may result in increased distribution in the environment of substances that can cause potential health problems. Another indirect effect is impact on the external environment that can adversely affect the quality of life.

It is difficult to get a clear picture of injuries suffered as a result of the handling of chemicals. As regards chronic effects, it is often hard to see any connection between exposure to a certain substance and an injury. Moreover, there is no comprehensive reporting system like that for medical products. Epidemiological studies are often the only way to find out about the long-term effects of chemicals on people. Obviously, such studies are usually limited to a single substance or group of substances, or a single health problem. It is therefore difficult to obtain an overall picture of the risks of chronic effects associated with the handling of chemicals by private individuals.

The problem of allergenic substances in chemical and other products makes it important to take further measures to reduce the risk of inducing hypersensitive reactions. Rules have been laid down to reduce exposure to nickel. It is also important that manufacturers should be obliged to declare any allergenic additives in products, even if they occur in very low concentrations. This rule is very important to people who are already sensitized, so as to help them avoid exposure to the substance in question.

As already mentioned, we come into contact with a large number of chemical products and other products that emit chemicals during their useful life. The emission of chemical substances often takes place in small quantities to the environment through wear and evaporation. Previously, especially, a substantial proportion of these emissions result from dumping.

The international trade in chemical products also makes it difficult to get a clear picture of the flows of various chemical substances. At the national level there are lists of restrictions based on criteria for hazardousness in environmental and health terms that are designed to reduce the use of certain categories of chemicals. In the long term, these lists also help to reduce the content of certain chemical substances in products.

Attention has focused on *electrical equipment*, in which large quantities of brominated flame retardants and other metals are stored. The use of *plasticizers* in flooring materials and some types of wallpaper is a health concern. Large quantities of these substances are stored in plastic materials and filler. Large quantities of *chemicals used for vehicle maintenance* and lubricating oils are used every year, and large quantities of these substances are spread to the environment, either through negligence or through diffuse distribution. Everywhere,

metals are very widely used. Metal products are worn and corroded, so that the component metals are released. There are a great many different types of *plastics*, often including various additives. Certain types of plastic can be recycled or incinerated without great risk to health or the environment, while it is more difficult to dispose of others safely. Other materials, e.g. *textiles*, are often treated with chemicals that are released during washing.

As mentioned above, the risks associated with the handling of products containing hazardous chemical substances should not only be considered at the individual level. Potential risks can also arise as a result of the large volumes and wide distribution of certain products, and the accumulation of hazardous persistent substances, such as metals or organic compounds. This accumulation causes diffuse emissions in the environment, and the substances concerned subsequently reach people through secondary exposure from food, drinking water and air.

The purpose of control of consumer products should be not to accept any unnecessary risks either in the short or the long term, either of primary or secondary exposure. This applies also to effects on the external environment. The control of chemicals in products should be extended. Since the trade in products is global, an important aspect is international cooperation on chemical control. We must learn more about the health effects and occurrence of chemical substances used in consumer products if controls are to be effective. A continued tightening of the rules on hazardous substances in consumer products, e.g. with respect to product information, handling instructions and safe packaging, and the continuing substitution of especially hazardous substances, represent other important measures.

The Chemicals Committee, which was set up in May, 1996, was instructed to carry out an assessment of the risk panoramas of chemical substances and to submit proposals on objectives and approaches in chemicals policy.

3.7 Noise

3.7.1 Noise nuisance

Noise, defined as undesirable sound, affects nearly everybody. Noise can disturb people's sleep and rest by making it difficult for them to get to sleep and impairing the quality of sleep, which also affects their daily

lives. Noise can also make it difficult to concentrate, to carry on a conversation or to listen to the radio or TV. Very loud noise can wholly or partially destroy the organ of hearing, which can cause isolation and great suffering. Tinnitus and temporary hearing impairments are common consequences of visits to concerts or discotheques, and such impairments can even be permanent. The most common effect of noise outside work, however, is general discomfort and stress.

The adverse effects of noise are thus of different kinds, but not usually directly related to actual illness. However, noise is probably the environmental nuisance that affects most people, and may seriously diminish the quality of life for those whose hearing is impaired by noise.

The main sources of noise nuisance are traffic and noisy neighbours. Several studies undertaken in various municipalities indicate that about 5–10% (400 000–900 000) of the population are significantly disturbed by traffic. About 2–6% (200 000–600 000) of the population are thought to suffer greatly from noisy neighbours. The corresponding figure for industrial noise is 1–2% (100 000–200 000 people).

About 1.5 million people are estimated to be exposed to noise levels from the traffic outside their homes that exceed 55 dBA, the long-term target proposed by the National Environmental Protection Agency. The percentage of those suffering exposures above this level was previously higher, about 3 million, but has fallen thanks to the noise abatement measures that have been taken and the re-routing of major thoroughfares (e.g. European roads) to bypass urban areas. However, many more noise abatement measures must be taken before the long-term objective is achieved.

The National Board of Health and Welfare's guideline value for indoor noise is 30 dBA equivalent sound level (continuous noise). The guideline value for maximum sound levels is 35–45 dBA. There are varying guideline values for low-frequency noise depending on the frequency.

Priority problem

Noise nuisance caused by traffic and noisy neighbours.

The reason for this prioritization is that even if noise nuisance does not cause serious illness, it affects many people by seriously impairing their quality of life.

3.7.2 Existing objectives

In 1994, the Riksdag adopted an action plan against noise based on the report (SOU 1993:65) which dealt with all kinds of noise problems. The general objective that was proposed was:

"Noise nuisance should be reduced substantially both with regard to noise levels and the number of people exposed to noise."

The debate on the action plan against noise in the Riksdag showed that there is general agreement on the need for vigorous measures against noise in our surroundings in order to ensure a good environment without adverse effects on health and well-being.

3.7.3 Proposed objectives

The general objective adopted by the Riksdag in 1994, together with the specified target, should be complemented so as to include both the National Environmental Protection Agency's guidelines and the National Board of Health and Welfare guideline values for indoor noise, including low-frequency noise.

General objective

Noise nuisance should be sharply reduced.

Environment quality objective

The noise levels in urban areas *and in indoor environments* must not exceed present guideline values. (The objective adopted by the Riksdag in 1991 should be extended so as to include indoor noise.) Noise levels in urban areas should thus not exceed 55 dBA equivalent sound level. The maximum level indoors should be 30 dBA equivalent sound level.

3.7.4 Discussion of the situation and previous measures

In conjunction with the adoption of the action plan against noise in 1994 a number of tasks were assigned to responsible authorities. The plan defines a good sound environment as a 24-hour mean not exceeding 40–45 dBA in urban areas. The orders included measures to reduce noise and to produce data on which to assess the effects of the noise. The National Environmental Protection Agency was entrusted with several tasks and is now collaborating with the other parties concerned in the preparation of an action plan against noise in the external environment. The general purpose of this plan is to coordinate noise abatement measures in various areas, e.g. road traffic, rail traffic, air traffic, and work and housing environments. The responsibility for the measures lies with the various sectoral authorities (the National Road Administration, the National Rail Administration, the Civil Aviation Administration etc.) and the National Environmental Protection Agency's role will be to stimulate and coordinate these efforts.

The National Environmental Protection Agency has proposed environmental quality targets for noise from road traffic, rail-bound traffic and air traffic. The equivalent outdoor noise levels from these sources should, according to the National Environmental Protection Agency, eventually not exceed 55 dBA.

In 1996, the National Board of Health and Welfare adopted guideline values for health hazards with respect to indoor noise, including values for low-frequency noise and high noise levels during concerts and at discotheques. The guideline value for indoor noise is 30 dBA equivalent sound level (continuous noise). The maximum recommended noise level for discotheques, concerts etc. are an equivalent level of 100 dBA, with 115 dBA as the absolute maximum.

The building standards issued by the National Board of Housing, Planning and Building limit the sound level from installations in buildings to a maximum of 30 dBA in bedrooms and drawing rooms and 35 dBA in kitchens.

Together with the interested parties in the housing market, the National Board of Housing, Planning and Building has elaborated a voluntary sound classification system for housing, which has resulted in a Swedish standard (SS 025267) for rooms in buildings, which is designed for use in evaluation of the sound climate in residential buildings. The classification can be used both for new buildings and in conjunction with modernization and offers consumers the opportunity to take sound levels into account when choosing their home. The Board

is promoting the implementation of this standard in the other Nordic countries.

Furthermore, the Board has adopted new standards for noise from installations in buildings and in bedrooms and drawing rooms. It is now working on a revision of the standards for airborne and impact sound insulation in housing.

To start with, attempts should be made to reduce noise at the source, for example by finding technical solutions that reduce noise generation and persuading people to adjust their behaviour so as not to make unnecessary noise. The next step is soundproofing where noise levels are still too high. Obviously, noise abatement measures are hampered by the fact that they are often expensive, particularly measures to reduce the noise from road traffic (noise barriers in the form of banks, insulation of fronts, windows etc.).

Another obstacle is the problem of cost responsibility. There is also a conflict between ventilation and noise. Increased ventilation can increase the air speed in ventilation devices, which may in its turn increase noise. Fans can cause low-frequency noise and people sometimes avoid opening the window and air valves because of the risk of noise. Properly built and maintained ventilation systems reduce the risk of noise from fans etc.

In a report on the cost of achieving outdoor levels of 65 dBA (equivalent sound level) compiled for the Commission in 1996 the National Environmental Protection Agency estimated the cost at approx. 3 billion kronor. The cost of noise abatement measures for road traffic is estimated at approx. 2.2 billion kronor and for rail and air traffic at approx. 500 and 160 million kronor, respectively.

The Government has allocated 50 million kronor to noise abatement measures as a combined labour market and environmental improvement measure. These funds are to be used primarily to replace windows or insert extra panes and to build noise barriers. The grants represent 25% of the costs. Residential buildings in districts where external noise levels exceed 65–70 dBA are eligible. Measures taken indoors can reduce levels by 10–15 dBA (applications for about 600 units have so far been submitted), at the same time as employment is provided at the rate of about four man-years per million kronor.

3.7.5 Proposed measures

- Traffic should be planned to take noise factors into account.
- Building owners should guarantee adequate sound insulation both between flats and against external noise.
- Property owners should ensure that fixed installations do not cause a noise nuisance.
- Labour market measures should continue to be applied to reduce exposure to noise.

3.8 Ionizing and non-ionizing radiation and electric and magnetic fields

3.8.1 Health effects

Ionizing radiation means all forms of radiation that can cause ionization in biological material and thus cause damage. Ionizing radiation originates from both natural sources (cosmic radiation, outer space, radioactive substances in the human body and radon) and from man-made sources such as X-ray equipment and nuclear reactors.

Non-ionizing radiation cannot damage biological material through ionization. However, it can cause damage through other processes, e.g. photochemical reactions and heat build-up. Non-ionizing radiation includes ultraviolet radiation, microwaves, radio waves and low-frequency electric and magnetic fields (<400 kHz).

People suffer acute injury through ionizing radiation only if the radiation doses are so high (1–10 Sv) that they can only occur in connection with accidents or unsuitable management of strong man-made radiation sources. In Sweden, the average annual radiation dose is under 4 mSv from both natural and man-made sources. Radon in buildings accounts for about half of this dose.

Radon causes 400–900 cases of lung cancer per year and is considered one of the major environmental health risks, particularly when combined with smoking. See section 3.2 for a further discussion of radon.

Malignant melanoma (a form of malignant skin cancer) is the form of cancer that is increasing most rapidly in Sweden at present. On average, the prevalence of malignant melanoma has increased during

the last two decades by about 5% per year and mortality has increased by 3% per year. This increase is attributed to modern sunbathing habits. UV radiation is estimated to cause 1 200–1 300 of the 1 400–1 500 cases of malignant melanomas every year, and of these about 300 cases lead to death. UV radiation also causes other types of cancer, e.g. squamous cell carcinoma, the prognosis for which is, however, much more favourable. The unfavourable trend as regards malignant melanoma may deteriorate still further if solar radiation increases in intensity due to depletion of the ozone layer. The use of solaria is also suspected of increasing the risk of malignant melanoma.

The health risks associated with the operation of *nuclear power plants* and the disposal of radioactive waste are normally very low. However, the potential risks in connection with accidents, war and sabotage are high. It is of the utmost importance that present safety levels be maintained. The radiological environment is subjected to extensive and continuous monitoring, which has primarily been set up in order to strengthen our preparedness for nuclear accidents in Sweden and abroad.

Several studies indicate a connection between exposure to *magnetic fields* and cancer, leukaemia in children in particular. Although this appears plausible, it is generally agreed that this is not a major problem in quantitative terms. Based on risk assessments reported in Swedish studies, a few cases (<10) of leukaemia in children per year may be attributed to exposure to magnetic fields.

Several thousand people in Sweden complain of various types of symptoms caused by electrical equipment, "electric hypersensitivity". There is so far no scientific proof of any connection between such symptoms and electric/magnetic fields.

Further research must be done on the mechanisms causing cancer and other effects.

Priority problems

Radon (see section 3.2) and UV radiation

3.8.2 Objectives

Existing objectives

There are no national objectives relating to radiation at present.

Proposed objectives

The prevalence of malignant melanoma must be reduced.

3.8.3 Discussion

Information on the need of protection, particularly for small children, from sunburn and unnecessary exposure to UV radiation has been given for ten years and must continue.

Because of the suspicion of a connection between exposure to electric/magnetic fields (EMF) and certain forms of cancer, the responsible government agencies have prepared a precautionary strategy, according to which exposure to EMF, apart from natural levels, should be avoided as far as is technically and economically possible. In other words, housing should not be built near existing power lines and other major sources of electric/magnetic fields, new power lines should not be routed near existing housing and efforts should be made in general to reduce exposure at work, in the home and in schools and nurseries as far as is technically and economically possible.

Despite extensive research into the potential health effects of EMF, the connection between EMF and health effects has so far not been proven. Further research in this field is necessary, both with regard to low- and high-frequency fields (created by power lines, mobile telephones and other electrical equipment).

3.8.4 Proposed measures

- Information should continue to be given on the risks of sunbathing.
- Safety regulations for nuclear power plants and radioactive waste must be stringent, and Sweden should make efforts to ensure high safety levels in neighbouring countries.
- Further research on the health effects of exposure to electric/-magnetic fields is an urgent priority.

3.9 Injuries

Injuries as a result of accidents are a major public health problem. In Sweden, accidents are the commonest cause of death among children and young people. Every year about 3 000 people die and 900 000 people visit a doctor as a result of accidents, and of these 140 000 are hospitalized.

Most injuries occur in the home or nearby. Most of those injured in the home are children or elderly people. Among the elderly, falling accidents are the main cause of injury.

Transport accidents in Sweden have in recent years caused about 600 deaths per year. The number of people injured is not known precisely, but it is estimated to be between 60 000 and 80 000 per year. The number of people who are hospitalized as a result of traffic accidents is estimated at 12 000–15 000 per year. Between 2 000 and 2 500 people are disabled every year. Children and adolescents are a particularly vulnerable group in this connection. For children and adolescents, traffic accidents represent the largest cause of death of all accidents. Unprotected road-users also run substantial risks in traffic. About 200 unprotected road users die every year. Most of these are pedestrians and cyclists, and about half of them are over 65. Injuries sustained in traffic accidents account for 10% of all injuries. 15–20% of injuries occur in conjunction with sports activities, about 8% in recreational areas and 7% in schools.

The number of patients treated in hospital for poisoning in 1993 was about 3 200, mainly from over-dosing of medicine and drugs. About 800 of those hospitalized for poisoning were children. Children are involved in accidents with chemicals about as often as with medicines, although only a few children every year show serious symptoms. The risks have been noted and measures taken, e.g.

substitution of products, product information and childproof packaging. However, it is important to pursue the efforts to reduce the risk of accidents among children.

Experience shows that a great deal can be done to prevent injury. In the last ten years, total mortality from accidents in Sweden has fallen by about 10%. The greatest reduction has been in fatal accidents among children. The number of traffic accidents and occupational injuries has also fallen. However, injuries are still the most common cause of death among children, adolescents and young adults. The number of people injured so seriously that they must be hospitalized has not decreased correspondingly.

An intersectoral national injury programme has existed since the end of the 1980s, and there are also regional and local injury prevention programmes. However, we still do not have a complete picture of the extent of injuries. This is mainly because the available statistics on causes of death and inpatient care do not provide sufficient data and because injuries are not always registered in outpatient care.

The responsibility for injury prevention is divided between many different players such as political decisionmakers, manufacturers with product responsibility and a large number of central and local government authorities. This divided responsibility makes it necessary to coordinate efforts and ensure effective exchanges of information between the parties concerned. This applies in particular to the health services' information on injury patterns, risk situations, risk environments, risk behaviour and risk products.

In several counties, injury action plans have been prepared as a concerted effort between the regional and local levels. In some counties the inhabitants can report accident risks to a contact in their municipality via the "risk hotline". The risk hotline enables the public to help in the documentation of hazardous environments and products.

The National Institute of Public Health is responsible for the development and coordination of the natural national injury programme that was launched at the end of the 1980s. This programme is based on intersectoral commitments at the local, county and central levels and close liaison between government agencies, research institutions, voluntary organizations and local authorities and county councils.

Priority problems

Accidents in the home and the immediate vicinity in conjunction with recreation and traffic accidents.

3.9.1 Existing objectives

In 1984 Sweden adopted the WHO's health strategy "Health for All". One of the objectives of this strategy was to reduce the number of deaths caused by accidents by 25% by the year 2000. A revision adopted in 1991 extended this objective to a corresponding reduction of injuries and disabilities as a result of accidents. The Swedish national injury programme is the vehicle for achievement of this objective. Several regional and local health programmes have also adopted the objective.

The Riksdag has adopted road safety objectives, the purpose of which is to reduce continuously the total number of deaths and injuries in traffic, the top priority being unprotected road users. The National Road Safety Programme has adopted quantitative targets, i.e. the number of deaths per year must be reduced to a maximum of 400 and the number of seriously injured people to 3 700 (the National Road Administration, the National Police Board, the Swedish Association of Local Authorities: the National Road Safety Programme 1995–2000, 1994). Subsequently, the National Road Administration formulated a "zero future", in which future operational strategy is described as follows: "The road transport system must be designed in such a way as to ensure that human errors and the consequences of these errors do not cause death or permanent ill-health. The responsibility for this rests on those who design the system."

3.9.2 Proposed measures

The registration of injuries that takes place today in inpatient care under the international classification of diseases (ICD) method does not provide sufficient information about the circumstances in which accidents occur. The ICD method records information about the cause of injury, but does not state where the accident took place or other important circumstances. The National Board of Health and Welfare has therefore drafted another registration system based on the Nordic NOMESKO classification, for use both in outpatient and inpatient care. However, due to the lack of time and staff, as well as of the necessary legislation, it has been difficult to implement this system.

The measures proposed by the National Institute of Public Health include the following:

- A uniform injury registration system both for outpatient and inpatient care, including information on the place of the accident, the course of events and what the injured person was doing at the time
- Intensified efforts in schools and among young people, including young adults
- The testing of models for safe municipalities, particularly in urban areas
- Further improvements in road safety and occupational safety.

So far, the work environment and the transport sector have received most attention as regards injury risks. However, today most injuries occur in the home or in conjunction with recreation. There are no clearcut supervisory responsibilities or strategies for preventive measures in this area. The National Board of Health and Welfare has proposed that the Health Protection Act should be made applicable to injuries caused by accidents in the home or in conjunction with recreation. This solution would make the local authorities responsible for monitoring accident risks in such environments and taking appropriate action.

- The health services should, both with respect to outpatient and inpatient care, register cases of injury, including information on the place of the accident and the course of events.
- Continued support should be provided for the national injury programme.
- Local authorities should monitor accident risks in the home or in conjunction with recreation and take appropriate action where necessary.

3.10 Sectoral measures

Sectors in this context are understood to mean divisions of society along economic lines. The Riksdag has on several occasions established the principle that each sector must accept environmental responsibility. This principle has been expressed in several connections:

- The players in any sector should take responsibility for preventing and solving existing environmental problems.
- The central agencies should coordinate, initiate and follow up measures in the various sectors.
- Environmental considerations must be integrated into all sectors, which means that environmental and economic aspects are to be integrated in planning and decisionmaking. This must take place at all levels.

Sectors are not a uniform concept, but they coincide with the groupings generally made by trade organizations and ministries. The Commission's terms of reference relate mainly to risk factors, and this report therefore contains very little discussion of sectoral activities. In many cases the main thrust of our proposals was set forth in the earlier sections of this chapter.

Those who engage in any activity, for example commercial operations, are also responsible for preventing any effects of this activity that are harmful to the environment or health. In response to the demands of environment-conscious consumers, industry has reduced emissions, produced environmentally more benign products etc. largely on its own initiative. Banks, insurance companies and other financial investors have also shown an interest in companies' environmental status. The ambition of integrating environmental and health considerations into activities in all sectors has also gained international acceptance.

Several environmental issues have become important to the market and are dealt with by different methods in different companies. The companies have also realized that it is important to have a carefully thought-out environmental policy at all levels. In recent years, instruments and programmes have been developed for the organization, planning and evaluation of companies' voluntary environmental health activities. Many companies coordinate their quality work with matters relating to the work environment, health and the external environment.

Environment-conscious consumers' demands for good environmental quality have also resulted in a number of concrete measures being taken by the companies both with respect to goods and services. Environmental audits and balances as a means of enhancing competitiveness, public and private procurement procedures specifying environmental standards for goods and services and "ecological" trademarks are some examples.

In most cases, the focus has been on environmental effects, but low emissions during production and product development, which lead to cleaner products, often also help to reduce health risks.

Producer responsibility for and interest in minimizing harmful effects on the environment or health is embodied unambiguously in the general precautionary rules in the legislation on chemicals and the Polluter Pays Principle, which all OECD countries now recognize. We wish to emphasize that it would be a good thing if similar rules applied to products other than chemical products. The legislation on product safety obliges producers to take responsibility for the safety of a product. Producers should take the necessary precautions to prevent health risks in connection with the normal use of their products.

Producer responsibility and the takeback obligation mean that producers must take back end of life products and see to it that they are recycled or safely disposed of. Statutory product responsibility already exists for certain products.

Under the Waste Disposal Act, one purpose of product responsibility is to ensure greater awareness of a product's environmental impact, since the producer must accept responsibility for the product at the end of its life. The Government's view is that producers should assume greater environmental responsibility for goods and services. In our opinion, producers should take the necessary precautions to prevent health risks and diffuse distribution of chemicals during the use of products. A useful instrument for this purpose is the use of lifecycle analyses that take health aspects into account.

Voluntary environmental labelling of products is becoming increasingly common for certain product categories. Health benefits are not the primary aim in this connection, but are often a side-effect.

Sections 3.2–3.9 contain proposals on objectives and measures relating to many problems that are important from the point of view of health on account of various substances and processes in the outdoor air, indoor environments etc. In this section we will summarize measures recommended for specific sectors.

3.10.1 Transport

From the point of view of health, measures relating to road traffic are very important on account of the large volumes involved and the fact that a large proportion of emissions from traffic occur in urban areas. Moreover, because of the large volumes involved, road traffic is a major source of diffuse distribution of chemicals.

One of the principles of current traffic policy is to promote efficient transport systems as a means of increasing general prosperity, and transport systems must therefore be improved. At the same time, the transport sector must satisfy basic environmental health requirements.

The sector must commit itself to attaining environmental objectives and putting sustainable transport systems in place.

Now that Sweden is a member of the EU, its emission standards for motor vehicles must be adapted to Community standards. The standards so far adopted by the EU are similar to those applying in Sweden today. Within the next five years, new standards will be adopted that will require substantial improvements as regards emissions from motor vehicles, including more stringent rules on emissions of nitrogen oxides, hydrocarbons, carbon monoxide and particulates. An agreement on a 15% reduction of fuel consumption is being discussed by the European Commission and the car industry.

Many measures have been proposed by various commissions appointed to investigate the environmental problems caused by traffic. Here are some of the most important from the point of view of health:

- Improvement of competitive conditions for environmentally sound public transport and measures designed to influence transport needs. New economic incentives and improvement of public road and rail transport systems.
- Improvement of the competitive conditions for goods traffic by rail and sea.
- Restrictions on road traffic in vulnerable areas.
- Measures designed to modify driving habits and speeds with a view to environmental improvement.
- Technical improvement of vehicles, fuels, aircraft, ships and mobile machinery.
- Introduction of environmental zones, including a system of charges or special environmental standards for vehicles permitted to use the zones.

All the measures taken in order to achieve the declared environmental objectives should be designed in such a way as to promote good health. In particular, measures designed to reduce the consumption of fossil fuels, e.g. increased fuel efficiency, must not involve an increase in the number of diesel-driven vehicles, which aggravate the problems of noise, nitrogen oxides, particulates and carcinogens.

From the point of view of both health and the environment it is essential always to choose the most energy-efficient means of transport for long-distance transportation. The increased use of motor vehicles with very low or zero emissions of substances that are harmful to health, and of electrically operated mobile machinery and tools, should be encouraged in order to reduce both air pollution and noise.

The general objective from the point of view of health should be to reduce injuries and noise and the impact on health of exhaust gases. To

achieve this, the conditions for public transport and pedestrian and cycle traffic must be improved. Urban planning measures, environmental zones, road tolls and economic incentives are important instruments in reducing road traffic.

Large-scale trials have been carried out in several countries with the gradual introduction of restrictions on road traffic, and these have resulted in increased use of public transport, a lower rate of injury and in some cases a reduction of air pollution.

It is also important that traffic systems should be designed in such a way as to improve the quality of urban life. The purpose of the Community network Car Free Cities is to greatly reduce the traffic in European inner cities by the introduction, inter alia, of environmental zones and road tolls of various kinds. There has been discussion in Sweden in recent years of various types of restrictions on road traffic, e.g. car-free city centres and environmental zones where more stringent vehicle standards are applied.

It is essential to provide the traffic sector, county administrative boards, local authorities and all other parties concerned with the instruments in the form of legislation and economic incentives/ disincentives, e.g. tolls and zones, that are necessary to improve the health and environmental situation.

Lower speeds in metropolitan areas usually bring environmental benefits, while also reducing the number of accidents and noise from traffic.

Voluntary environmental labelling and product profiles for boat engines, snow scooters and small mobile machinery (e.g. lawn mowers) should be encouraged and are the subject of legislation that is being drafted or has been proposed (SOU 1995:97, Ds 1995:59).

Motor vehicles are mass-produced products that require a good deal of maintenance and use a large number of auxiliary chemicals and spare parts. Wear, leaks and unsatisfactory disposal of environmentally harmful consumer goods are a major source of diffuse distribution of hazardous substances. For this reason, it is important to obtain a comprehensive picture of the impact of traffic as a source of diffuse distribution of pollutants.

Our proposals

Section 3.1 on outdoor air contains a discussion of general objectives and measures designed to improve air quality. The following proposals relate specifically to traffic:

- Within the framework of their sectoral responsibility the traffic and transport authorities, in particular the National Road Administration and the local authorities, should take the necessary measures in order to achieve and evaluate the national health-related objectives relating to air pollution and noise.
- The relevant legislation should ensure that county administrative boards and local authorities have the necessary instruments in the form of legislation and economic and other incentives to be able to achieve the environmental health objectives in areas with heavy traffic.
- The use of vehicles with very low or zero emissions, and of electrically operated mobile machinery, should increase.
- The traffic and transport authorities should study the diffuse distribution of hazardous substances, apart from emissions of exhaust gases, and propose appropriate measures.
- Quality of life should be taken into consideration in conjunction with traffic planning, e.g. by encouraging pedestrian and cycle traffic.

3.10.2 Energy

From the point of view of health, *hydro power* and *solar and wind energy* are good sources of energy.

Oil-fired heating has lost ground in recent decades to electric heating. Emissions from domestic oil-fired heating are relatively small, provided that the equipment is properly maintained and the sulphur content of the fuel is low. Large energy production plants using coal or oil that are operated on a continuous basis produce low emissions of air pollutants per energy unit produced. However, the combustion of fossil fuels such as oil, coal and natural gas cause emissions of carbon dioxide into the atmosphere, which contributes to the greenhouse effect.

Nuclear power only accounts for very small emissions of radioactivity, but the Chernobyl accident ten years ago taught us that a reactor accident can have serious and long-term effects. It is therefore extremely important to maintain a high level of security in Sweden's nuclear power plants and ensure that radioactive waste is safely disposed of. Technical and financial assistance for improving security in nuclear power plants should be an element of the development aid given to countries in Eastern Europe.

The expansion of the district heating systems for the heating of towns in Sweden have contributed greatly to the improvement of air quality. Combustion in large, well-controlled plants ensures relatively small emissions of carcinogenic organic substances and, provided that they are treated, emissions of metals and sulphur and nitrogen oxides can be kept at low levels.

The method of heating that now accounts for much the largest emissions of particulates and carcinogens is *individual small-scale wood-fired heating*. Small wood-fired boilers in densely populated areas can also be a nuisance to those living nearby due to the noxious smell and irritation of the airways. The National Board of Housing, Planning and Building's building standards contain limit values for emissions from wood-fired boilers in connection with replacement and new installation. These values are 30 mg of tar/MJ of fuel for manual fuelling and 500 mg of CO/m^3 for automatic fuelling. One problem is that the existing rules do not apply the same standards to older houses as to newly-built houses, which would be desirable in areas with high air pollution levels.

Consequently, we are in favour of efforts to introduce more stringent standards for emissions from individual wood-fired boilers using biofuels. The emission standards proposed by Sweden for adoption as CEN standards probably go as far as is feasible at present, but they are still not satisfactory in the context of health. Even if all wood-fired boilers complied with the National Board of Housing, Planning and Building's emission standards, they would cause emissions of particulates that are almost on a par with those from traffic. Only about 5% of domestic wood-fired boilers are equipped with environmentally approved combustion technology.

An increase in the use of wood (biofuels) for heating purposes should, in urban areas, be accompanied by a corresponding increase in the proportion of heat supplied by district heating plants or medium-sized distribution boards, the emissions from which are lower than those from individual boilers. Otherwise, wood-fired heating is likely to remain a major source of air pollutants (particulates and carcinogens) in urban areas.

Gas stoves in households can emit high levels of nitrogen oxides, and good ventilation is therefore essential.

Since many homes, schools and nurseries suffer from inadequate ventilation (see section 3.2.1), there is a potential conflict between the need of good ventilation and the need to save energy. Ample supplies of (cheap) energy are essential to human health and well-being. If all buildings were ventilated in accordance with the standards established by the National Board of Housing, Planning and Building for new buildings – 0.35 l/s per square metre of floor area – the additional

energy requirement would amount to approx. 6 TWh. This corresponds to about one nuclear reactor and may be compared with the total energy consumption of the household and service sector, which is 150 TWh. It is therefore important to develop systems that comply with the ventilation norms while being energy-efficient. Continued investment in the technical development of energy-efficient ventilation is important.

Proposed measures

Section 3.1 on outdoor air contains a discussion of general objectives and measures to improve air quality. The following proposals therefore only deal with wood-fired boilers.

- Emissions from wood-fired boilers should be reduced substantially in densely populated areas by a changeover from individual heating to heat supplied by district heating plants or medium-sized distribution boards using biofuels.
- The general emission standards for wood-fired boilers should be more stringent than those currently in force.
- The Health Protection Ordinance should allow local authorities to prohibit small wood-fired boilers or the use of certain boilers in some areas.

3.10.3 Industry

Direct emissions from industrial plants have decreased substantially in the last few decades, and the environmental efforts of both companies and authorities now focus on preventive rather than corrective measures.

The use of environmentally harmful chemicals has been reduced, both in industry as a whole and in individual products. The principle of substitution, the purpose of which is continuous improvement in terms of environmental health, is applied in the legislation on both the work environment and environmental protection. The characteristics and use of products are of increasing environmental importance compared with the production phase. Present and future health risks are largely associated with the diffuse distribution of chemicals in products during use and final disposal.

Producer responsibility is one of several means of achieving cleaner production of cleaner products. The purpose is to ensure closed cycles of material flows and better utilization of residues. This would minimize the quantities of residues that must be disposed of.

The current waste disposal legislation provides for producer responsibility for packaging (plastics, glass, aluminium, steel plate, paper, corrugated cardboard and board), newspapers and car tyres, and obliges producers to take back end of life products and see to it that they are recycled or safely disposed of. Statutory product responsibility already exists for certain products. Proposals have been presented or are being discussed that would extend producer responsibility to construction and demolition wastes, end of life electrical equipment, textiles, furniture and motor vehicles. There is also a form of "voluntary" product responsibility for nickel-cadmium batteries.

The trend in industry towards quality criteria, and standards for quality and quality management standards will have a favourable effect on environmental efforts as a whole. Another important factor is the use of environment audits as means of improving the environment. Lifecycle analyses also establish the environmental impact at all stages of a product's lifecycle, which should help to reduce environmental and health risks. Lifecycle analyses are described in greater detail in section 6.5.

Products that are manufactured in large volumes, products that are exposed to heat and mechanical products exposed to wear make special demands on clean production that avoids the use of substances that are harmful to health. Even small concentrations of such substances make a tangible contribution to the negative environmental and health effects of hazardous substances, in particular through diffuse distribution.

Technical development or the use of new techniques is also an important means of reducing the diffuse distribution of hazardous substances via products.

Proposed measures

- Health aspects should be emphasized in environmental product profiles and lifecycle analyses.
- The precautionary rules in the legislation on the environment and chemicals should be better defined so as to specify producers' responsibility for minimizing health effects and the diffuse distribution of pollutants from products throughout their lifecycle.

3.10.4 The construction sector

The health problems caused by indoor environments, which were described in section 3.2, are associated with the construction, operation and maintenance of buildings and with their users' habits and activities. Proposals relating to this sector are presented in section 3.2 on indoor air.

3.10.5 Agriculture

The leakage of nutrients from agriculture causes algal bloom in lakes and watercourses and increased nitrate levels in individual sources of water supply and agricultural areas. The National Environmental Protection Agency has proposed measures designed to prevent the leakage of nutrients, which are likely to reduce the effects of these substances in individual wells, lakes and watercourses. The programme includes measures relating to the handling of manure, riparian strips, environmental charges on artificial fertilizer etc. As yet, the programme has not proved sufficiently effective.

The leakage of nutrients is due, apart from spreading on agricultural land, to precipitation and the properties of the soil. The results of general measures are not entirely predictable. The owners of individual wells should therefore be informed of the risks of increased nitrate levels in agriculture-intensive areas.

The National Chemicals Inspectorate tests and approves pesticides that are used in Sweden. Pesticides that are approved may only, in conjunction with agricultural products, be used according to the instructions and in such doses that the residues in the crops do not exceed the National Food Administration's limit values. In most cases, the residues are far below these values. According to the National Food Administration rules, drinking water must not contain pesticides, and where this does occur it may be assumed to be the result of faulty handling. The present rules are relatively effective and must remain in force.

Ecological agriculture is becoming increasingly popular, although it still only accounts for a very small proportion of arable land. The trend towards cultivation without the use of artificial fertilizers should be encouraged.

The use of sludge as fertilizer is expected to increase. The possible content of pollutants in sludge has made this use controversial. If sludge is to be used as fertilizer, it should be as free from pollutants as possible.

4 International cooperation – discussion and proposals

There is intensive international activity today in the field of environment and health. WHO-Europa initiated the process leading up to the meeting of ministers of the environment and health in Helsinki in 1994 at which the Declaration on Action for Environment and Health in Europe was adopted. All the 52 countries in the WHO's European region have undertaken, under this declaration, to prepare national action plans addressing environmental health problems in their countries by 1997. At the Helsinki meeting it was decided to set up a committee, the European Environment and Health Committee, for the purpose of coordinating and supporting the member countries' efforts to meet the objectives of the Declaration. The Committee consists of representatives of the WHO, EU, UN and OECD.

The International Programme on Chemical Safety (IPCS), which is run by the WHO together with several other international bodies, is engaged in significant global cooperation on chemicals.

Another WHO organization is the European Centre for Environment and Health. Sweden has taken part, often through the Institute of Environmental Medicine, in several projects establishing risk assessments for various environmental pollutants, including Air Quality Guidelines for Europe.

The WHO's European office has done very valuable environmental work in connection with the drafting of the Declaration on Action for Environment and Health in Europe and following adoption of the declaration in 1994. Sweden should play an active part in ensuring that the WHO gives sufficient consideration to environmental health concerns.

The Government has in various ways sought to promote cooperation between the Baltic Sea countries and has made it clear that it intends to intensify its initiatives for strengthening relations with these countries. These efforts should also include cooperation on environmental health.

In 1992, the Baltic Sea countries agreed on an action plan to reduce emissions of pollutants and nutrients into the Baltic Sea. The primary objective of these measures is wastewater treatment, but they also include environment and health monitoring and environmental

education projects. Swedish companies and environmental authorities are participating in these projects.

A large number of international agreements and conventions have been adopted with a view to remedying global and regional environmental problems. The purpose of these agreements is to reduce emissions of greenhouse gases and acidifying substances, the production and use of freons and emissions into air and water of metals and organic pollutants.

Following its accession to the EU, Sweden incorporated an extensive body of binding Community rules relating to the environment into the national legislation, e.g. on air and water quality, chemicals, wastes and food. The ministries concerned participated, often through the relevant government agencies, in a large number of expert groups on such matters, particularly groups reporting to the European Commission.

In recent years, environmental and health matters have acquired greater prominence in the EU. Under the Community's Fifth Action Programme on the Environment the EU is to pursue sustainable development in such a way that continued socio-economic development does not take place at the expense of environmental and natural resources. This programme is currently being revised.

At the end of January, 1996 the European Commission submitted a draft action plan intended to accelerate implementation of the Community's Fifth Action Programme on the Environment and render it more effective. The following five priority areas are identified in the action plan:

- more consideration of the environment in other policies
- development of environmental policy instruments
- better application of environmental legislation
- greater awareness of sustainable development
- international cooperation.

After only one year of membership, Sweden has made its mark in environmental matters in the Council and seeks also to make use of the opportunities provided by Community rules to maintain more stringent national provisions. In Sweden's environmental activities in the EU the Government has prioritized the struggle against acidification, the implementation of ecocycle management, preservation of biological diversity, a high level of ambition in the field of chemical control and reduced use of pesticides.

The EU has not made the same progress in public health as it has in environmental matters. The first initiative was taken in 1986, when an action plan against cancer was adopted. Only after the Maastricht

Treaty, under which the EU assumed formal powers in the field of public health (Article 129), was the public health perspective broadened. One of eight programmes in this area is *Pollution related diseases*, which is to enter into force in 1998 and operate until 2002. The purpose of this programme is to designate various public health activities in the Union as priority areas for EU support.

Several environmental health problems, such as transboundary air pollution, cannot be solved at the national level. Here Sweden, with its high environmental health profile, can set a good example. Since environmental health is such a large field, and one for which several different ministries and agencies are responsible, national coordination is essential prior to EU negotiations.

In our view, Sweden should urge that environmental health issues be given general priority in the EU, in particular:

- application of the substitution and precautionary principles
- priority for environmental health issues, both with respect to short- and long-term effects, in the field of chemical control
- high priority for environmental health issues in connection with air pollution
- high priority for environmental health issues in connection with efforts to reduce the risk of transmitting infections through food
- high safety standards for nuclear power plants and the handling of radioactive waste
- high priority for research in the field of environmental medicine.

Proposals

- Sweden's participation in international cooperation on matters concerning the linkages between environment and health should be better coordinated.
- Sweden should make every effort to ensure that environmental health issues are given general priority in international cooperation, particularly in the EU and the WHO.

5 The role of the public sector – discussion and proposals

5.1 Government agencies

Several *central supervisory authorities* are responsible for matters relating to environmental health risks. *The National Environmental Protection Agency* and *the National Board of Health and Welfare* have a special status as the central supervisory authorities with overall responsibility for the external environment and health, respectively. It is of the utmost importance that both the National Environmental Protection Agency and the National Board of Health and Welfare address environmental health issues within their respective spheres.

Several other supervisory authorities are responsible for important specific areas, e.g. *the National Food Administration, the National Radiation Protection Institute, the National Chemicals Inspectorate* and *the National Board of Housing, Planning and Building*. The Commission makes no proposals regarding this division of responsibilities, which appears appropriate and effective.

The National Institute of Public Health is not a supervisory authority, but it nevertheless has a key role in supporting and developing public health activities.

The Institute supports local and regional public health activities and promotes cooperation at the national level between various bodies that is designed to influence factors relevant to public health. Its activities are based on a scientific approach.

It is important that the National Institute of Public Health, in close cooperation with the relevant authorities, organizations and enterprises, should further develop its work in the field of environment and health at the national, regional and local levels. Apart from the type of programme on which the Institute's work on environmental health is currently based (allergy, injury and accident programmes), it should also gear its activities to preparing data and providing support for local information and opinion-influencing activities within the framework of Agenda 21 programmes.

The Institute of Environmental Medicine has an important role as a national expert body in the field of environmental medicine. Accord-

ing to its instructions, the Institute is to engage in research and education and carry out investigations in the field of physical and chemical environmental medicine and health protection. In particular, the Institute is to collaborate with authorities, institutions and organizations in order to ensure that the resources in this sector are efficiently used. Since 1988, the Institute of Environmental Medicine has been part of the Karolinska Institutet.

It is a great advantage that research-oriented and investigation-oriented activities are closely linked, since scientific expertise is essential for investigative work of high quality. It is invaluable that the Institute of Environmental Medicine should have the resources to engage in practical, society-oriented work (see also chapter 6).

At the county level the *county administrative boards* have a key role as the authorities responsible in their respective counties for most matters relating to environmental health.

According to their instructions, it is also the task of the county administrative boards to see to it that the national objectives adopted in various sectors are achieved at the county level and to follow up and evaluate the counties' efforts to achieve these objectives, which means that these boards play a significant role in implementing and monitoring the national environmental health action plan.

Proposals

- The present division of responsibilities between central supervisory authorities should be retained.
- A separate programme on environment and health should be set up by the National Institute of Public Health, the purpose of which should be to prepare data and provide support for local information and opinion-influencing activities and to develop methodologies for health-promoting work.
- The county administrative boards should intensify their commitment to health protection issues and should, in particular, assist in the implementation and monitoring of the environmental health action plan.
- The county administrative boards should appoint an organization for county health protection experts.

5.2 Local authorities

At the local level, the local authorities have overall supervisory responsibility for environmental and health protection. The local authorities also have other important roles, e.g. responsibility for planning, information and education and operational responsibility for the various activities. In addition, the local authorities have a key role when it comes to initiating, coordinating and stimulating local Agenda 21 activities and other efforts designed to activate citizens. A well-informed and committed public is essential for successful environmental health activities.

All in all, this gives the local authorities a unique platform for preventing and eliminating environmental health risks. Local authorities have access to most other necessary instruments and are sufficiently close to the citizens to ensure successful mobilization.

It is of crucial importance to a local authority's environmental health activities that the senior local authority officers are genuinely interested in these matters.

It is important for the local authorities to make the most of their resources and to combine the instruments at their disposal in an efficient manner. Often, they must balance supervisory activities against promotional efforts, information, awareness enhancement etc. Intensified efforts to increase the knowledge and commitment of local citizens should be regarded as a complement to existing environmental and health protection activities.

According to the National Institute of Public Health survey (1995) of the local authorities' public health activities, more than half of the local authorities now have intersectoral councils that deal with public health matters. Elected representatives or officers from environmental health committees and departments are represented on many of these.

Local authorities have a key role in the implementation of many of the measures proposed in the action plan. These will be discussed in the sections on each subject.

Proposals

- Local authorities should intensify their information activities to ensure that local citizens are well-informed and interested in environmental health issues.
- Intensified opinion-influencing activities should be regarded as a complement to existing environmental and health protection activities.
- Supervision of environmental health protection should be maintained and improved by integrating environmental health in to all local Agenda 21 activities.
- Health aspects should, in cooperation with the parties concerned, be integrated into all local authority planning.

5.3 County councils

The county councils' direct responsibility for environmental health matters consists of a statutory responsibility for the environment in the operations run by them and responsibility for promoting public health in accordance with the Public Health Act and the Protection Against Infection Act.

The county councils play an important part in connection with research in the fields of social and environmental medicine. Nowadays, most counties have access to environmental medicine expertise, although only a few have environmental medicine departments as such, since this expertise is integrated into departments of social, occupational and environmental medicine or other medical services. Most county councils have a plan of operations for environmental medicine. Environmental medicine structures should be coordinated in order to make efficient use of existing resources.

Compelling reasons suggest that, as a complement to players at the national and local levels, as well as the regional level, the county councils should be involved in Agenda 21 programmes. County councils and local authorities, being directly elected local and regional political bodies, are well placed to help mobilize people's involvement in democratic processes.

Proposals

- All county councils should have access to expertise in environmental medicine, either in the context of county environmental-medicine services or of regional cooperation.
- All county councils should have a plan of operations or an action plan, whether an independent programme or one that is integrated into a broad-based public health programme.
- As a complement to the activities at the national and local levels, and the activities of county administrative boards, the county councils should integrate their public health activities into Agenda 21 programmes.

6 Ways and means of reducing environmental health risks – discussions and proposals

This chapter deals with some of the instruments available in connection with the prevention and elimination of environmental health risks. Effective environmental health programmes normally require the use of a combination of instruments such as economic incentives, information, opinion formation and legislation.

6.1 Agenda 21 and other declarations

The principal international declarations in this field are the Rio Declaration (1992), Agenda 21 (1992) and the Helsinki Declaration on Action for Environment and Health in Europe (1994). The Rio Declaration, Agenda 21 and the other conventions adopted at the UN Conference in Rio in 1992 were signed by representatives of about 150 countries and by the EU.

One of the objectives set forth in Agenda 21 is that local authorities should initiate consultation procedures with the local population and reach a consensus on a local Agenda 21 by 1996. Agenda 21 has been very well received in Sweden. All the 288 local authorities are now engaged in local Agenda 21 programmes.

The opening paragraph of the Rio Declaration emphasizes the need to consider the effects of the environment on human health. It is important to broaden the base of Agenda 21 activities so that they cover health issues to a greater extent than is the case at present. Closer liaison between Agenda 21 activities and public health programmes would probably bring many advantages. The merits of public health programmes are well-established, long-standing local commitment backed by the county councils' resources. The merits of Agenda 21 activities are that they raise local awareness of environmental issues and often receive strong political backing.

6.2 Supervision and other health-promoting work

The supervision exercised by the local authorities, county administrative boards and central supervisory authorities is the basis of all environmental and health protection activities. However, there is also a need of other efforts based on citizen involvement. A well-informed and committed public is essential for success in this field and, at the same time as the impact on environment and health of major point sources, for example in industry, decreases, the more important consumption and lifestyles become for environment and health.

Therefore, the best course is often to combine supervisory measures with information and opinion influencing activities. An important instrument in this connection is local, regional and national programmes for which concrete objectives, strategies and evaluation principles have been formulated. Agenda 21 and strategies for regional environment are the chief instruments, but other local and regional environmental health programmes are also important.

6.3 Environmental monitoring

Central government environmental monitoring in Sweden takes place on a national and a regional level. The purpose of national monitoring is to describe the state of the environment, assess the threats, analyse the national and international impact of various emission sources and provide data for decisions on appropriate measures and follow these up. One of the ten subprogrammes in the national monitoring system is "health-realted environmental monitoring". This comprises relevant measurements of the physical environment, exposure measurements, studies of the frequency of annoyance reactions due to noise and air pollution, a human specimen bank and the urban environment.

The local authorities are also engaged in extensive monitoring, e.g. measurements of pollution levels in urban air, lakes and watercourses.

The health-related environmental monitoring program started as part of the government environmental monitoring programme in 1993, and has thus only been under way for three years. Our knowledge of what people are actually exposed to is still incomplete. This is an obstacle to an assessment of the health effects that may be expected from factors in the physical environment, and the extent of such effects.

The Ministry of the Environment recently appointed a Commission to investigate the orientation, scope, structure and financing of environmental monitoring. The investigator will analyse the possibilities, and describe the consequences, of increased sectoral responsibility for environmental monitoring and its financing.

6.4 Health monitoring

Sweden has a long tradition of keeping population records and is therefore in a unique position to collect and register information in records of diseases. The Epidemiological Centre at the National Board of Health and Welfare is responsible for the national records, which provide information on various diseases and other kinds of ill-health, e.g. cancer records, medical birth records, deformity records, cause of death records and inpatient care records. Moreover, outpatient records, allergy records and the creation of national injury records are at the experimental stage.

Every four years, The Epidemiological Centre publishes a national public health report which provides an up-to-date review of changes in the patterns of disease and health risks in various population groups and possible reasons for such changes. The risk factors studied include lifestyles, social factors and physical environment factors.

More attention should be given to analyses of the significance of the environment in the national public health report. In addition to this, a separate environmental health report should be made with details and analyses of trends in patterns of ill-health that may be attributable to environmental factors. An important element in connection with the preparation of such reports is assessments of the extent to which health inequalities are linked to physical environment factors. Furthermore, the environmental health report should contain assessments of the health effects of the total exposure to factors in the outdoor air, indoor environments, food and other environmental risk factors. Special attention should also be given to the connection between environmental health risks, lifestyles and other living condition factors.

6.5 Instruments in industry

The procedures to be observed by companies in their environmental activities, *environmental standards*, are published in the international ISO 14 000 series. These standards apply to organization and to products, e.g. lifecycle analysis and environmental labelling. They are designed to help industry take more environmental responsibility and proceed from "management by external rules to management by internal objectives". Decisions at all levels may in the final analysis affect the environment. It is therefore important that established procedures for environmental work should apply to company as a whole and to the entire production cycle, starting with the planning stage. The EU has adopted a Regulation on environmental standards.

The importance of the overall environmental impact of products, from manufacture to recycling or disposal, is being increasingly recognized. The waste phase and the use of products sometimes cause a greater environmental impact than their manufacture.

Lifecycle analysis (LCA) is a methodology designed to describe a product's total environmental impact from the cradle to the grave. The various aspects dealt with in an LCA are specified in a classification list, which in the Nordic countries includes health effects, including the work environment. The classification list must be as complete as possible. However, there is no obstacle to limiting LCAs to selected items in the classification list.

Environmental standards and tools such as LCAs may play an important part for the environment by helping to put the entire company's operations on an environmentally sound footing. The environmental managements systems' focus on the work environment and impact on the external environment mean, however, that matters such as diffuse distribution, e.g. exposure via food, infection and contaminated water, and the problems of the indoor environment are not dealt with in very great detail.

It is important that environmental health experts participate in the work of formulating standards.

6.6 Environmental impact assessments (EIAs)

EIAs are now a statutory requirement for all operations that are subject to government permission under about 20 laws. EIAs must contain

assessments of the impact on environment, health and the consumption of natural resources to be acceptable. However, assessments of the anticipated effects on health have often been inadequate.

Health effects must be taken into account in connection with various policy areas, irrespective of whether EIAs are compulsory or not.

6.7 Planning

Local authorities have overall responsibility for the planning of land use and building. Land, water and the physical environment in general must be used in such a way as to promote sustainable management in ecological, social and national economic terms.

Local authorities are obliged to present general plans describing their use of land and water areas during the next 15–20 years. In our view, these plans should also contain explanations of how they contribute to the achievement of national, regional and local health objectives.

6.8 Grants and economic instruments

The Rio Declaration reaffirms the Polluter Pays Principle. Economic instruments have been applied for a number of years in Sweden as a means of reducing environmental impact. Environmental taxes and charges raise the cost of harming the environment and make it profitable to develop environmentally sounder solutions.

Unlike taxes and charges, grants of various kinds are used as economic incentives. A specific example is the various incentive packages provided by the Government in order to create jobs and improve the environment.

We propose that a coherent plan be elaborated with a view to promoting employment and reducing environmental health risks, especially the elimination of defects in indoor environments, noise abatement measures and maintenance of water supply and sewerage installations.

6.9 Research

Advanced research is essential to enable us to learn about the causes of environmental health problems and remedies for them. High-class research is also crucial to Sweden's opportunities for influencing national and international rules, which affect our environment to such a large extent.

Research in the field of environmental health involves several disciplines and faculties, research councils and institutions.

Research in environmental medicine is mainly conducted by the departments of occupational and environmental medicine, which are often associated with university and other hospitals. Environment-related health research and environmental research that is relevant to public health are also conducted by the universities. In addition, there is the Institute of Environmental Medicine, which is part of the Karolinska Institutet. Research in environmental health and the Institute of Environmental Medicine's practical activities have been evaluated on several occasions and have been found to be relevant, of high quality and extensive considering the limited resources.

Several industry-run research institutes do research that is sometimes health-related. The National Food Administration also conducts its own research activities.

At the national level, research in environmental medicine is supported by several bodies. The sectoral agencies also directly contribute funds for research.

Our investigation has revealed many research needs, and there is no doubt that environmental health research must be expanded if these needs are to be met. This report mentions studies of future environmental threats to reproduction, follow-up studies of allergies and hypersensitivity among children, multidisciplinary research on indoor environments and accidents, improved exposure assessments including quantification of actual exposure, studies of the health effects of moderate noise levels and electromagnetic fields etc.

The merging of departments and clinics for occupational and environmental medicine reflects the similarity of many issues in these fields. Another example is the setting up of a cofinancing programme by the National Environmental Protection Agency's research board and the Council for Working Life Research, which has operated successfully for a number of years. Thus there appears to be plenty of scope for more collaboration between work environment research and other environmental-medicine research in the fields of toxicology and epidemiology. Consideration should be given, in the context of research policy, to the possibility of cofinancing all environmental-medicine

research in the fields of toxicology and epidemiology out of a joint fund.

6.10 Proposals

- The health services' preventive activities, including social and environmental medicine, should be clearly defined.
- The scope of local public health and Agenda 21 activities should be broadened to include health to a greater extent, without any restrictions being placed on the resources allocated to established environmental health activities.
- The national and regional health-related environmental monitoring systems should be expanded to include, in particular, exposure data, and the National Environmental Protection Agency should assume coordinating responsibility.
- The national public health report should also include descriptions and analyses of environment-related health problems. The report should include a separate environmental health report.
- Effects on health should be considered and described not only in connection with environmental impact assessments but also with other measures having a potential impact on environment and health.
- The local authorities' responsibility for considering health aspects in connection with local authority planning should also apply to the local authorities' general plans, which should include specific objectives for the protection of human health and safety.
- Aspects of health protection and environmental medicine should be integrated into the subject matter of a Swedish Environment Network on the Internet.
- A coherent plan should be elaborated with a view to promoting employment and reducing environmental health risks, especially defects in indoor environments, noise abatement and maintenance of water supply and sewerage installations.
- Research on the extent of exposure to various environmental health risks and the extent of environmental health problems is important. It is particularly important to develop quantitative measures for exposure and health effects.
- Research on the importance to health of indoor environments, taking into account medical, chemical, structural and behavioural aspects, is particularly important.

- The Institute of Environmental Medicine should be provided with greater resources for applied research and risk assessment, without any cuts being made in the other relevant authorities' R&D funds.
- Collaboration between work environment research and environmental-medicine research should be intensified.
- The Commission emphasizes the importance of disseminating research results in a coherent and readily understandable form and the need for the responsible authorities to evaluate and use these results in environmental health activities.
- We recommend that the environmental training provided by industry should be extended to include other health aspects as well as the work environment.

7 National Environmental Health Action Plan

7.1 Introduction

Compared with many other countries, both Sweden's environment and its people are in good health. The main health risks were eliminated a long time ago, stringent legislation was passed and a comprehensive system of administrative supervision to protect the citizens' health was introduced. The high standard of living and education were contributory factors. However, there are still several problem areas that require further measures. Allergy risks, radon and indoor smoking, accidents, air pollution in urban areas, the transmission of infection via food and water and the accumulation of toxins in the environment and people are examples of factors that represent substantial health risks.

Environmental health risks occur in many different sectors and are dealt with by a variety of authorities and organizations. It is therefore essential to obtain an overall picture of this aspect of environmental and public health. By signing the Declaration on Action for Environment and Health in Europe, which was adopted by the ministers of health and the environment in the WHO's European region at a meeting in Helsinki in 1994, Sweden also undertook to present a national environmental health action plan by 1997.

The action plan is based on a review and analysis of our present knowledge about the connections between environmental risk factors and ill-health and a review and analysis of the authorities and other parties concerned, as well as of the legislation, policies and instruments that exist to prevent and eliminate these risks. The role of the various sectors in relation to environmental health risks, and their responsibilities in this respect, are also reviewed.

Ten general guidelines are proposed for the task of reducing environmental health risks (environmental health activities), as well as objectives and indicative measures for various health-related environmental factors.

The action plan confines itself to chemical, physical and biological risks and injuries caused by accidents in environments other than workplaces. Unemployment and economic, social and psychological

factors should be dealt with in future public health action plans. Work environment measures are thoroughly dealt with in the legislation and by authorities and research bodies within the Ministry of Labour. There is also a long tradition of workplace organization within the framework of cooperation between management and labour.

The action plan does not cover lifestyle factors, e.g. smoking, alcohol, drugs and an unsuitable diet. Nor does it cover medicines or other medical products. The only infectious diseases covered are those caused by contamination of food and water and inadequate ventilation.

7.1.1 Objectives, methods and measures in environmental health activities

The obvious risk objectives of a national environmental health programme are those that relate to health effects, exposure and structures. It is sometimes appropriate to complement overall objectives by targets to be achieved within a given space of time. The objectives of such an action plan differ from those that should be set for public authorities, enterprises or other organizations.

As a rule, the measures proposed in this action plan are of a general nature and are formulated as indicative measures. The proposed exposure objectives and indicative measures will not guarantee achievement of the general health objectives, but they represent significant steps in that direction. Subsequent evaluations will indicate what can and must be done in order to make further progress towards the declared objectives.

The purpose of this action plan is to provide a clear picture of the objectives and measures that are necessary to improve environmental health, but not to propose detailed plans as to how each objective should be achieved. Background material, descriptions of ongoing improvements and proposals for further measures were prepared in connection with the action plan. In many cases enterprises and agencies have access to large amounts of data that could be used to make detailed plans for each area.

The cost of the various measures that we propose should be calculated by the sectors and authorities concerned. This has in fact already been done in many cases. However, experience has shown that there are many different ways of making cost estimates, and the estimates vary greatly. It is equally important to calculate the cost of omitting to take any preventive measures, but such estimates are very rare. Furthermore, there is no agreement on methods of valuing

suffering and death at various ages, and no scale of priorities is free from value judgments.

Investments in improved health often coincide with investments for other reasons, and they seldom affect the public sector, since the general principle is that the individual polluter should prevent or pay for the damage. In any case, the purpose of environmental health activities is not primarily to reduce production losses or future health care costs, but to prevent ill-health and improve public health and well-being.

The object of this plan is to pave the way for action. It calls on political structures, authorities, enterprises and other organizations to continue to achieve environmental improvements that promote progress in the field of public health. Many measures are already being prepared, but in other cases new initiatives must be taken and new tasks defined. Additional investigations may be necessary, in particular regarding economic effects and financing options.

For the action plan to be implemented, it is essential that it should receive the necessary publicity. It will therefore be distributed widely. It is not directed at any particular agency or organization; all those involved must continue to work in their specific fields. The question of monitoring its implementation will be dealt with later in this chapter (section 7.2.10).

The report of the World Commission on Environment and Development (the "Brundtland Commission") coined the term "sustainable development", which it defined as "development ... that ... meets the needs of the present without compromising the ability of future generations to meet their own needs." Many environmental health risks have been addressed and obstacles to improved health eliminated. However, the increasing proportion of children and adults suffering from allergic hypersensitivity and accumulation of toxic substances that are suspected of affecting reproduction and foetal development are examples of new threats to sustainable health development.

The proposed action plan is intended to give an impetus to measures that will increase knowledge and raise awareness of the consequences for health of environmental manipulation and political decisions, to indicate the long-term planning measures that are necessary in order to maintain the high level of environmental health in this country, and increase knowledge both about suspected risks and about the effects of the measures taken, and thus create the conditions for sustainable development. The plan has therefore been called *Environment for Sustainable Health Development.*

7.2 Guidelines for national environmental health activities

The guiding principle for the work of preventing environmental health risks is to identify and allow for health aspects in all sectors and in the many systems and principles involved in environmental work. This section establishes the guidelines that should be applied in environmental health activities for the next few years. They draw on important principles that have proved their worth and indicate the potential for further measures and the need of a high level of preparedness for future problems. The order in which these ten guidelines are discussed does not imply any priority between them.

7.2.1 The high level of health protection should be maintained

The development towards prosperity and the protective measures introduced during the last hundred years have been of vital importance to the progress made in improving public health. These preventive measures must be maintained in order to avoid epidemics, poisoning and other serious health problems. The measures relate in particular to water purification, the treatment of wastewater and wastes, traffic planning, food hygiene, radiation protection, electrical safety, road safety and safety for children, housing hygiene, noise abatement, and the control of emissions from industry. Local, regional and national planning and supervision have played a crucial part in improving health protection and promoting health.

The action plan proposes improvements in several of these areas, while failure to maintain the measures currently applied may involve considerable risks.

7.2.2 The precautionary principle should be applied to environmental health activities

The United Nations Conference on Environment and Development (Rio de Janeiro, 1992) adopted the precautionary principle, according to which measures should be taken where a negative impact on health or the environment is suspected, even where there is no actual proof. This approach is well-established in connection with epidemics. The recent

case of BSE (mad cow disease) and the enormous scale of the measures taken to deal with a suspected, but far from certain, risk of infection from infected meat is a good example of the precautionary principle in action. Another well-known example is the action taken to reduce emissions of freons, which are thought to deplete the ozone layer, aggravate the greenhouse effect and increase UV radiation, which causes an increase in skin cancer. It is much better to intervene at an early stage rather than sit back and wait for impending disaster.

Therefore, even if the precautionary principle involves acting on circumstantial rather than hard evidence, there must be proper scientific awareness of the quality of the underlying studies and of the potential and limitations of risk assessment. Adequate scientific data are essential for the proper application of the precautionary principle in order to avoid the risk of ill-considered action.

Another way of preventing ill-health is to apply proper safety margins in establishing limit values and other guidelines for maximum tolerable exposure levels. The principle of substitution, i.e. that less hazardous substances should be substituted for more hazardous ones wherever possible, is another element of prudent precaution.

In the last analysis, political judgment, and not scientific judgment alone, decides what action is to be taken. It is important to understand how different groups in different circumstances and at different points in time evaluate risks and health.

7.2.3 Manufacturers must take the necessary precautions in order to prevent damage to health

An active policy is being pursued to compel those who produce and handle products to assume greater environmental responsibility and prevent health risks. Where damage occurs, the Polluter Pays Principle applies, and it is therefore in the manufacturers' interests to do everything they can to avoid the consequences.

There is a large body of rules relating to producer responsibility for chemical products, construction and buildings, consumer goods etc. In the application of these rules the health aspects and the producers' responsibility both for health and environmental aspects during the entire lifecycle of a product should be clearly defined.

It can be difficult to identify the producer and establish for how long he is responsible for a product in relation to the buyer and the way the product is used. It is worth trying an insurance system on the lines of

occupational injury insurance and structural defects insurance, designed in such a way as to reward preventive environmental health activities.

Environmental profiles should be prepared for products, premises and installations, and the profiles should contain health information where this is relevant. Similar profiles should be prepared for housing, and they should include data on noise and sound insulation, air exchange, damage due to damp etc. Health aspects should also be taken into account in establishing criteria for environmental labels.

7.2.4 International cooperation on environmental health requires high competence and expert participation

Sweden's environment is very much dependent on international conditions and rules, e.g. the conventions on air pollution and the sea and the rules on trade in hazardous goods and standardization. Cooperation with the EU and the countries of Eastern Europe is of particular importance to Sweden's environmental health situation. The WHO plays an important part in identifying environmental health risks and integrating preventive measures, not least by supporting the development of national action plans in Europe.

Active participation in international cooperation is therefore important in order to achieve results for the benefit of the citizens of Sweden and other countries. Apart from taking active part in international organizations such as the OECD, EU, the World Bank, WHO and other UN agencies, we must possess a high level of scientific competence based on adequate research resources and education. Furthermore, there must be effective procedures for consultation between the Swedish participants in international environmental health activities, since these are carried on by many bodies and organizations.

7.2.5 Labour market resources should be used for improvements in environmental health

Improvements in environmental health are an investment for the future, and the benefits are usually long-term rather than short-term. Because of the high level of unemployment, substantial labour market funds have been allocated for environmental improvements that have effects on health, modernization grants in particular. These measures are extremely important from the point of view of health, since the state of

public health is not only improved by environmental measures but by the fact that the adverse effects of unemployment on health are also reduced. Programmes that are linked to employment measures should be expanded and complemented. Measures designed to improve the indoor environment and reduce radon levels, the maintenance and replacement of water supply and sewerage systems and noise abatement measures are especially important.

The ongoing large-scale programme of further education, which is to be expanded with the help of labour market funds, should also include education on the health risks associated with environmental problems, for example in the construction and service industries. The working life development programme can, by providing employment in public and voluntary environmental measures, contribute significantly to the solution of environmental health problems.

7.2.6 Health impact assessments of major political decisions should be performed

Legislation enacted in the 1990s requires environmental impact assessments (EIAs) to be made prior to decisions on permission. Although these assessments do take the impact on human health into account, they concentrate mainly on other environmental effects. The need of health impact assessments of important political decisions at both the national, regional and local levels has already been voiced and is even greater in the context of sustainable health development.

The authorities and research bodies concerned should refine methods of evaluating health effects in EIAs and other relevant contexts. This work could suitably be coordinated with the development of economic analysis models that compare the cost of preventive health measures and the cost of neglecting to take such measures and also evaluate the measures themselves.

7.2.7 Environmental health activities should be developed together with environmental and public health activities

There is a long tradition in Sweden both of public provision of health services and voluntary health work, for example the temperance movement's struggle against the effects of alcohol, and health improvement has often been an element of the work of popular movements such

as consumer, tenant and sports associations. Great environmental efforts have been made in the last few decades both by industry, the public sector and voluntary organizations. Agenda 21 groups have gone from strength to strength in the last few years and now represent a dynamic popular movement. In many places there are close links between health work and environmental activities, and these links have proved very rewarding, as well as being consistent with the basic principles of the Agenda 21 documents adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992.

Individuals' own efforts can help a great deal to reduce environmental health risks. These may take the form of efforts by pressure groups to bring about necessary changes in the local community, but they may also consist in refraining from smoking indoors, or cycling or using public transport instead of a car, using hand mowers instead of motor mowers and not using pesticides or making bonfires, upgrading defective wood-fired boilers, taking care not to disturb the neighbours by unnecessary noise etc. Such changes in behaviour can sometimes take place rapidly, especially following information campaigns. It is a well-known fact that people's general environmental behaviour has improved considerably in recent years, that smoking in public places has decreased greatly thanks to the pressure of public opinion and that information and efforts by the trade can help to change eating habits.

Local public health work consists largely of providing information, and local information officers have plenty of information to offer. Since environmental health risks involve many different sectors, a national focal point is needed as a complement to sectoral activities. The National Institute of Public Health should therefore set up a permanent environmental health programme to support the environmental health aspects of public health work at various levels and be responsible for coordinating information activities on environmental health issues. It should also develop and evaluate methods of achieving preventive, health-related changes in behaviour.

7.2.8 The supervisory and research and information structures should be pluralistic

Environmental health risks occur in many different sectors and are dealt with by a variety of authorities and organizations. Since health aspects are often integrated into other knowledge in the various sectors, especially about how risks should be eliminated, it is important that all the relevant central supervisory authorities should continue to be

responsible for health risks in their respective fields. The National Board of Health and Welfare and the National Environmental Protection Agency have overall responsibility for supervision of health and the external environment, respectively.

Frequent formal and informal consultations should take place between the ministries and authorities responsible for the environment and public health. Environmental health matters should be dealt with by the ministerial group on public health matters, the Director-Generals group of the National Institute of Public Health, the Toxicological Council, whose secretariat is located at the National Chemicals Inspectorate, as well as by other groups. The authorities and other parties that have assisted in the elaboration of this national action plan should consider appropriate forms of consultation for the purpose of following developments in the field of environmental health.

Local authorities have traditionally assumed the most important task in preventing environmental health problems. This work should be undertaken in cooperation between various local authority bodies and between the local authorities and other relevant public and private bodies. The authorities involved should provide industry with unambiguous and consistent information.

The general public's need of reliable information on environmental health matters is met by local environmental health committees, the health services, primary care and the county councils' departments of occupational and environmental medicine. These medical units should, however, be expanded so as to be available to the public in all county councils, either under agreements with a regional entity or by setting up new units. The effectiveness of environmental and health protection must be maintained despite the economic difficulties facing local authorities, county councils and county administrative boards.

7.2.9 Research and education should be strengthened

The R&D activities that are needed to reduce environmental health risks cover economics, natural sciences, medicine, law and social and behavioural science. In many cases, the R&D needs coincide with research done on other environmental or health issues. This section will therefore mainly deal with research and education in environmental medicine.

Sweden has a national research institute for environmental medicine, the Institute of Environmental Medicine, and small departments of occupational and environmental medicine at the universities. Some

research councils distribute funds for relevant basic medical research and toxicology and a research foundation for environmental strategy supplies funds for environmental improvement technology. Some funds for R&D are also supplied by some government agencies. However, compared with e.g. occupational health research the resources for applied environmental health research, and for development work, are small.

Globalization and new environmental health problems make it necessary for Sweden to strengthen its research resources, e.g. as regards the effects of persistent toxins on hormone and immune systems, the connections between various environmental and lifestyle factors and social conditions, the development of health impact assessments and analyses of the economic aspects of health issues. Development work is needed on effective environmental health monitoring, risk comparisons, preventive strategies, health-promoting measures within the framework of Agenda 21 programmes etc.

More resources must be allocated to the Institute of Environmental Medicine, in particular to allow it to expand its applied research and risk assessment work. Furthermore, the authorities involved in environmental health monitoring must have resources of their own in order to finance scientific reports and commission investigations relevant to health aspects, for example from the Institute of Environmental Medicine.

The financing and prioritization of R&D on environmental health risks in relation to other requirements is a political matter. However, it is only reasonable that those who create potential health risks should contribute sufficient funds to meet the resource needs of an adequate research structure. Other feasible solutions are to intensify cooperation between occupational medicine and environmental medicine research and to increase cofinancing of such research.

Environmental health inspectors, staff groups in occupational and environmental medicine and toxicologists receive environmental health education. Health aspects are dealt with in many environmental courses at various levels and education in environmental health is also an ingredient of the training of medical and nursing staff. Technology, economics and community planning are areas where there is a particular need to improve educational facilities.

7.2.10 The action plan should be followed up and environmental health monitoring strengthened

Environmental health work is done in several sectors, both private and public, each of which monitors health protection in the short and long term by means of evaluation programmes and sectoral measures. Such evaluation efforts should be made continuously. There is a corresponding need for continuous evaluation of the results of national and regional environmental health activities.

Environmental monitoring does take place on a small scale, but has only considered health aspects to a small extent and has not concentrated on individual uptake, although this is crucial to an assessment of health effects. In many cases, individual measurements and targeted epidemiological studies are necessary in order to make accurate assessments of the connection between health effects and exposure and of developments in the environmental situation.

The national public health report made by the National Board of Health and Welfare in cooperation with the relevant authorities should be expanded to improve reporting on environmental health development. This would require close cooperation with those who carry out measurements of environmental factors from various sources and those who carry out epidemiological studies.

County administrative boards play an important part in publicizing national objectives and monitoring achievement, organizing and following up environmental health monitoring programmes and assisting in regional and national data collection. The boards should appoint county health protection experts.

The proposed national action plan has for the first time covered most of the environmental health risks that occur in Sweden. The plan should be evaluated with respect to guidelines, objectives and measures after about five years and updated on the basis of new knowledge and the experience gained. The interaction between living conditions, environmental risks and lifestyles should be analysed in order to provide a more integrated perspective on the interrelationship between environmental factors and other factors relevant to public health.

7.3 Environmental health risks – objectives and measures

This section contains a brief summary of the current situation in Sweden as regards various environmental health risks and the general health objectives, environmental quality objectives and types of measures that are appropriate in each case.

7.3.1 Outdoor air

General health objectives

> Air quality should be improved so as to eliminate the remaining risks to human health caused by emissions from traffic, industry, energy production plants or other activities.

Particulates, nitrogen dioxide and ozone are currently the air pollutants that are responsible for the greatest risk of effects on the airways. Nitrogen dioxide levels are highest in urban areas, where the main source is road traffic. Ozone levels, on the other hand, are usually highest outside urban areas, since ozone is produced in large-scale processes by photochemical reactions between nitrogen oxides and hydrocarbons. The highest ozone levels result from the transport of polluted air masses from the continent.

These air pollutants can affect the health of asthma sufferers and persons suffering from other respiratory disorders, increase the prevalence of lower respiratory tract infections among children and affect the lung function. There is also evidence of a correlation between these air pollutants and increased hospitalization and mortality. This pollution is estimated to be the cause of several hundred hospitalizations for respiratory disorders every year in Sweden and many more cases involving milder symptoms.

Air pollution also increases the risk of cancer. The major sources of emissions of carcinogens are diesel traffic (including mobile machinery) and small wood-fired boilers. The wood-fired heating component is significant even in urban areas. The main causes are unburned organic material (containing PAHs) and certain light hydrocarbon compounds (especially ethylene, benzene and butadiene). Air pollution is estimated

to cause 100–1 000 cancer cases in Sweden every year, including almost 100 cases of lung cancer.

Environmental quality objectives

- The present situation as regards air pollution must not be allowed to deteriorate.
- By 2005 nitrogen dioxide levels should not exceed an hourly mean of 100 $\mu g/m^3$.
- In the long term, ozone levels should not exceed an hourly mean of 80 $\mu g/m^3$.
- By 2010 the long-term mean levels of ethylene, benzene and benzo(a)pyrene should not exceed 1, 1 and 0.0001 $\mu g/m^3$, respectively (long-term mean values).

In 1991, the Riksdag (the Swedish parliament) set time-related targets for reductions of emissions of nitrogen oxides, VOCs and carcinogens. It also declared that the levels of carbon monoxide, nitrogen dioxide, sulphur dioxide, soot and particulates must, by 2000, be lower than the guideline values set by the National Environmental Protection Agency. Health requirements justify more ambitious environmental quality targets for nitrogen dioxide and particulates, since new studies indicate effects at lower levels, and new targets should be set for ozone and carcinogens. New criteria on data should be prepared for particulates without delay.

The Institute of Environmental Medicine has documented health-based guideline values – "low-risk levels". Radical measures, not least at the international level, will be necessary to achieve the environmental quality target for ozone, and for this reason no year is given. The low-risk levels determined for benzene, ethylene and benzopyrene correspond to levels that, discounting the background level, are theoretically equivalent to an excess lifetime cancer risk of 1 in 100 000.

Indicative measures

Although a great deal has been done to reduce emissions of air pollutants, the levels of nitrogen dioxide, ozone, particulates and carcinogens are still so high that further measures are necessary. Since nitrogen dioxide levels in urban areas mainly derive from traffic, these measures must target exhaust gases. The main sources of particulates and carcinogens are small wood-fired boilers and diesel traffic

(including mobile machinery). On the other hand, the ozone levels must be brought down through substantial reductions in nitrogen oxides and hydrocarbon emissions in Europe as a whole.

A great deal has been done to adapt the transport sector to environmental and health requirements. Further measures are being implemented, or have been proposed or discussed by various committees or expert bodies. The following measures, although they do not guarantee that the health objectives will be attained, represent important steps towards reducing the health effects of air pollution:

- Sweden should, within the framework of the EU and international air pollution conventions, seek to achieve substantial reductions of emissions of nitrogen oxides and volatile organic compounds.
- Manufacturers, users and the relevant authorities should take steps to reduce emissions of carcinogens from diesel vehicles, including mobile machinery, wood-fired boilers and small engines.
- Within the framework of their sectoral responsibility the traffic and transport authorities and the local authorities should take the necessary measures in order to achieve the national health-related objectives relating to air pollution and noise.
- The relevant legislation should ensure that county administrative boards and local authorities have the necessary instruments in the form of legislation and economic and other incentives to be able to achieve the environmental health objectives in areas with heavy traffic.
- The use of vehicles with very low or zero emissions, and of electrically operated mobile machinery, should be encouraged.
- The traffic and transport authorities should study the diffuse distribution of hazardous substances, over and above emissions of exhaust gases from traffic, and propose appropriate measures.
- More consideration should be given in conjunction with traffic planning to the quality of life aspects, e.g. by increasing the number of pedestrian streets and cycle tracks and restricting motor traffic in urban areas.
- More stringent general emission standards should be introduced for new wood-fired boilers.
- The Environmental Protection Ordinance should be amended so as to allow local authorities to prohibit small wood-fired boilers or the use of certain boilers in specific areas.

7.3.2 Indoor air

General health objectives

> No-one should need to risk sickness or symptoms caused by defective indoor environments.

The increasing prevalence of allergies in the industrialized western world is thought to be due, inter alia, to defective indoor environments, especially the occurrence of damp and inadequate ventilation resulting in an accumulation of mildew, mites, animal epitel, chemical residues and tobacco smoke. Radon gas, especially together with tobacco smoke, is a significant risk factor for lung cancer, and tobacco smoke can also cause cardiovascular disease and increase the risk of allergies.

Ventilation is often inadequate. It does not meet the minimum standards laid down by the National Board of Housing, Planning and Building nor, in four of five detached houses, the National Board of Health and Welfare's guideline values for health hazards. About half of all schools, nurseries and apartments in tenement buildings have defective ventilation. It is estimated that in about 10% of all housing damage due to damp is so serious that repairs should be made without delay.

400 000–500 000 Swedes experience symptoms caused by the indoor climate. 20–30% of juvenile asthma and bronchitis among children may be attributed to their parents' smoking, 5–25% to furred pets in the home and 10–20% to defective ventilation. It is, however, not clear what components or combinations of factors cause the various symptoms.

About 20% of the population is exposed daily to tobacco smoke in the home, which is estimated to cause several hundred deaths from cardiovascular disease and a further 40–80 cases of lung cancer per year.

Radon levels in 70 000–120 000 detached houses and 20 000–80 000 apartments exceed the National Board of Health and Welfare guideline values for health hazards. An estimated 400–900 cases of lung cancer per year in Sweden are caused by radon in housing. Most of the victims are smokers. Eventually, mean radon gas levels in housing should not exceed 50 Bq/m^3.

Environmental quality objectives

- Defective ventilation in housing, schools and nurseries should be repaired.
- All housing, schools and nurseries where radon gas levels exceed the guideline values for health hazards (400 Bq/m^3 of air) should be adjusted by 2010.
- Nobody should be exposed to tobacco smoke against their will.

Indicative measures

Indoor environments appear to have deteriorated considerably as a result of the energy-saving measures implemented in recent decades. This applies particularly where the ventilation system has not been adjusted to increased insulation. Insufficient attention has been paid to soil conditions in the building of foundations for detached houses. Substantial measures have subsequently been taken to remedy these problems, e.g. financial grants, grants for necessary technical measures, information, education etc.

The ventilation needs to be improved in housing, nurseries and schools, primarily by ensuring that the compulsory ventilation checks are effective.

Nevertheless, the situation is very unsatisfactory, and health problems seem to be on the increase, in particular because more and more people are being sensitized as a result of protracted health effects.

In the future too, therefore, building owners will have to accept the burden of responsibility for building healthy buildings, rectifying defects and informing tenants about the proper care of residential and other buildings. Further research is needed to find out which components, or combination of components, are primarily responsible for various health effects. Improved ventilation will, however, reduce the levels of most suspect substances.

Ventilation checks are now compulsory, but have not been carried out to anything like the necessary extent. An inquiry was recently set up to report on the experience gained from these checks and to propose any necessary changes. It is extraordinary that public premises for young people, i.e. schools and nurseries, do not always comply with existing ventilation rules.

Several of the measures set forth in the action plan have been initiated and future investigations will show whether they are sufficient.

- Building owners should be responsible for ensuring that construction materials do not emit hazardous substances when buildings are taken into use.
- All buildings should be built to be radon-proof and a radon profile should be supplied in conjunction with sale.
- Special measures to ensure that children are not exposed to tobacco smoke and radon should be taken by the relevant central authorities, county councils, local authorities and other parties concerned.
- There is an urgent need of more research and education on the importance of the indoor environment for health, especially in chemistry, structural engineering and behavioural science.
- Environmental profiles should be prepared for buildings and should cover factors that can affect health, e.g. ventilation, radon, noise and sound insulation.
- Investment should be made in the development of technologies for energy-efficient ventilation.

7.3.3 Contamination of drinking water

General health objectives

> No-one should need to risk sickness caused by water from public or private sources of water supply.

In comparison with the rest of Europe, Sweden's water supply situation is very satisfactory, since we have many lakes and relatively unpolluted groundwater. Most towns use lakes as sources of drinking water after treatment. There are about 1 800 groundwater catchments and about 400 000 private wells for permanent residents and 200 000–400 000 wells in permanent recreation accommodation, the water from which is not normally treated.

About 2–10 outbreaks of infection via drinking water involving about 3 000 people are reported every year, although the actual figures are probably much higher. Most of the reported outbreaks occur in small communities and are usually due to technical defects, faulty connections etc. as a result of which wastewater infiltrates the drinking water system. Many municipal water supply and sewerage systems are obsolete and need to be replaced. Good planning and adequate resources are essential for maintenance.

The main problems associated with contaminated well water are high levels of nitrates in agricultural areas due to the use of fertilizer and naturally high levels of fluorides and radon in the soil and bedrock. It is estimated that the fluoride levels in about 50 000 private wells exceed the limit value for water "fit for drinking with reservations", thus increasing the risk of discoloured teeth (due to damaged dental enamel). The radon levels in wells drilled in rock involve cancer risks, both from the drinking water and from inhalation of the radon gas given off by the water.

Indicative measures

- Local authorities should maintain long-term plans for maintenance, renovation and replacement of water supply and sewerage installations and for training and technical measures designed to reduce the risk of infection from waterworks.
- Local authorities should inform owners of wells about factors that may affect the quality of water and the measures that can be taken to prevent contamination.

7.3.4 Infections and pollution in food

General health objectives

No-one should run the risk of being infected by food.

Food poisoning is a major problem that according to questionnaires affects about 500 000 people a year in Sweden. About 2 000–3 000 cases of food poisoning are reported annually. In most cases the probable cause is faulty treatment of food in restaurants, cafeterias or homes.

Many potential health problems associated with pollutants in foods, e.g. bacteria, fungal toxins and mutagens in the surface of fried meat, can be partly attributed to handling problems. The National Food Administration has issued handling recommendations in order to minimize the risks associated with these substances.

Much of the pollution to which we are exposed reaches us through food. This applies in particular to persistent substances that can accumulate in the food chain, e.g. chlorinated organic compounds such

as dioxins and PCBs and the heavy metals lead, cadmium and mercury. The lead content in the blood of Swedish children has fallen, since their diet includes less lead, which in its turn is because of the decrease in the lead content of petrol.

The methylmercury content of freshwater fish is so high that pregnant women are advised not to eat such fish because of the risk of slight brain damage to the foetus. Dioxins and PCBs can cause cancer, immunological effects and reproductive disorders. People who eat fat fish from polluted areas can accumulate such high levels of pollutants that they subsequently may affect health. Foetuses and breast-fed babies are especially vulnerable risk groups. The National Food Administration has issued diet recommendations for such fish.

The cadmium content of cereals, wheat in particular, continues to increase on account of depositions and the presence of cadmium in artificial fertilizer. There is only a small safety margin to levels that may cause slight chronic kidney disorders.

There is adequate regulation and supervision of additives in food, and the associated health risks are therefore much smaller than in the case of pollutants. However, a high level of protection must be maintained and unnecessary additives avoided. A problem that has attracted attention in connection with the recycling of various materials is the risk of migration of undesirable substances from packaging to food.

The effects on people of persistent substances that accumulate in nature and in the body are not sufficiently well-known, for example as regards effects on the hormone system. These risks may be very serious, and intensified research in this areas is an urgent priority. There is also a need of more research on "natural" toxins in food.

Environmental quality objectives

- All food should be sufficiently free from pollutants to obviate the need for dietary recommendations.
- The mercury content of fish must not exceed the natural background level, 0.2 mg/kg of fresh weight (long-term objective).
- The cadmium content in cereals must not increase from present levels and should eventually drop. It should not exceed 0.1 mg/kg.
- The content of dioxin-type chlorinated substances in fish must not exceed 1 ng/kg of fresh weight expressed as TCDD equivalents (long-term objective).

Indicative measures

Sweden's emissions of metals, dioxins and other chlorinated organic compounds have fallen sharply during the last ten years. Today, most of these derive from foreign sources, via water, air and products. Coordinated, far-reaching international commitments are required to make it possible to achieve the specified environmental quality targets. Furthermore, more effective chemical control is necessary in order to prevent the spread of new problem chemicals and effective disposal of products containing persistent organic compounds and metals.

- Sweden should seek, in the EU and international conventions, to bring about more radical reduction measures for heavy metals, especially mercury and cadmium, and persistent organic substances distributed via the air, water or products.
- The National Food Administration, in cooperation with local authorities and other interested parties, should provide information on proper food handling in order to reduce the risk of food poisoning and transmission of infections.
- Research on substances with potential hormonal effects is an urgent priority.

7.3.5 Noise

General health objectives

Noise nuisance should be reduced substantially.

Noise, defined as undesirable sound, affects nearly everybody. Noise can make it difficult to carry on a conversation or it can disturb people's sleep and rest. Very loud noise can wholly or partially destroy the organ of hearing or cause a temporary hearing impairment. The most common effect of noise outside the workplace is general discomfort and concentration problems, which many people regard as serious restrictions on the quality of life.

The main sources of noise nuisance are traffic and noisy neighbours. 5–10% (400 000–850 000) of the population are significantly disturbed by traffic and 2–6% (170 000–500 000) by noisy neighbours. The corresponding figure for industrial noise is 1–2% (85 000–170 000 people). 1.5 million people are thought to be exposed to noise

levels from the traffic outside their homes that exceed 55 dBA, the long-term target proposed by the National Environmental Protection Agency.

The National Board of Health and Welfare's guideline value for health hazards due to indoor noise is 30 dBA.

Environmental quality objectives

- The noise level in urban areas should not exceed 55 dBA equivalent sound level.
- The noise level indoors should not exceed 30 dBA equivalent sound level.

Indicative measures

A report on noise, containing proposals for an action plan on noise, was presented in 1993. The Riksdag debated the plan in 1994 and instructed the National Environmental Protection Agency to prepare a programme for collaboration between various organisations with a view to reducing noise in the external environment. In connection with new construction, the building owner is responsible for seeing to it that the sound insulation norms in the building standards are complied with. Labour market measures can be applied to reduce noise by means of noise barriers.

- Local authorities should, in connection with planning, see to it that the traffic will not disturb residents.
- Building owners should guarantee adequate sound insulation both between flats and against external noise.
- Property owners should ensure that fixed installations do not cause a noise nuisance.

7.3.6 Radiation

General health objectives

The prevalence of malignant melanoma must be reduced.

Ionizing radiation means all forms of radiation that can cause ionization in biological material and thus cause damage. Non-ionizing radiation can cause damage through other processes, e.g. heat build-up and cell-damaging photochemical reactions in the optical wavelength range.

Ionizing radiation originates from the bedrock, nuclear reactors, X-ray equipment and outer space. Ultraviolet radiation (including sunlight), visible light, microwaves and radio waves are non-ionizing forms of radiation, including electromagnetic fields from power lines and electrical devices.

Ionizing radiation from radon increases the risk of lung cancer and is dealt with in the action plan together with the indoor environment (see section 7.3.2). The effects of ionizing radiation cannot be completely eliminated, but a variety of measures can be taken to reduce exposure to such radiation.

The health risks associated with the operation of nuclear power plants and the disposal of radioactive waste are normally very low. However, the potential risks in connection with accidents, war and sabotage are incalculable. It is of the utmost importance that present safety levels be maintained as long as the reactors remain in operation and the waste is active. For Sweden, it is important to contribute to improvements in the safety of nuclear power plants in neighbouring countries, in Eastern Europe in particular.

Malignant melanoma (a form of malignant skin cancer) is the form of cancer that is increasing most rapidly in Sweden at present. On average, the prevalence of malignant melanoma has increased during the last two decades by about 5% per year and mortality has increased by 3% per year. This increase is attributed to modern sunbathing habits. UV radiation is estimated to cause 1 200–1 300 of the 1 400–1 500 cases of malignant melanomas every year, and of these about 300 cases lead to death.

Children who live very close to power lines are exposed to an increased risk of blood tumours (leukaemia), although this is a rare form of tumour. There is also a suspected connection with brain tumours among adults. There is also discussion of hypersensitive reactions in connection with electric and magnetic fields, but the

connection has not been established. Further research on mechanisms relating to electric and magnetic fields and health problems is important.

Indicative measures

The health effects of various forms of energy have been thoroughly investigated and many authorities are involved in measures together with the industries concerned. The risk of sunburn has also been noted and several information campaigns have been conducted.

- Safety regulations for nuclear power plants and radioactive waste must be stringent, and Sweden should make efforts to ensure high safety levels in neighbouring countries.
- Information should continue to be given on the risks of sunbathing.
- Further research on the health effects of exposure to electric/ magnetic fields is an urgent priority.

7.3.7 Injuries caused by accidents

General health objectives

> No-one should be injured due to accident risks that can be prevented.

Every year about 3 000 people die and 900 000 people visit outpatient care as a result of accidents. 140 000 of these are hospitalized. In 1990, the total cost of injury was estimated at approx. 62 billion kronor, or 4% of GDP. Fatal accidents are the main cause of death in the age group 1–44, but the elderly are also affected to a great extent. The statistics on inpatient care indicate that injuries caused by falls are the main cause of hospitalization as regards both men and women aged over 65. The extent of injuries caused by accidents still makes them one of the most serious environmental health risks.

In the last ten years, total mortality from accidents in Sweden has fallen by about 10%. The greatest reduction has been in fatal accidents among children and in the workplace. However, the number of people injured so seriously that they must be hospitalized has not decreased correspondingly.

In both these groups the number of deaths has dropped from over 400 in the 1950s to less than 100 in the 1990s. Injuries and deaths from traffic accidents have decreased sharply in the last 20 years, despite the increase in motor traffic. These gratifying results are attributable to a combination of more stringent legislation, local protection work, increased knowledge, increased use of various kinds of protective equipment, safety standards for machines, plant and products, and structural measures. This bright picture is darkened by several disasters in this part of the world that have reminded us of our vulnerability, the Chernobyl and M/S Estonia disasters in particular.

The encouraging experience gained from various sectors has, since the late 1980s, been drawn on in concerted injury prevention measures. These measures, integrated into the national injury programme, are organized by the National Institute of Public Health. We support this work and also propose the following measures:

- The health services should, both with respect to outpatient and inpatient care, register cases of injury, including information on the place of the accident and the course of events.
- Local authorities should monitor accident risks in the home or in conjunction with recreation and take appropriate action where necessary.

This report contains proposals for a national environmental health action plan for Sweden. The report presents the relevant scientific data, organizations and instruments and the discussions on which the proposals are based. The proposals are made in the context of the need to consider health aspects in all sectors. They define important principles for environmental health activities, recommend new objectives and guideline values and draw attention to the need of new research and a high level of preparedness for future problems. The action plan was commissioned by the Government and will be examined by the Cabinet Office and the Ministries and modified if necessary before being presented to Parliament.

FRITZES

Postal address: S-106 47 Stockholm, Sweden • Tel +46-8-690 9190 • Fax +46-8-20 50 21

ISBN 91-38-20389-8 • ISSN 0375-250X