

Ten environmental measures



**The ten most important environmental
measures to improve public health
in the County of Stockholm**

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Preface

Our knowledge of how a ruined or deteriorating environment affects the health of every person is considerable, and growing. Within The County of Stockholm Council, we needed a clear and concrete, easy to read and easily accessed review of what we must, and can, do – now and in the near future.

This is the background to the assignment given by the Stockholm County Council Assembly in November 2004: to develop an action list of the ten most important environmental measures that can improve health in The County of Stockholm. The result is the report you are holding in your hands.

It makes for scary reading, although the content was mostly to be expected. We know very well that air pollutants, noise, tobacco smoke, UV radiation and different allergens affect human health.

The report is unique in that it not only presents, from a scientific basis, the environmental factors that affect our health; it also provides examples of the costs incurred as a result of environmental problems, so long as society continues to accept them, together with proposals for what can be done to deal with those problems.

What you are holding in your hands is a knowledge bank. Some proposed measures are cost-free; a simple decision is all that is needed. Other measures require an investment equivalent to a small fraction of the potential savings.

My challenge to the reader is simple: No matter what your role is in society, take this report to heart, and implement it in practice. If you do not think that the reward in terms of reduced human suffering is sufficient, there is an additional, self-interested bonus: reduced costs to society.

Stockholm, August 2005

Bengt Cedrenius

County Council Commissioner 2002-2005

Preface

This report presents a scientifically based inventory of the ten most important environmental measures to improve public health in the County of Stockholm. It is the result of a political initiative by the Stockholm County Council addressed in late 2004. The task was given to a working party of experts on environmental medicine at Stockholm County Council Centre for Public Health. The results were reported in June 2005 and formally adopted by the County Council in September 2005. The present version of the report, in English, is updated and slightly revised.

When adopting the report, Stockholm County Council decided to take several steps in health-promoting direction, in accordance with the proposals presented in the report:

- All services and companies belonging to the County Council should, whenever possible, claim that allergenic constituents in procured products are substituted by non-allergenic alternatives.
- Stockholm Transport (AB Storstockholms Lokaltrafik, the public transportation company) should specify how to increase the percentage renewable fuels in bus transportation to 50 % by the end of year 2011.
- Stockholm Transport should develop an action plan and cost assessment to counteract health hazards to the general public caused by air pollution and noise from the bus traffic.
- All services and companies belonging to the County Council should suggest urgent measures, besides proposed information activities, to counteract negative health effects caused by tobacco smoke, UV irradiation, and air pollution and noise from other traffic.

Financial resources to fulfil these tasks were given to the services and companies concerned in the County Council in the budget for year 2006.

Stockholm, March 2006

Åke Wennmalm, MD

Environmental Director

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Summary

A working group that included representatives of the Stockholm County Council^a Centre for Public Health, and the Environmental Department at the Stockholm County Council, was assigned by the County Council Assembly to identify ten actions deemed by the working group to be the most important environmental measures that the Stockholm County Council should undertake to improve public health in the county. The working group considered only those environmental factors that have, at present, a scientifically proven effect on health in The County of Stockholm. This report will therefore need to be revised as new knowledge is gained.

The most important measures identified by the working group are as follows (the list is not in priority order):

- Continuously inform other action parties about the importance of air pollutants to public health, and of the need for improvements.
- Ensure that Stockholm Transport^b and other organisations within the Stockholm County Council responsible for transport have the resources they need to reduce emissions of air pollutants from vehicles, through such actions as more effectively reducing emissions from their own vehicles and working machines; using alternative fuels (e.g. ethanol, biogas and hydrogen gas) in their own vehicles; and requiring such actions in procured transportation services.
- Ensure that Stockholm Transport and other organisations within the Stockholm County Council responsible for transport have the resources they need to reduce noise through, for example, better muffling of the sound from vehicles and traffic systems, and noise-reducing building facades.
- Ensure that Stockholm Transport has the resources to implement an action plan for increasing the percentage of travellers who choose public transport, by making it more customer oriented.
- Continued support to ex-smokers, and campaigns to reduce the number of people recruited to take up smoking.
- Inform healthcare workers and the public about the risks of solariums, and about what periods during the year and the day when UV risks are greatest. Work to get warnings out through the media when needed.
- Actively restrict products containing allergens among products procured by the Stockholm County Council.
- Provide information, staff training, and public education about ways to avoid contact allergy and skin disease from wet work.
- Develop requirements for healthy working environments in the Stockholm County Council's own operations and in contracts with suppliers.

^a Stockholm County Council's mandate is to ensure that its residents (1.9 million citizens in 26 municipalities) have access to healthcare and public transport.

^b Stockholm Transport plans and procures, on behalf of the Stockholm City Council, public transport by bus, underground, commuter and local trains for a total of 622,000 travellers.

- Initiate and stimulate research on the environment-induced health impacts of road traffic, in order to clarify the connections between
 - different kinds of pollutants
 - different particle sizes in solid air pollutants
 - noiseand the diseases that seem to be correlated to these factors.

Introduction

The assignment

- On November 24, 2004, the Stockholm County Council Assembly decided to give the County Council Executive Board the task of producing a list of the ten most important environmental measures to improve public health in The County of Stockholm.

Factors concerning the psychosocial environment were not included in the task.

This work constitutes a part of the County Council's work on health and environmental issues. Closely related areas are dealt with in the County Council environmental policy (mainly with regard to impact on the outdoor environment), the public health policy (adopted in June, 2005 and according to this policy Stockholm County Council shall work for a good health among the entire population), and the policy on food that currently is under development.

Target group

This report is aimed for political decision-makers engaged in reduction of illness related to environmental factors within the County of Stockholm. The measures in the report are intended to benefit the population of The County of Stockholm.

Organisation

The project was conducted by a working group consisting of:

- Tom Bellander, Associate Professor, Epidemiologist
 - Antonios Georgelis, Associate Professor, Toxicologist
 - Per Gustavsson, Associate Professor, Senior Physician
 - Magnus Lindberg, Professor, Senior Physician
 - Magnus Svartengren, Professor, Senior Physician
- all at Stockholm Centre for Public Health, Dept. of Occupational and Environmental Health
- Pia Lindeskog, Dr.Med.Sc, Nutritionist, Stockholm Centre for Public Health, Dept. of Health Promotion and Prevention
 - Lena Gustafsson, Environmental Department
 - Elisabet Åman, Environmental Department
 - Lars Hällbom, PhD, Kemi & Miljö Konsulterna AB (Project leader)

Additional persons have temporarily been included in the working group when needed.

The project leader has reported to a steering group consisting of:

- Carola Lidén, Professor, Head of Department, Stockholm Centre for Public Health, Dept. of Occupational and Environmental Health
- Stefan Wallin, Chief Environment Officer, Environmental Department
- Åke Wennmalm, Environmental Director, County Council Executive Board Administration Group Executive (Convener)

Definitions and boundaries

A number of basic concepts used in the terms of reference have been given the following definitions by the working group:

Environment

Environment refers to *"Everything that is outside humans"*.

Comments

The concept of environment has a number of definitions depending on the context. The working group has been guided in its work by the definitions of the Swedish National Encyclopaedia and by the environmental standard ISO 14001. In addition, we have used the sixteen environmental objectives adopted by the Swedish Parliament for direction.

The environmental quality objectives adopted by the Swedish parliament guide all society's environmental work. An overall vision is that we must leave the next generation a society in which the great environmental problems have been solved. Human health is a fundamental parameter within the environmental objectives (<http://miljomal.nu/english/objectives.php>).

Among Sweden's environmental objectives, the following have had direct relevance to our choice of relevant environmental issues, since they are directly linked to health aspects:

- **Clean Air**
- **Non-Toxic Environment**
- **A Safe Radiation Environment**
- **A Good Built Environment**

We have made the following determinations regarding the other environmental objectives:

- **Reduced Climate Impact.** We have not been able to see any possibilities to make a direct link between the impact on the climate and health on a scientific basis. A changed climate can obviously, over time, have a large impact on the quality of our food, the spread of new diseases etc. We have however made the determination that it is not possible, at this stage, to address such effects.
- **Natural Acidification Only.** Acidification of land and water can be of significance to health through leaching of toxic metals into food and drinking water. We have made the determination that these effects have been addressed within the framework of the objective "Non-toxic Environment".
- **A Protective Ozone Layer.** The depletion of the ozone layer can impact health through increased UV radiation. We have made the determination that we address these effects within the framework of the objective "A Safe Radiation Environment".
- **Zero Eutrophication.** Eutrophication of fresh water and seas can have secondary health impacts, e.g. through reduced quality of drinking water, changed

availability of certain food and increased occurrences of toxin-producing micro-organisms. We have made the determination that we address these effects within the framework of the objective "Non-toxic Environment".

- **Flourishing Lakes and Streams, A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos, Thriving Wetlands, Magnificent Mountain Landscape, Sustainable Forests, A Varied Agricultural Landscape.** We have made the determination that these objectives are certainly of importance to health, since the availability of these natural environments is of great importance to recreation and therefore to our wellbeing. Other secondary health effects can also arise from the impact on these natural environments. However, we are unable to identify clear cause-effect relationships that are relevant to this project.
- **Good-Quality Groundwater.** We have made the judgement that we address the important health effects of deteriorating ground water within the framework of the objective "Non-toxic Environment".

Environmental factor

In this report "environmental factor" refers to "*A phenomenon in the surroundings that affects human health*".

We have excluded psychosocial factors in accordance with the steering group's directions. In addition, we have chosen to exclude the following factors that we understand are not considered as "environmental factors" in the terms of reference:

- Physical injuries caused by e.g. accidents
- Infectious diseases

City planning can also be considered to be an environmental factor, since it creates or prevents opportunities to physical exercise by planning green areas, pedestrian and bicycle roads, etc. However, this issue is excluded because it constitutes another part of the Stockholm County Council's work.

Finally, we have excluded the effects of electromagnetic fields from, for example, built-in switch boxes, power lines, transmission towers, computer screens and cell phones. The issue has newly been thoroughly investigated (7, p 254-258) and the authors could not find any well documented health effects related to the field intensity that the population is currently exposed to. The authors stressed, however, that it is still too early to make a determination about the health effects of longer-term exposure to cell phones and other equipment that has not yet been used for a longer period of time.

Comments

There are a number of approaches to identifying environmental factors with a potential impact on health. One approach, which is being used in the standard work on environmental management systems, is to start from human activities, and trace individual environmental factors. An example: road traffic is considered to be an environmental factor whose environmental impact can be split into the following parameters:

- Emission of greenhouse gases
- Air pollution
- Road accidents
- Water pollution
- Noise
- Soil pollution

At the next stage, the subject of air pollution can be split, for example, into particles, nitrogen oxides, sulfur oxide, hydrocarbons etc. The subject of particles can be split into dust from combustion and from the wear and tear of roads, tires, tire studs, etc.– and these can in their turn be split further according to particle size.

Another approach is to start with different kinds of pollutants on the macro level (air pollution) or micro level (organic airborne particles within certain size ranges) and to identify the sources of pollution.

A third approach that is widely used today is to start with the 16 national objectives that have been determined by the Swedish Parliament and to relate these to the problem in question. This approach has the advantage of being based on objectives that have been selected after both a scientific and a political discussion, and that are well supported and thus easy to communicate and gain acceptance for.

We have chosen to use all these approaches.

Health

The working group has used the WHO definition: *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"*.

Environmental measure

In this report "environmental measure" refers to *"A measure that affects the environment so that preconditions for health are created or strengthened"*.

Comments

We have taken effects on the Stockholm County population as our starting point in this project. We have of course not proposed any actions that have a negative effect on the populations of other regions.

Health effect

No clear-cut definition is given, but different parameters are needed to measure health effects. The working group has tried to quantify improvement (and worsening) of health, rather than of illness.

Objectives

1 – Environmental factors and health

The objective was to produce a catalogue of known diseases or medical conditions that are caused or worsened by environmental factors, as well as to catalogue these environmental factors. The catalogue should be supported, to the extent possible, by a clear and scientifically based description of the environmental factors and their relationship to health. The catalogue is based on the scientific documentation that is available today and should therefore be updated at the interval of every couple of years, as new scientific knowledge is gained.

2 – Possible measures

The objective was to produce a list with at least one possible measure, in order to reduce the negative impact on health for each of the catalogued environmental factors. The list should be supported by a description – based on scientific evidence – of the expected effects of the measure on the environmental factor and of the subsequent expected positive health effect.

3 – Prioritization

The objective was to prioritize the ten measures that the working group considers to be the most important among the listed measures. The list should also, to the extent possible, indicate who is responsible and has the mandate to implement the measure; an estimate of the implementation costs and benefits; and the cost of no implementation. In this project, the working group will only proceed with the environmental factors that have a documented effect on health in the County of Stockholm. The purpose here was to be able to state with certainty that the proposed actions will have a positive effect on health. Many of the other identified environmental factors are also important to reduce, because of the risk of future health effects (the precautionary principle); but it has not been part of our assignment to prioritize on that basis. The prioritisation applies to the present state of our knowledge. New knowledge regarding health effects, as well as an altered exposure situation, can in the future provide a basis for another prioritization.

Method

The working group consisted of some of the county's leading experts on environmentally related health issues. All of them are active researchers. These persons were responsible for collecting all the relevant scientific data that were used in the work, and for guaranteeing that an adequately broad scientific network was used to cover all important research in the field. The work was led by an external project leader, whose task was to chair meetings in order to facilitate agreement on the evaluation of scientific data, prioritization of the importance of the environmental factors, and the reasonableness of the proposed measures and their prioritization. The project leader was also responsible for documenting the work in a report, and for guaranteeing that the wordings in this report represent the opinion of the entire group.

Results and conclusions

1 – Environmental factors and health

The working group has, in Table 1, synthesized known relationships between health and environmental factors. The data sources were reports and scientific publications by group members or other employees of the Stockholm Centre for Public Health, and by other external sources.

Table 1 presents the environmental factors that have scientifically well-demonstrated relationships to human health effects. An important criterion for inclusion in the table has been that the health effects related to these environmental factors are known to affect, or are suspected to affect, the general population within the Stockholm region.

Global – regional – local environmental factors

The environmental factors that we have compiled include, to a small extent, those global factors that tend to dominate today's environmental debate. It is obvious that the greenhouse effect can lead to considerable health effects by, for example, making it possible for tropical diseases to spread, by causing lack of drinkable water in new geographical areas, etc. Due to their global distribution among other issues, these environmental factors are difficult to link to a specific health effect in a rigorous way. This does of course not mean that they should be considered as a smaller risk factor than many of the other factors that we have listed in the tables; but the task in this project was to identify factors where one, *with certainty*, can claim that the undertaken measures will lead to improved public health in the region.

Regional environmental factors, such as the accumulation of toxic substances in the Baltic Sea, are also of such character that it is difficult to find ways to link a specific factor to a specific health effect.

We have thus ended up with more local environmental factors such as air pollutants of mostly local origin, noise of entirely local origin, allergens in the surroundings, etc.

Voluntary and involuntary exposure

According to the project directives, we should not include environmental factors to which we willingly expose ourselves. In some cases, such factors can still be found in the tables, since they comprise both voluntary and involuntary exposure elements. One example is smoking, where measures to reduce exposure to tobacco smoke will also reduce the involuntary exposure to tobacco smoke in the smoker's vicinity as well as the smoker's involuntary exposure to cadmium. As a side effect there is, in addition, a much greater health effect in terms of reducing illness among smokers that stop smoking, and we have not found any reasons to refrain from including this in the benefit of the measures to be taken.

Table 1. Environmental factors with scientifically well demonstrated relationships to human health effects and where it is demonstrated, or where it on good grounds may be suspected, that the effects exist in the Stockholm region.

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Air pollutants	In common for air pollutants regardless of source	10% bothered by air pollutants ^{1 p. 14} Environmental quality norm for NO ₂ is exceeded ^{1 p. 36} Annual average Stockholm city 2003 for NO ₂ was 18 µg/m ³ and for PM ₁₀ (breathable particles smaller than 10 µm) was 14 µg/m ³ . ¹¹	Respiratory diseases, cardiovascular diseases ^{1 pp 30,34, 39} and lung cancer ^{1 p42 ff}	Cost per case of lung cancer 1.8-11.8 MSEK ²⁶	About 270 hospitalisations in Stockholm due to respiratory diseases, of which 60 are due to particles and 210 due to NO ₂ ^{1 p. 50} . About 390 due to cardiovascular diseases, thereof 100 particles, 290 NO ₂ ¹⁰ , 100 - 200 lung cancer cases per year in the country ^{1 p. 30 ff} . A reduction of PM _{2,5} by 3.5 µg/m ³ would lead to a total gain of 280,000 years to live in the region ¹⁰ .	NOx is decreasing, but not ozone or PM ₁₀ . Recommended values are exceeded ^{1 p. 14} . Transition to bio fuels in small and medium sized installations can increase particle emissions ²⁵ .
	Traffic Energy production, industry and construction insignificant compared to traffic ³	Black smoke 9%, heavy diesel 1%, light diesel 0,5%, petrol with catalyst 2%, petrol without catalyst 10%, working vehicles, Stirring up dust from roads probably as big as exhaust. Stirring up 87%, exhaust in total 8% ¹³ .				Number of fatalities per day increases about 2% per each increase of the ozone concentration by 10µg/m ³ . Heavily increasing hospitalisation at Swedish normal concentrations ^{1 s41} .

Table 1, continued

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
	Occupational environment	In average 15% (women) and 20% (men) report that they are exposed >1/4 of the working day ² . Among construction workers 76% exposure to dust/fibers, dentists/dent. nurses exposure to acrylates, hairdressers/beauticians 50% ² to aerosols. Exhaust from engine 4% ² .	Large range of diseases, e.g.: allergy/asthma (hairdressers, flour dust etc.), COPD (construction workers), lung cancer (i.a. exhaust from engine), myocardial infarction by fine particles ² .	Cost per case of asthma attack 900-2,600 SEK ²⁶ .	About 2% of male labour force in Stockholm exposed to exhaust from engine to the extent that increased risk of lung cancer exists. Addition of about 7 cases per year ²⁴ . About 2% of all cancer cases caused by working conditions according to the cancer committee, 22 cases per year in total in Stockholm.	Varying.

Table 1, continued

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Indoor air quality	<p>Building materials</p> <p>Contaminated land</p> <p>Interior fittings</p> <p>Activities in the premises</p> <p>Ventilation</p> <p>Growth of micro-organisms</p>	<p>10-20% bothered by indoor environment, 7% experience symptoms due to their dwelling^{1 p. 14}</p>	<p>Discomfort, experienced inconvenience, respiratory symptoms, asthma^{7 p.159}</p>	<p>Cost per case of asthma attack 900-2,600 SEK²⁶</p>	<p>In The County of Stockholm about 200,000 (20% of slightly more than a 1 million nationally^c) adults 19-81 years of age report symptoms due to factors in the indoor environment^{1 p.58}. Nationally more than 1,000 children age group 4 years or younger develop infant asthma yearly related to damp problems in their dwellings^{7 p.130}.</p> <p>Corresponding national estimate, based on (Statistics Sweden) 104,644 children in the age group 0-4 in The County of Stockholm, can roughly estimated mean that about 250 children within this age group suffer from asthma symptoms due to damp/mold damage in their dwellings.</p>	<p>Extensive exposure. Large portion of the day is spent in different indoor environments. Significant exposure of small children.</p>
Radon	<p>Building materials</p> <p>Ground</p>	<p>About 40,000-80,000 persons in The County of Stockholm (200,000-400,000 in Sweden) are exposed to levels above the threshold limit^{1 p. 10}</p>	<p>Lung cancer^{1 p. 170}</p>	<p>Cost per case of lung cancer 1.8-11.8 MSEK²⁶</p>	<p>Prevalence in Stockholm can be estimated to 80 cases per year. 400 cases of lung cancer in the country^{1 p. 10} (whereof 80% are smokers⁴⁵).</p>	

^c The Swedish population is approx. 9,000,000, the Stockholm area population is approx. 1,900,000.

Table 1, continued

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Passive smoking	Smoking	About 6% at home, 5% at work, 4% elsewhere, 12% in total ^{1 p. 61}	Lung cancer, myocardial infarction, ischemic heart disease, respiratory infection, asthma, sudden infant death ^{1 p. 62-65}	Cost per case of lung cancer 1.8-11.8 MSEK ²⁶ . Cost per case of asthma attack 900-2,600 SEK ²⁶	30-60 cases of lung cancer, slightly more than 1,000 persons getting myocardial infarction and ischemic heart disease ^{1 p. 14} , peri-natal mortality ^{7 p. 42} , coupling to asthma ^{7 p. 117} , slightly more than 500 cases of repeated ear infection, slightly more than 500 cases of asthma, single cases of sudden infant death ^{7 p. 148} .	In general declining exposure ^{1 p. 14} .
Passive smoking at work	Smoking	8% of all employed staff in Stockholm year 2001 ^{6 p. 32}	Cardiovascular diseases, lung cancer, respiratory diseases ^{7 p. 152 ff}	Cost per case of lung cancer 1.8-11.8 MSEK ²⁶		Declining 1991-2001 from about 20% to 8% ⁶ . Domestic medical care workers are still exposed.
Medical drugs (active medical substances)	Cytotoxics, antibiotics and others	Handling within health care sector. Nurses plus a 5-10 times bigger group of assistant nurses, cleaning staff, laundry service staff, garbage handlers, and others ³⁰	Hypersensitivity reactions, cytotoxics-related effects ³⁰		In average about 15 cases per year are reported in the workplace injury statistics. Hidden statistics due to imperfect workplace injury reporting within health care ³⁰ .	Constant. Number of reported cases varies between 8 and 22 during 1992-2000 ³⁰ .

Table 1, continued

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Noise	Road, train, and air traffic Disotheque/concerts Toys Neighbours Fans	About 20% annoyed by road traffic and neighbours whereof half by road traffic ^{1 p. 14} . According to the Swedish Environmental Protection Agency 30% in Stockholm city and 20% in the remaining county are exposed to building facade noise levels in their dwelling >55 dBA (threshold limit). 1/3-experience symptoms ⁴⁴ The rate of annoyed persons has increased between 1997 and 2002 ^{20 p38}	Reduced hearing, disturbance of sleep, increased risk for disease related to hypertension ^{1 p.124} . Tinnitus, reduced learning ^{7 p. 212} . General annoyance. When exposed to air traffic noise reduced school performance, mainly memory, with an estimated 1-2 months developmental delay in relation to the Swedish compulsory education curriculum. Hypertension, indications of increased risk for myocardial infarction ⁸		3-4% of twelve-year-old children report tinnitus, 3% insomnia, road traffic causing half, 24% discomfort school/after-school centre, 4% discomfort at home ^{7 p. 212} . Hearing loss <10% of age group 20-30 years. 2-3% of ischemic heart disease (vascular spasm + myocardial infarction) can have noise as contributing factor ⁸ .	Road traffic noise unchanged? Noise from fans and installations in buildings is increasing ^{1 p.14} .
	Occupational environment	In Stockholm: Men 19%, women 15% exposed to noise to the extent that conversation at a distance of 1 m is made difficult ⁴			In total 1,700 reported work place injury cases per year in Sweden (2003), considerable hidden statistics except for noise causing hearing loss ⁴ .	Exposure unchanged among men in Stockholm 1991-2001, 20%. Among women the rate increased from 13 to 15%. Increase within pre-school ⁴ .
UV light	Sun Solariums	The entire population, varying depending on sun habits and time spent in countries closer to the equator.	Malignant melanoma, squamous cell carcinoma, basal cell carcinoma, cataract ^{7 p. 247} .	Cost per case of skin cancer 28,000-519,000 SEK ²⁶ . Cost per UV-induced skin diseases in the Stockholm region 162 MSEK/year ¹⁵ .	Causes large share of skin cancer ^{1 p. 14} . Melanoma + squamous cell carcinoma < 5,000, basal cell carcinoma 25,000-30,000 ^{7 p. 246 ff}	Mainly depending on sun habits ^{1 p. 14} .

Table 1, continued

Environmental factor		Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Allergenic substances in products	Fragrances	Cosmetics, skin care products, chemical products, etc.	Exposure of entire population	Contact dermatitis, contact allergy, hyper-reactivity ^{1 p.147ff.}	Cost per case of contact allergy 79,000-690,000 DKK ²⁶ .	Fragrance substances belong to the most frequent skin sensitizers; allergy in tested dermatitis patients >8% ³ .	Increasing exposure. Some restriction by legislation ^{3, 16, 17} .
	Preservatives	Water-based products (paints, cosmetics, skin care products, metal working fluids etc)	The entire population and in some occupational environments ¹⁸ .	Contact dermatitis, contact allergy ^{1 p.16ff.}	Cost per case of contact allergy 79,000-690,000 DKK ²⁶ .	Preservatives belong to the most frequent skin sensitizers, tested dermatitis patients 3-10% ³ .	Exposure varies due to addition of new substances. Increase for cosmetic related allergen ^{16, 17, 18} .
	Nickel	Metal objects (utility goods, industry, tools, jewellery etc.)	Within the population in general, in some occupational environments	Contact dermatitis, contact allergy ^{1 p.161ff.}	Cost per case of contact allergy 79,000-690,000 DKK ²⁶ .	3-7% of men, 8-27% of women in different age groups ^{1 p.162} Sensitisation by skin contact with objects that release nickel ^{1 p.14}	Up to now increasing but new legislation (EU Nickel Directive) limits nickel in jewellery etc. ^{1 p.167} .
	Rubber chemicals and latex	Rubber products (protective gloves, medicinal products, toys, condoms etc.)	The entire population. Health care sector, cleaning services, chemical industry, handling of food ^{4 p. 81, 19} .	Contact dermatitis from rubber chemicals; immediate allergy (urticaria, rhinoconjunctivitis, asthma, anaphylaxis) from latex ^{19 p. 10 ff.}	Cost per case of contact allergy 79,000-690,000 DKK ²⁶ .	Contact allergy to rubber chemicals 1-3% in dermatitis patients. Immediate allergy in population < 1%, within health care sector 5-25% depending on exposure ¹⁹ .	In the population - increasing? In health care sector decreasing? In food handling increasing?
Wet work (health care, service occupations etc.)		Work with frequent contact with water, detergents, food etc.	Very common, considerable risk factor for hand eczema ³ . Within the population in general (domestic work) and within service occupations, health care ^{19, 22}	Contact dermatitis, mainly hand eczema ^{1 p. 161ff}		Hand eczema prevalence 15-20% in exposed groups/occupations ^{6 p.82}	High exposure, can be reduced through legislation, directions, working routines ²³ .
Exposure to food that damages health		Supply of fast food	About 50% of men are overweight/fat, about 35% of women, about 15% of children/adolescents			50 persons per day pass the limit for being overweight or fat in the County of Stockholm ⁴⁶	No sign of declining exposure to fast food ⁵ .
		Strong marketing of energy-dense food	- "-			- "-	No sign of declining marketing ⁵ .

Table 1, continued

Environmental factor	Source	Exposure rate	Disease	Cost	Disease prevalence (no. cases per year)	Exposure/trend
Physical load during work		As an example in the population: Heavy lifting men 27%, women 19% ⁶			Rate of men with lower back problems: 5-25% in different occupational groups, highest among cleaners, fitters, construction workers, freight handling etc. ⁶ Among women 7-29%, highest among auxiliary nurses, assistant nurses, dentists, dental nurses ⁶ .	Increasing illness.

Comments to table 1

Air pollutants

The city population is exposed daily to air pollutants that originate, to a large extent, from the combustion exhaust produced by vehicle traffic. Extensive research has demonstrated that exposure to air pollutants, and perhaps mainly particulate air pollutants, is clearly associated with health effects like increased morbidity and mortality in lung diseases and cardiovascular diseases (48, 49, 54). It has also been observed that the number of hospital emergency room visits among persons with asthma is increasing, as well as the need for medication, in response to increased air pollutant concentrations (49, 59). Epidemiological studies have demonstrated a correlation between exposure and asthma attack, with only about a one-day delay. Exposure chamber studies on diesel exhaust ($PM_{10}=300\mu g/m^3$ for 2 h or $PM_{10}=108\mu g/m^3$ for 1 h) have demonstrated that diesel exhaust causes an inflammatory response in lower airways in healthy subjects, exemplified with an increase of the share of neutrophil granulocytes, as well as an increased concentration of different inflammatory mediators (e.g. interleukin (IL)-6, IL-8) in induced sputum and lung-rinse liquid (52, 55). Some inflammatory effects have also been found in persons with asthma in response to increased concentrations of IL-6 in induced sputum (53). But the perhaps most dramatic effect in that study was a significantly increased bronchial reactivity to metacholine following exposure.

Short-term exposure in a road tunnel (Söderledstunneln) has been demonstrated to enhance the allergic response in people mildly affected by asthma, at a subsequent allergen provocation, compared to a control exposure with filtered air (60). Recent research has demonstrated, in an exposure study, that two hours of exposure in Söderledstunneln induces a mild inflammatory response in the lower airways in healthy people (51), with a significant increase of lymphocytes and alveolar macrophages in lung-rinse liquid.

Particles in the city environment are however of different origin. Partly they consist of exhaust particles that are mainly of small size, that is, less than 100 nm. Partly they consist of coarse particles from tires (with or without studs) in contact with the road surface, wear from e.g. brakes, or sanding. Coarse particles are typically large and best measured by particle size like $PM_{2.5}$, or PM_{10} . Exhaust particles on the other hand contribute only to a small extent to the mass, and are better measured by particle number.

It is still not clear how to evaluate risks in different particle environments. Forsberg and Segerstedt have reported, in a study prepared for the Swedish Road Administration (50), that road dust increases airway problems and leads to additional hospital emergency room visits and hospital admissions due to problems in the respiratory organs, for example asthma. There are no indications in this study that road dust exposure affects hospital admissions of cardiovascular diseases, which could be because it is the finer, exhaust-related particles that explain the relationship of PM_{10} to acute cases of cardiovascular diseases, as has been demonstrated also for Stockholm. Knowledge is still limited, and it is not possible today to claim with scientific certainty that particles of different kinds have completely different effects. In conclusion, one should be somewhat careful when interpreting parameters that are weighed together without considering the source. A special case is the rail environment in the underground. Due to friction when hitting the brakes, a very high particle exposure, with high metal content (mainly iron) and less exhaust components, is generated in spaces where ventilation is limited. *In vitro* studies suggest that such particles may have considerable effects. Knowledge is still very

incomplete whether these particles are less or more damaging to health and such studies should be given high priority.

We have chosen to handle air pollutants collectively both in this compilation, and in our discussion of measures to be taken. Air pollution is a complex mixture of different harmful substances, where one substance often originates from many different sources. For some substances there are good data that show the relationships of the separate substance to negative health effects (e.g. 1, p 28 ff, 7 p 166 ff), but this does not mean that one can exclude that different types of pollutants interact to affect health.

As regards particles, there is an ongoing scientific discussion (e.g. 1 p 28 ff, 7 p 166 ff) on the separate risks of particles of different sizes, where the larger sizes ($>PM_{2.5}$) are mainly considered to increase the frequency of airway diseases, and the finer sizes are mainly considered to affect the frequency of cardiovascular diseases. The picture is not fully complete because of the uncertainty, among other factors, regarding the separate effects of different kinds of particles on our bodies, such as black smoke from the combustion of fossil fuels, black smoke from combustion of biofuels, and particles that are stirred up from road. Studies indicate that there are big differences in the way particles behave in and affect the body. Our assessment is that it is important to reduce all air pollutants that are presented in the table. By handling air pollutants with a collective approach, we believe that the measures that are proposed in this report will also reduce the concentration of other potentially harmful substances in the air.

Smoking

A person's own smoking obviously causes considerable greater damage to his or her health than the smoking of other people. In our assignment, smoking in itself is not considered to be an environmental factor, but to be a matter of behaviour. There are, however, still measures against smoking in our list of actions, since cadmium pollution from tobacco is an environmental factor as defined in this assignment. Passive smoking, due to exposure to tobacco smoke from other people smoking, is also of great concern.

A special problem exists regarding domestic medical care workers who are exposed to tobacco smoking in the homes of their patients. It is not obvious who can influence this situation, since it concerns both the occupational and domestic environment.

A question for the County Council is also the appropriateness of offering cigarettes and tobacco in the premises of the County Council.

Medical drugs

Only effects of medical drugs that have been documented in the occupational environment of the health care sector are dealt with in this table.

UV light

UV radiation from the sun is a natural environmental factor, but modern sun habits are nonetheless causing different kinds of UV-induced tumours, both life threatening and deforming, that cause considerable suffering and that cost very large sums of money within the health care sector. It is presently not possible to separate to what extent the disease is caused by natural UV radiation or by artificial radiation in solariums. It is also not possible to assess if the depletion of the ozone layer caused by man to any extent has so far influenced the number of persons suffering from UV-induced tumours. Also nobody can say if the depletion of the ozone layer will continue, and what the level

of depletion will be when it reaches its maximum. Therefore, we have chosen to handle all types of UV radiation as a common environmental factor.

Allergens in products

Contact allergy is a delayed, cell-mediated reaction that causes eczema when the skin is exposed to the allergen. Contact allergy is common among the population (approximately 15-20% has contact allergy to at least one of the most common contact allergens) and it may have far-reaching consequences for the affected individual. The most common causes are metals (mainly nickel), preservatives, fragrances and rubber chemicals in products. Many contact allergens exist both in the occupational environment, where health care workers are heavily exposed (6), and in other environments where time is frequently spent (such as the domestic environment). Sensitisation to contact allergens and elicitation of dermatitis reactions in persons that already suffer from allergy can be limited and prevented by measures that reduce skin exposure, e.g. through legislation and through procurement of products with a limited content of common allergens.

Immediate allergy (IgE mediated) to latex (latex allergy) is another type of allergy that during recent years has been observed as a problem within the health care sector, in health care workers and in patients, and among other sectors. Latex allergy causes hives and/or problems in the mucus membranes (e.g. asthma) and can also result in anaphylactic shock. The problems can be reduced through interventions in product procurement. This work is already going on in parts of the health care sector, but it can be further developed.

Wet work

So-called wet work (occupations with frequent contact with water and detergents, fresh foodstuffs, oil etc.) is, together with contact allergies, one of the most important risk factors for hand eczema. Hand eczema is common and 10% of the adult population has hand eczema sometime during one year (one-year prevalence). Young women are more frequently affected than others, due to more exposure to wet work and also nickel allergy. Hand eczema can result in more frequent changes of job, sick leave and use of healthcare services. The risk to develop hand eczema can be reduced by preventive skin care programmes including limitation of frequent and intense exposure of hands to water, detergents etc., and with the correct use of protective gloves and moisturisers.

Food

Food is like a chemical soup. Nutrients, the biological reason for consuming food, have of course a basic effect on body functions and health. Besides the nutrients, a large number of other substances in food can affect health, for example phyto estrogens, phenols and mold toxins. In addition to naturally occurring substances, food contains a number of chemical substances as a consequence of human activities. During production, food can be contaminated by compounds such as chemical pesticides, and be contaminated with cadmium from fertilizers. During industrial processing, substances are actively added that can affect health, such as nitrite. In addition, a multitude of substances are used within industry in order to improve the industrial process in different ways. During the preparation and processing phase, harmful substances can be formed such as nitrosamines, acrylamide and mutagens that are formed when frying food. The actual importance of these substances to health is not known.

Many of the chemical substances that are being used in society or that are being formed from combustion can be found in food, since they can contaminate the food chains via soil, water and air. There is a risk that the chemical society ends up on the dining table. An example of this is the contamination of fish in the Baltic Sea with substances like PCB, dioxins and bromated flame retardants.

The most up to date analyses of the impact of food on health are presented in two reports from WHO (9, 21). Slightly more than 60% of the mortality among European women and slightly more than 50% of the mortality among European men can be explained by risk factors associated with diet and diet-related factors.

The relationship of food to different diseases often includes many different diet factors or diet-related factors. The emergence of cardiovascular diseases can, for example, be affected by type of dietary fats, pholates, anti-oxidants and being overweight. According to the WHO expert group, the evidence can be split into "convincing, probable, possible and insufficient" (9). According to the WHO expert group there is a demonstrated relationship (convincing + probable) between a number of diet factors and certain chronic diseases. For example, the risk for cardiovascular diseases, certain forms of cancer, type 2 diabetes and excessive weight decreases at increased consumption of fruit, vegetables, and dietary fibre. Unsaturated fatty acids and moderate alcohol intake decrease the risk for cardiovascular disease. While energy dense food (mainly fat and sugar) promotes excessive weight that, together with high intake of salt and saturated fatty acids/trans fatty acids, increase the risk of cardiovascular diseases, type 2 diabetes and certain forms of cancer.

In addition to the relationships presented above, the WHO expert group regards the evidence to be probable that heavy marketing of energy-dense food, fast-food outlets (exposure to availability) and adverse socioeconomic conditions promote weight gain. They further believe that there is evidence that school and home environments that support healthy food choices for children reduce the risk of weight gain.

Regarding health effects of exposure to foreign substances or naturally occurring substances in food, there are very few studies that are relevant to the Stockholm region. There is today no documentation, except for random samples and individual minor studies, on the prevalence and levels of alien substances in the food. Compare this with the documentation of the nutrient content in food that is based on extensive analysis. This means that it is nearly impossible to make an estimate of the exposure. Most substances, both foreign and naturally occurring, exist in small quantities in food, but since a very large population probably is being exposed – for example, the entire population is probably exposed to the chemical pesticides and dioxins – possible health effects may become noticeable or considerable.

Other environmental factors that cause known human health problems

The working group made the judgement that some environmental factors that cause known human health problems were of less concern for the present task. The judgement was based on available scientific documentation indicating that measures, that have already been taken, have resulted (or are on the way to result) in reduced environmental impact of the factor to harmless levels.

The determination of the working group has the following basis.

Lead

As shown by (1) and (7), lead exposure has strongly decreased during the last years in Sweden and is today not considered as a potential health problem in the Stockholm region. The reason for this is mainly the phasing out of lead additives in petrol, but also improved industrial processes as well as improved waste treatment.

Methyl mercury in fish

The load of mercury to the environment in Sweden has declined over a long period of time (1, 7, Swedish Environmental Protection Agency website), and this has also resulted in slowly decreasing concentrations of methyl mercury in freshwater and in Baltic Sea fish. The accumulated amount of mercury is however large; and the decline is going very slowly. Methyl mercury is harmful mainly to a growing foetus (7), but the mercury concentrations in Swedish women are generally down to safe levels. It is however important that we continue to follow the development of this trend, and that the National Food Administration advice regarding food is being communicated and followed.

Dioxins and PCB

The environmental contamination of these organic substances has been reduced dramatically during the last 20 years. Also, the concentrations in fatty Baltic Sea fish, which are the most important source of PCB intake for the Swedish population, have declined (1, 7). The concentrations however still exceed the threshold limits set by the EU allowed in fish used for food. The concentrations in the body tissues among the Stockholm region population are close to the level where there is a risk of damage to health. It is therefore important that the National Food Administration advice regarding food is being communicated and followed.

Chemical pesticides

The working group has not found any evidence that chemical pesticides in food, including drinking water, have caused any damage to health in Sweden (35). The random samples that the National Food Administration takes regularly also show that it is not common that threshold limits are exceeded. Sampling of sources of water supply also demonstrates that threshold limits are rarely exceeded. It is on the other hand common that there are residues in food, mainly in imported food. Knowledge about exposure and health effects of exposure is very limited. In a pilot study from the US, five residues from chemical pesticides were studied in urine from children who had eaten mainly conventional or organic food respectively (37). Among those children that had eaten mainly conventional food, the secretion was six times higher compared to children that had eaten mainly organic food. It is not known if this has any impact on health. It can however be concluded that it is not desirable to have foreign substances in food. Consumption of fruit and vegetables in accordance with the recommended amount of 0.5 kg/day would for many inhabitants in Sweden mean a doubled exposure to chemical pesticide residues. It is not known if this has any impact on the health of the population, but it is not a desirable development.

Some other environmental factors

Environmental factors that cause scientifically well-proven health effects in laboratory animals and in some cases in humans, but where there is no available documentation that indicates that they have any measurable effects on public health in the Stockholm region, were also considered.

Phthalates

Phthalates exist everywhere in our environment and people are continuously exposed during their lifetime (1, 7). Data from animal experiments provide clear evidence of damage to testicles and disturbance in reproduction, among other effects. There is however no evidence of negative human health effects at the exposure levels that are known from the Stockholm region. Since data that imply negative human health effects are beginning to emerge (14), it is important to carefully follow the development of this trend and to begin working now, as much as possible, for a reduction of exposure to phthalates in all situations (precautionary principle).

Alkylphenols

Butylphenol has caused pigment alterations and allergic reactions in people when in contact with the skin, but besides this there are no proven effects (1, 2). Risk assessment of this product group is going on within the EU and should be carefully followed, since the extensive use of this product group means a continuous exposure of the entire population.

Bisphenol A

Intake of bisphenol A has not been demonstrated to promote damage to humans but is well documented in animal experiments (41, 42). Focus is currently on feeding bottles of polycarbonate that can result in exposure to relatively high concentrations of bisphenol A. Bisphenol A is however a well known skin sensitiser (contact allergen).

PFOS (perfluorooctanyl sulfonate)

PFOS has not been demonstrated to promote damage to humans but is well documented in animal experiments (43, p 5). New studies show that the concentrations in human serum are increasing and have passed the safety margins for "Predicted No Effect Concentration," that is, 1% of the dose where damage has been observed in animal experiments (43 p 6).

Bromated flame retardants

There are no proved human health effects of bromated flame retardants (1, 2). The exposure paths are mainly the same as for PCB and dioxins but the exposure is so far considerably lower. Regarding the effects that are similar between bromated flame retardants and PCB/dioxins, the bromated flame retardants have a weaker effect per weight unit. It is not known to what extent the different groups of substances can promote additive or synergetic effects. Since the concentrations of bromated flame retardants (as a group) in the environment are increasing, it is however important to monitor the trends carefully; and application of the precautionary principle makes it necessary to avoid the use of products that add bromated flame retardants to the environment (29).

Acrylamide

There are no proven human health effects of acrylamide in the diet, but there are epidemiological studies that indicate that acrylamide in the diet does not rise the cancer incidence (FAO website). An alarming report from the National Food Administration in 2004 has led to extensive research in the world, and it is important to follow this research.

Exposure to acrylamide in the occupational environment is not considered to be a health problem today (Professor Lars Hagmar, Department of Occupational and Environmental Medicine, Lund University Hospital, pers comm). The Hallandsås tunnel was an extreme exception (38).

Medical drugs

There are no proven human health effects of medical drug residues in the environment (39), but there is a relatively large number of documented damage to animals in nature (39).

Cadmium

The main sources of cadmium exposure are well established (11, National Food Administration website) as well as the fact that cadmium causes impairment of certain functions in kidney cells (7) among other problems; and that it is likely that the effects occur at considerably lower exposure than earlier believed (1, 11). It is not demonstrated that the described function impairment also means a reduction in kidney function large enough to be classified as a disease. We can therefore not provide an estimate of the extent of cadmium-induced diseases, although there are strong reasons to believe that cadmium is part of the picture for a number of patients with impaired kidney functions.

Combination effects of environmental pollutants

We are today exposed to a very large number of foreign chemical substances originating mainly from the chemical industry. It is mostly unknown what combination effects this exposure can create, and during our work we have not found any documentation that makes it likely that we can demonstrate clear public health effects of such combinations in the Stockholm region. This is nonetheless a field that is of major importance, and that the Stockholm County Council will follow very carefully in the future.

2 – Possible measures

It would certainly be presumptuous of the working group to believe that we have sufficient knowledge within all the concerned fields to be able to make a complete list of possible measures to reduce the health risks of all the environmental factors that are listed in table 1. We have used the collective knowledge of the group and available literature in the following way:

- As regards environmental factors for which the mandate to undertake measures lies with other responsible authorities than the Stockholm County Council, we have pointed out for which environmental factors measures are needed, without providing details on which technical measures that are necessary. We have, as far as possible, presented the potential health improvement and, when possible, translated this into economic terms. A compilation of the work of the group is presented in table 2.

- As regards environmental factors for which the Stockholm County Council has the mandate to undertake measures, we have concretized and made cost estimates for the proposed actions, to the extent possible given the competence of the group, available literature and, when needed, contact with external experts. We have quantified the health benefits and, using a rough methodology, put economic figures on these benefits. A compilation of the work of the group is presented in table 3.

The working group thinks that the Stockholm County Council, as the main responsible authority for health care in the region, has the overall responsibility to convey knowledge about the health effects of all the environmental factors that are presented in table 2 to the other responsible authorities. The County Council has also the responsibility to make sure that the health effects of the environmental factors are considered in all contacts with these responsible authorities.

Table 2. Identified possible measures, for other action parties than the Stockholm County Council, to improve public health in the County of Stockholm by reducing the exposure to negative environmental factors.

Objective	Measure	Mandate	Environmental factor
Reduced NOx concentration	Reduce emissions from shipping	Swedish Maritime Administration and others	Air pollutants
	Reduce emissions from road traffic	Parliament	
Reduced PM ₁₀ concentration	Decreased traffic	Each municipality	Air pollutants
	Phase out wood burning without best exhaust purification techniques/Increase connection to the district heating system	Building managers and owners The parliament Actors responsible for road maintenance	
	Alternative fuels		
	More efficient exhaust reduction in vehicles and diesel fuelled machines. Reduction of occupational limits for motor exhaust		
	Expanded and more restricted environmental zones		
	Improved road paving/Dust suppression/ Adjusted quality of crushed stone for prevention of ice formation/Improved road cleaning		
	Regulated use of studded tires/Studded tires fee/ Reduced environmental fee for non-studded tires		
	Congestion charges/ Traffic regulation at high PM ₁₀ concentrations		

Table 2, continued

Objective	Measure	Mandate	Environmental factor
Indoor air quality not a cause of disease	Information about indoor air quality and health	Swedish National Institute of Public Health	Indoor air quality
	Developed ventilation that is adapted to the operations/activities	National Board of Health and Welfare	
	Objectives and action plans that lead to that 85% are satisfied with the indoor air quality	Building managers and owners	
	Fulfil existing obligatory ventilation control (OVK) norms		
	Set threshold limits for indoor air quality indicators		
	Mapping of harmful humidity in buildings, taking measures		
	Systematically conducted humidity dimensioning of new constructions		
	Use of humidity safe and low-emitting building materials		
Follow up of the indoor climate 2-5 years after the final inspection of new constructions and reconstructions; with technical measurements and questionnaire to users			
Radon reduced cause of disease	Radon inventory	Each municipality	Radon
	Ventilation of radon	House owners	
	Reduced smoking	Swedish National Institute of Public Health	
	Smoking ban in public premises	National Board of Health and Welfare	
Passive smoking not a cause of disease	Reduced smoking	Employers	Passive smoking
	Smoking ban at all work places		

Table 2, continued

Objective	Measure	Mandate	Environmental factor
No noise-induced diseases	Congestion charges	Actors responsible for roads House owners	Noise
	Noise absorbing asphalt		
	Traffic noise barriers		
	Noise-reducing building facades		
	Sound insulation of residential buildings		
	Noise reduction in residential buildings		
	Service of ventilation installations		
Reduce all types of UV-induced cancers	Regulate the allowed use of solariums in accordance to the Swedish Radiation Protection Agency (SSI) recommendation	Parliament Swedish National Institute of Public Health National Board of Health and Welfare Municipalities	UV light
	Education of preschool staff, preschool children and their parents		
	Review preschool playground design		
	Try to get the travel agencies to hand out information to parents of small children		
	Inform about periods of the year and during the day when the UV risks are greatest		
Reduce the incidence and prevalence of contact allergy and hand eczema	Inform and educate employees and the general population	Swedish Chemicals Inspectorate Swedish Work Environment Authority National Board of Health and Welfare Municipalities Occupational health care Employers	Allergenic substances in products
	Comply with the EU Nickel Directive and other regulations concerning skin sensitisers		

Table 2, continued

Objective	Measure	Mandate	Environmental factor
Reduce the prevalence and the incidence of hand eczema	Inform and educate employees and the general population about risks and preventive measures	Swedish Work Environment Authority Occupational health care	Wet work (health care, service occupations etc.)
	Requirements for healthy working environments in contracts with suppliers	Employers	
	Improve the work routines to reduce harmful skin exposure		
Reduce incidence of becoming ill due to physical load during work	Intensify the work to prevent unfavourable physical load during work	Swedish Work Environment Authority Occupational health care Employers	Physical load during work

Cost estimates

Measures

When available from the scientific literature, we have made cost estimates. When we have considered it possible to make cost estimates on our own, we have made them with full reservation that these estimates are uncertain.

Health benefits

The experience of the working group has, together with contacts with experts at the Stockholm School of Economics and the Swedish Institute for Health Economics, given us a clear understanding of the complexity and the costs of making good health economic estimates, as well as of making them comparable for different types of environmental factors. We have found that the only accessible way to deal with the issue within the framework of this project is to use schablon costs for institutional care (number of days) and non-institutional care (number of visits) and, when occurring, reduced life quality and loss of years to live. Schablon figures have been taken from (26) and (40).

3 – Prioritization of measures

To prioritize the most important measures, the group has focused on the environmental factors that have the largest impact on public health.

For those environmental factors where responsible authorities other than the Stockholm County Council have the mandate to undertake measures, we have compiled the environmental factors together with proposed comprehensive measures in table 2.

For those environmental factors where the Stockholm County Council has the mandate to undertake measures, we have compiled the environmental factors together with those measures that are most important, according to our assessment, in table 3. The basis for prioritization has been the measures that the group expects to have the greatest impact on public health, and that are technically clearly feasible. Where we have seen an absolute need for undertaking measures against an environmental factor, but where we have not been able to propose concrete actions due to lack of available knowledge, we have instead proposed either further research, or assigning divisions of Stockholm County Council the task of compiling further basic data for decision-making.

It is evident from these tables that the exposure to many environmental factors cannot be sufficiently reduced through measures that are undertaken by one single responsible authority. It is therefore very important that all concerned actors in the region find efficient ways of cooperation to undertake the needed measures.

Table 3 contains the proposed ten measures that, in our opinion, are most important, together with a description of their expected effect on public health.

Our estimate of the cost of information measures are based on the group's experience of the need for staff and other resources for this type of activity. Based on experience, a ten-year time period is needed to achieve a lasting effect of this type of measure.

Factors that have been given lower priority

The following factors have not been prioritized in the subsequent work of recommended environmental measures for the Stockholm County Council:

Indoor air quality

The factor is of major importance to health, and a long list of possible measures has been identified during the project. The factor has still not been prioritized because:

- its complex nature makes it difficult to quantify the health impact;
- a regulation system does already exist and Locum^d has been assigned to work with the issue.

Radon

The issue of radon is of less importance to the Stockholm County Council's own operations, and has been included in the recommended measures for other responsible authorities.

Food

Provided that the Stockholm County Council food policy is adopted^e and implemented, the working group thinks that it is not necessary to propose additional measures in this report. The County Council should also give attention to, and co-operate with, other action parties on reducing the exposure to energy-dense food and increase the exposure to low-energy food. This could be done within the framework of the County Council action program against weight problems.

^d Locum AB is one of Sweden's larger property managers, with a property portfolio of about 2.4 million square meters in the Stockholm region. Major tenants are healthcare institutions in Stockholm County. Locum AB is owned by the Stockholm County Council

^e The Stockholm County Council Executive Board adopted the food policy on 21 March 2006

Table 3. The ten most important environmental measures for the Stockholm County Council to improve public health in the County of Stockholm.

Measure	Expected effect and time until effect	Cost	Benefit	Environmental factor
Continuously inform about the importance of air pollutants to public health, and of the need for improvements	Reduced emission of NOx. Reduced emission of particles. Reduced noise	About 2 MSEK per year over a period of 5-10 years	To potentially eliminate the effects of both NOx and particles. If all NOx from traffic is eliminated: Health care costs minus about 17 MSEK (500 hospital admissions, 33,838 SEK ⁴⁷ per case) in the Stockholms County. Considerably larger savings for society. If all PM ₁₀ from traffic is eliminated: Health care costs minus at least about 5.5 MSEK (160 hospital admissions, 33,838 SEK ⁴⁷ per case) in the Stockholms County. Considerably larger savings for society. Gain of 280,000 years to live at a reduction of PM _{2.5} by 3.5 µg/m ³ ¹⁰ .	Air pollutants
Ensure that Stockholm Transport and other actors within the County Council organisation responsible for transport have the resources they need to reduce emissions of air pollutants from vehicles, through such actions as more effectively reducing emissions from their own vehicles and working machines; using alternative fuels (e.g. ethanol, biogas and hydrogen gas) in their own vehicles; and requiring such actions in procured transportation services	Reduced emission of NOx. Reduced emission of particles.	The need to be budgeted by Stockholm Transport		
Ensure that Stockholm Transport and other actors within the County Council organisation responsible for transport have the resources they need to reduce noise through, for example, better muffling of the sound from vehicles and traffic systems, and noise-reducing building facades	Reduced noise	The need to be budgeted by Stockholm Transport	Health benefits through reduced noise in the form of reduced prevalence of cardiovascular diseases, reduced prevalence of hearing damage and reduced disturbance.	
Ensure that Stockholm Transport has the resources to implement an action plan for increasing the percentage of travellers who choose public transport, by making it more customer oriented	Reduced emission of NOx. Reduced emission of particles. Reduced noise	The need to be budgeted by Stockholm Transport		

Table 3, continued

Measure	Expected effect and time until effect	Cost	Benefit	Environmental factor
Continued support to ex-smokers, and campaigns to reduce the number of people recruited to take up smoking	Reduced prevalence of airway diseases, lung cancer and cardiovascular diseases among smokers and passive smokers. Reduced exposure of smokers to cadmium	About 2 MSEK per year over a period of 5-10 years	For passive smokers: 54 - 708 MSEK through reduced health care costs for lung cancer ²⁶ . Additional savings for reduced prevalence of myocardial infarction, ischemic heart disease, asthma, repeated ear inflammations. Considerably larger savings for society. For smokers: Same as above but to a greater degree.	Passive smoking
Inform healthcare workers and the public about the risks of solariums, and about what periods during the year and the day when UV-risks are greatest. Work to get warnings out through the media when needed, including daily solar UV index	Decreased number of cases of UV-induced disease. Time until effect uncertain but at a guess between 10-20 years	About 2 MSEK per year over a period of 5-10 years	The total cost of UV-induced disease in the Stockholm region 162 MSEK/year ¹⁵ .	UV light
Actively restrict the level of allergens permitted in products procured by the Stockholm County Council	Studies show that it is possible to reduce the incidence of latex allergy within the health care sector, by active work with procurement of products with low allergen content. Time until effect: emerging effects 1-2 years.	Costs for information material and web support in the order of magnitude 400,000 SEK/year over a period of 5-10 years	79,000 - 690,000 SEK per individual times 15-20% of the adult population. Calculated cost per one case of nickel allergy (Danish figures) about 290,000 DKK. Reduction of nickel allergy by 50% would in Denmark result in a gain over 20 years of 9,700 MDKK.	Allergenic substances in products
Provide information, about ways to avoid contact allergy and to avoid skin disease from wet work	Studies show that reduced exposure results in decreased prevalence of contact allergy. E.g. nickel allergy in Denmark and chromium allergy in Sweden.	About 2 MSEK per year during a period of 5-10 years		Allergenic substances in products + wet work
Develop requirements to secure healthy working environments for the Stockholm County Council's own activities and in contracts with suppliers	Reduced prevalence of allergy diseases and of disease caused by physical load during work.		Reduced number of days of sick leave. Not known today how many persons that are on sick leave due to hand eczema in Sweden.	Allergenic substances in products + wet work + physical load during work

Table 3, continued

Measure	Expected effect and time until effect	Cost	Benefit	Environmental factor
<p>Initiate and stimulate research on the environment-induced health impacts of road traffic in order to clarify the connections between</p> <ul style="list-style-type: none"> – different kinds of pollutants – different particle sizes in solid air pollutants – noise <p>and the diseases that seem to be correlated to these factors</p>	<p>More efficient prioritization of accurate measures in the future</p>			

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Stockholm County Council
Stockholm Centre for Public Health
PO box 175 33, SE-118 91 Stockholm

Ph +46 8 737 35 00 Fax +46 8 737 29 19
centrumforfolkhalsa@sll.se
www.folkhalsoguiden.se

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