

Nordic strategy for the **Arctic** climate and environmental pollutants



Nordic strategy for the Arctic climate and environmental pollutants

ANP 2006:773

© Nordic Council of Ministers, Copenhagen 2008

ISBN 92-893-1257-2

Print: Scanprint as, Århus 2008

Design: Kjell Olsson

1st edition (2006) copies: 1,000; 2nd edition (2008) copies: 400

Printed on environmentally friendly paper

This publication can be ordered on www.norden.org/order.

Other Nordic publications are available at www.norden.org/publications

Printed in Denmark



Nordic Council of Ministers

Store Strandstræde 18

DK-1255 Copenhagen K

Phone (+45) 3396 0200

Fax (+45) 3396 0202

Nordic Council

Store Strandstræde 18

DK-1255 Copenhagen K

Phone (+45) 3396 0400

Fax (+45) 3311 1870

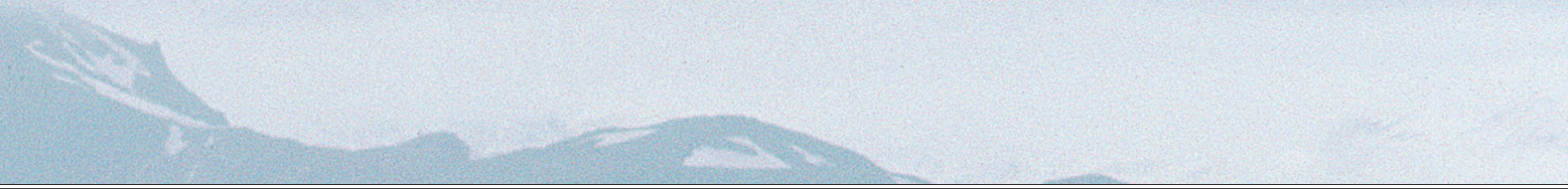
www.norden.org

Nordic cooperation

Nordic cooperation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and three autonomous areas: the Faroe Islands, Greenland, and Åland.

Nordic cooperation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic cooperation seeks to safeguard Nordic and regional interests and principles in the global community. Common Nordic values help the region solidify its position as one of the world's most innovative and competitive.



Contents

Summary 4

1 Introduction 6

1.1 Background 6

1.2 About the strategy 7

2 Environmental pollutants in the Arctic 10

2.1 Status and trends 10

2.2 Effects 12

3 Climate change in the Arctic 14

3.1 Status and trends 14

3.2 Effects 15

4 The climate affects environmental pollutant transport and impact 16

5 Nordic strategy for the Arctic climate and environmental pollutants 18

5.1 Environmental pollutants 18

5.2 Climate 23

Appendix 1:

Terms of reference and composition of steering committee 28

Appendix 2:

Relevant international cooperation processes and treaties 30

Appendix 3:

References 34

Appendix 4:

Abbreviations 35

Summary

The Arctic region is experiencing some of the fastest and severest climate change on Earth, with massive physical, ecological, social and economic changes that will have repercussions far beyond the Arctic. The Arctic also functions as the “destination” of long-range environmental pollutants transported by air or sea currents from more southern latitudes.

Knowledge about climate change and documentation of environmental pollutants in the Arctic are of strategic significance to the Nordic Council of Ministers’ and the Nordic countries’ efforts to limit emission of greenhouse gases and reduce the supply of environmentally harmful substances. Adopted by the Nordic environmental ministers, this Nordic strategy for climate and environmental pollutants in the Arctic primarily aims to serve as a joint platform for continued internal environmental cooperation in the Nordic Council of Ministers and for cooperation between the Nordic countries in the areas covered by the strategy. The strategy is not exhaustive as regards potential areas of cooperation and projects, but promotes joint Nordic initiatives in the period covered by the strategy.

The strategy identifies the following objectives and sub-objectives for the Nordic cooperation on environmental pollutants and climate change:

Environmental pollutants **Objective:** The Nordic countries will jointly increase and communicate knowledge about the occurrence and impacts of environmental pollutants in the Arctic environment and society for the purpose of reducing global discharge and emission of environmental pollutants.

- **Sub-objective EP1:** to exploit knowledge thus encouraging international forums to reduce the use and discharge and emission of organic environmental pollutants and heavy metals.
- **Sub-objective EP2:** to support the development of knowledge of the occurrence and impacts of environmental pollutants in the Arctic in key areas.
- **Sub-objective EP3:** to focus on the effect of climate change on the distribution and impacts of environmental pollutants in the Arctic.

Climate **Objective:** The Nordic countries must cooperate to increase and communicate knowledge about climate change in the Arctic and its regional and global consequences with a view to reducing global emission of greenhouse gases in keeping with the long-term goals of the Convention on Climate Change.

- **Sub-objective C1:** to exploit knowledge about climate change in the Arctic thus encouraging international forums to limit emission of greenhouse gases in keeping with the long-term goals of the Convention on Climate Change.
- **Sub-objective C2:** to exploit knowledge about climate change in the Arctic to support the adaptation work in the region.
- **Sub-objective C3:** to support the development and communication of knowledge in key areas and long-term monitoring of prioritised environmental indicators.

1 | Introduction

1.1 Background

Knowledge about climate change and its forecast impacts as well as documentation of environmental pollutants in the Arctic are of strategic importance to the Nordic countries' efforts to limit emission of greenhouse gases and reduce the supply of environmentally harmful substances. This is the reason why the Nordic Council of Ministers' Nordic Environmental Action Plan 2005–2008 states that a strategy needs to be devised which focuses on and gives priority to the Nordic environmental initiative in the Arctic in terms of climate and environmental pollutants (particularly POPs and mercury). A new Environmental Action Plan was sanctioned in October 2008. A steering committee was appointed in the summer of 2005, consisting of representatives from the Nordic countries, including the Faroe Islands

The Arctic is still regarded as clean and virtually unspoilt. However, polluting discharge and emission from sources outside the polar regions, e.g. greenhouse gases, substances depleting the ozone layer and environmental pollutants, as well as discharge and emission of radioactive substances are changing the picture. Photo: Jesper Madsen, National Environmental Research Institute



and Greenland, and tasked with preparing such a strategy. The terms of reference and composition of the steering committee are outlined in appendix 1.

In October 2008, the Nordic Council of Ministers adopted the Arctic Cooperation Programme 2009–2012, which lays down the framework for Nordic cooperation in the Arctic. The programme also allocates funds that can be spent on Arctic initiatives in the environmental sector, e.g. follow-up on the present strategy.

1.2 About the strategy

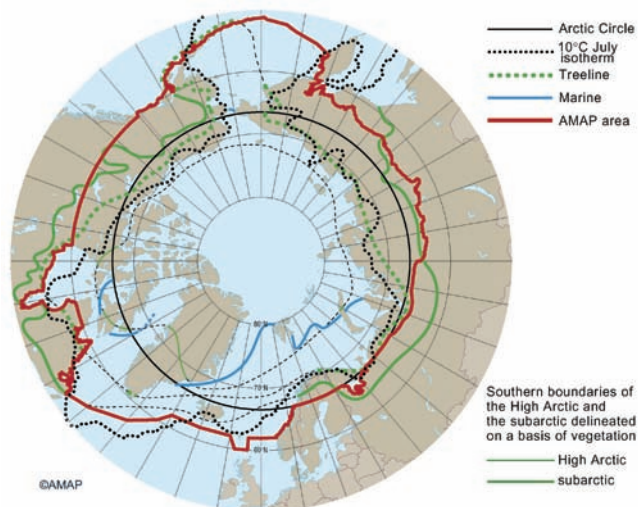
The Nordic strategy for climate and environmental pollutants in the Arctic aims to serve as a joint platform for continued internal environmental cooperation in the Nordic Council of Ministers and for cooperation between the Nordic countries in the areas covered by the strategy.

1.2.1 Time frame

In keeping with the Nordic Council of Ministers' Nordic Environmental Programme and the Arctic Cooperation Programme, the Nordic strategy for climate and environmental pollutants will apply to the Arctic until 2012, but the strategy contains elements that will be relevant and of significance beyond the time frame. The climate and environmental pollutants problems develop constantly, so the strategy must be dynamic and updated as new knowledge is acquired and processes are completed and initiated.

1.2.2 Geographical delimitation

Geographically, the strategy has been delimited to address problems particularly related to the parts of the Nordic region within the Arctic region as defined by the Arctic Council's working group's Arctic Monitoring and Assessment Programme (AMAP) and in the Arctic Climate Impact Assessment (ACIA) reports (ACIA, 2004; ACIA, 2005).



The Arctic. The red line shows the delimitation of the region as defined by the AMAP working group and the ACIA reports. This is also the area covered by this strategy. Source: AMAP

1.2.3 Strategy structure

The strategy addresses environmental pollutants and climate separately. Moreover, a separate assessment focused on the effect of forecast climate change on transport and impact of environmental pollutants. The strategy opens with a short description of the problems of the two themes (sections 2, 3 and 4). The actual strategy (section 5) lists a general objective and several sub-objectives under each of the two themes. The following elements were assessed for each sub-objective:

- Areas of cooperation: Problems and initiatives in key organisations and processes on which the Nordic countries must focus jointly during the strategy period. Processes and organisations are to some extent identified in which the Nordic countries are already making strong joint efforts, and the purpose is to highlight the need for continuing and strengthening this cooperation. Relevant organisations and processes are described in more detail in appendix 2.

- *Projects*: projects that should be launched during the strategy period. The projects fall within the following categories: (i) comparing and making existing knowledge available, (ii) launching information initiatives and (iii) complete examinations. The strategy does not describe projects proposed in detail, but includes them as foundation for preparing project applications later to be followed up in relevant Nordic Council of Ministers working groups. Where relevant, it would be a good idea to complete projects in cooperation with other regional organisations in the Arctic. Detailed cost estimates have not been prepared for the project proposals, but projects specified in more detail can probably be completed at DKK 1 million or less per project.
- *Areas in need of greater initiatives*: A few major research-specific problems are fundamentally important in order to shed further light on the problems of climate change and environmental pollutants in the Arctic (see also section 1.2.6). The scope of the projects means that own processes are needed to develop the ideas and that it takes longer time to complete them. Different research environments are addressing these problems. Strictly speaking, this theme falls outside the strategy's terms of reference, so no systematic review and discussion have taken place of such research-specific problems. These

problems must, above all, be addressed through closer cooperation and coordination by the national research initiatives.

The strategy is not exhaustive as regards possible areas of cooperation, projects and areas where greater initiatives are called for, but promotes joint Nordic initiatives during the period covered by the strategy. The different elements of the strategy are not prioritised between them.

1.2.4 Strategy follow-up

The relevant authorities in the Nordic countries will be jointly responsible for following up the prioritised areas of cooperation addressed in the strategy. The follow-up must take place at several levels. The strategy assumes contact and cooperation between the delegations of the Nordic countries at meetings in relevant international forums. The working groups of the Nordic Council of Ministers should be assigned specific responsibility to ensure current overview of strategy follow-up.

Our knowledge about the impacts of climate change and environmental pollutants in the Arctic develops constantly. The same can be said of the international cooperation in the areas. Hence, the strategy needs to be updated to serve, over time, as an effective tool for Nordic cooperation. The committee of senior officials in

AMAP: The Arctic Monitoring and Assessment Programme (AMAP) is a working group under the Arctic Council that undertakes and coordinates work related to mapping out and monitoring pollution in plants, animals and humans in the Arctic. AMAP has published a number of reports on different problems related to environmental pollutants in the Arctic. The AMAP secretariat is based in Oslo, Norway.

ACIA: Between 2000 and 2004, in concert with the International Arctic Science Committee (IASC), the Arctic Council conducted a comprehensive analysis of climate change in the Arctic known as the Arctic Climate Impact Assessment (ACIA). The objective of the ACIA work is to spotlight the consequences of climate change in the Arctic and of increased ultraviolet radiation due to ozone layer depletion. The results of the ACIA process are presented in a popular scientific report (2004) and a scientific account (2005).

environmental issues bears the responsibility for such updating being performed.

1.2.5 Need for political action

Climate change and the inflow of environmental pollutants into the environment are challenges of such significance that comprehensive and clear political and strategic measures are a must. On the one hand, global mechanisms to reduce and prevent discharge and emission resulting in climate change and distribution of environmental pollutants need to be in place, and, on the other hand, strategic measures to counter inevitable change must be launched. The knowledge about change and the impacts of change in the Arctic may serve as weighty arguments in such work. These factors are fundamental in this strategy. The Nordic countries must work together on implementing the international treaties and mechanisms adopted in this connection.

1.2.6 Need for a research-specific move

A huge gap in knowledge about the climate change and environmental pollutant problems in the Arctic has been established through the ACIA reports and the AMAP work as well as other relevant processes. The Nordic countries will be facing many of the same challenges in their Arctic regions in terms of climate change and the supply of environmental pollutants and their consequences for the environment and society.

Additional knowledge in this respect will be of strategic importance to the continued international work to reduce emission and discharge of greenhouse gases and environmental pollutants. Enhanced Nordic cooperation to narrow this research-specific knowledge gap is thus a basic move that should be made in the strategic work on climate change and environmental pollutants in the Arctic. A clear need exists for overall Nordic focus on research cooperation on these problems in the years ahead. This will contribute to strengthening the knowledge base for drawing up policy related to adaptation and preparedness in these areas, and the follow-up on the Nordic report concerning the need for knowledge about the Arctic (TemaNord 2007:580).

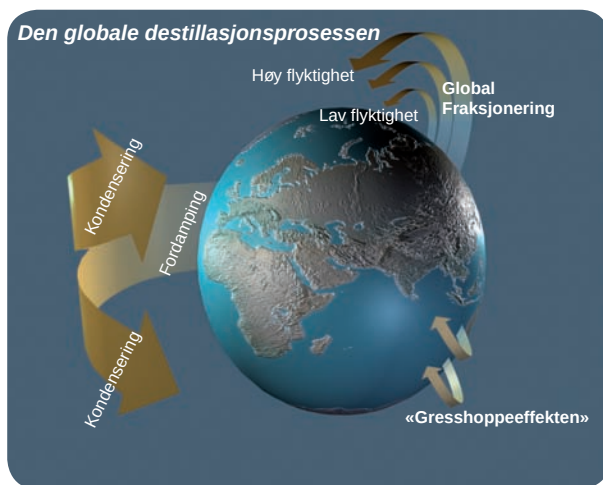
2 Environmental pollutants in the Arctic

2.1 Status and trends

Environmental pollutants are substances that are not or only slightly degradable through natural processes and that can, even in small concentrations, have harmful effects on the natural environment by being toxic and building up in harmful concentrations in the food chain. There are few local sources of discharge and emission in the Arctic, and most environmental pollutants are transported from areas in more southern latitudes by air and sea currents as well as rivers and sea ice. The Arctic Monitoring and Assessment Programme (AMAP) under the Arctic Council has worked extensively to map out and monitor the pollution of plants, animals and humans in the Arctic.

POPs, or persistent organic pollutants, are slowly degradable man-made environmental pollutants and pose a special challenge. Many of these environmental pollutants are fat-soluble and easily accumulate in the fat deposits of organisms, and animals feeding on plants or animals containing these substances will accumulate even higher levels. In the Arctic environment, where most species depend on solid fat reserves, POPs are therefore a significant concern. Even though AMAP's mapping out has revealed that the level of POPs in the Arctic is generally lower than in warmer latitudes (AMAP, 1998; AMAP, 2002; AMAP, 2004), high levels have nevertheless been registered in species at the top of the food chains.

The past couple of years have also seen more non-regulated POPs and partly regulated POPs in the Arctic environment – e.g. PFOS observed in increasing concentrations and brominated flame retardants registered circumpolarly. AMAP's mapping out has also demonstrated that the levels of some regulated POPs such as PCB have decreased in the Arctic since they were regulated, whereas the level of other substances such as



Air is the fastest transport mechanism and able to carry pollution to the Arctic in the course of days or weeks. Substances evaporate under warmer conditions and are carried by the wind. They condense under colder conditions and reach the surface through rain, snow or as direct settlements. They may then again evaporate and be carried towards the poles in multiple cycles – known as the grasshopper effect. Illustration: Norwegian Polar Institute



Whale flensing. Relatively high concentrations of organic environmental pollutants and heavy metals have been found in species at the top of the food chain in the Arctic, e.g. the whale. Health effects have been demonstrated in humans who still greatly use and depend on traditional and local raw materials in their diet. Photo: Staffan Widstrand

HCH has, although the reason is unknown, remained more stable than expected in spite of reduced consumption.

Among the environmental pollutants constituting a threat to the Arctic are a number of heavy metals such as mercury, lead and cadmium. Although AMAP (AMAP, 2005) has established that the atmospheric concentration of heavy metals in the Arctic is generally low compared to the global background level and that the con-

centration in the ground, lakes, rivers and the sea lies within the global standard, high levels of a few substances have still been determined in a few species. Moreover, AMAP has shown that the concentration of heavy metals in the Arctic is, with a few exceptions such as vanadium and nickel, generally lower today than a few decades ago.

However, mercury gives rise to special concern. According to estimates, the global discharge of mercury pro-

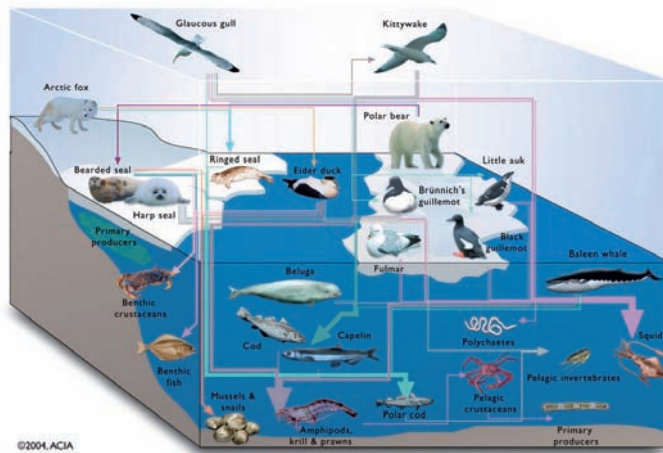


Illustration of the food chain in the Arctic marine environment. Environmental pollutants spreading in Arctic regions build up through several stages in the food chain and finally accumulate in large amounts in predators at the top of the food chain, e.g. the polar bear, the Arctic fox, the seal and the Ross's gull. Source: ACIA (2004)

duces an annual fallout of mercury of 150-300 tonnes in the Arctic. Mercury reaches the Arctic by air, sea currents and rivers, but today the contribution of each means of transport is unknown. Mercury and mercury compounds are toxic and bioaccumulate in organisms and build up the food chain. Previously, mercury in the atmosphere was believed to settle only slightly on hills. More recent research indicates that on account of very special chemical and physical conditions in the atmosphere in the spring in the Arctic, slightly reactive mercury can transform into reactive mercury. The reactive types of mercury settle faster on hills and are more available to biological material. This being the case, the Arctic is more exposed to mercury pollution than other parts of the Earth (AMAP, 2003). More recent studies also suggest that a warmer climate can affect the accumulation of mercury in the food chain, e.g. when algae that easily accumulate mercury are given better growth conditions (Outridge et. al, 2005).

2.2 Effects

Mercury-related health effects have been demonstrated in humans in the Arctic. In the Faroe Islands, studies have shown that if fetuses are exposed to mercury, e.g. caused by the mother eating pilot whale meat, this has an adverse effect on the development of the central nervous system and the regulation of blood pressure in children. Studies following such children through their adolescence indicate that these observed effects are irreversible (AMAP, 2003b). AMAP has also established that POPs, PCB in particular, seem to affect human health in the Arctic (AMAP, 2003b). Primarily fetus and baby development seems to be affected, and high PCB levels have been shown to affect the gender distribution in that the fertilised eggs with male anlage abort more easily (AMAP, 2004b). POPs can also cause cancer and affect the capacity for reproduction, the immune system and the metabolism. As in the case of mercury,

these effects are related to diet and mainly concern the ethnic groups that still greatly use and depend on traditional and local raw materials, particularly marine mammals, in their diets.

Animals eating prey containing heavy metals and POPs will accumulate higher levels than the animals of prey. This mechanism means that we find the lowest levels of environmental pollutants in plant and animal plankton and the highest levels in species at the top of the food chain. Studies have shown that POPs and their metabolites can affect the capacity for reproduction, the immune system, the hormone system and the development of the brain and bones. The problems with POPs in the Arctic are mainly related to the marine ecosystem. AMAP estimates that the levels of environmental pollutants in some animals at the top of the food chain are

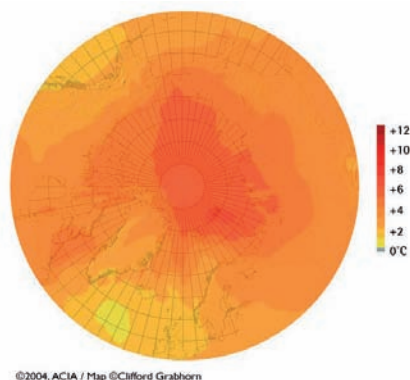
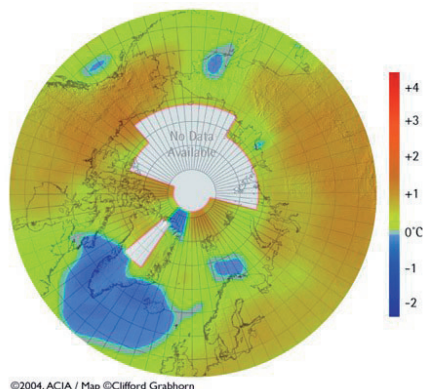
high enough to affect individuals and probably also populations. This applies to the polar bear, the Ross's gull, the Arctic fox, the killer whale and the dog whelk, for instance.

Mercury, lead and cadmium have both acute and chronic health and environmental effects in high concentrations. However, low concentrations of mercury can also affect the production of sperm and eggs as well as reduce the viability of both fetuses and young animals in addition to causing damage to the central nervous system and brain of mammals. Concentrations of mercury giving rise to concern have been registered in a few marine mammals and sea birds, but the extent is yet to be fully mapped out. Less information exists about the effects and vulnerability status for the biota in freshwater and land environments in the Arctic.

3 Climate change in the Arctic

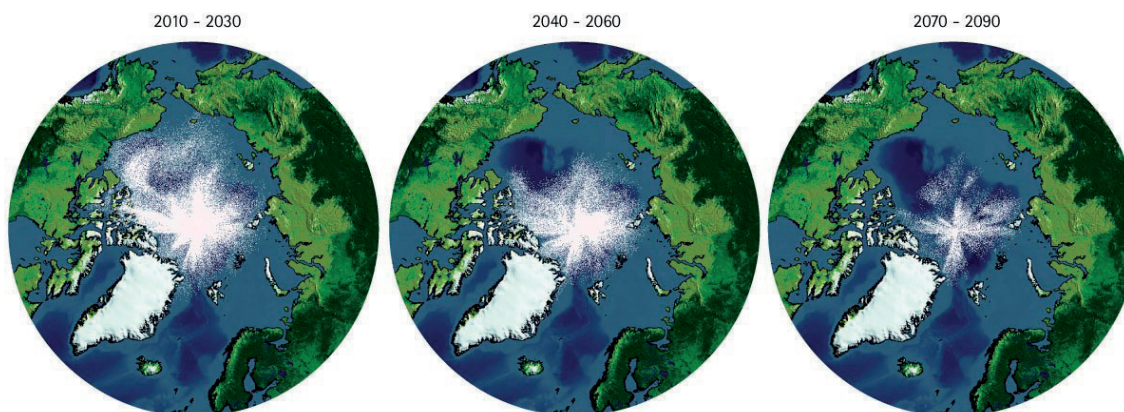
3.1 Status and trends

The Earth's climate has always been changing on account of natural processes. However, increasingly stronger evidence points to warming caused by man-made emission of greenhouse gases now happening in addition to the natural changes. The UN climate panel drew the conclusion in 2001 that new and strong evidence exists that most of the warming observed in the course of the past 50 years is attributable to man-made activities (IPCC, 2001). Changes in temperature, precipitation and wind will affect the natural basis and may impact seriously on people and society. In concert with the International Arctic Science Committee (IASC), the Arctic Council has conducted an extensive and documented analysis of climate change in the Arctic and the impacts for the region and the rest of the world. Arctic Climate Impact Assessment reports (ACIA, 2004; ACIA, 2005) show that the average temperature has increased by about 1° C over Eastern Greenland, Scandinavia and North-West Russia over the past 50 years. Measurements also show record-high temperatures of the water coming from the North Atlantic to the Arctic. The average winter temperature over landlocked areas in Scandinavia has risen by some 2° C and by 2–3° C in North-West Russia.



Actual and forecast temperature changes in the Arctic. The top chart shows the change in average annual temperature between 1954 and 2003, while the bottom chart shows the forecast change in average annual temperature until 2090. Source: ACIA (2004)

Model calculations made in the ACIA work (ACIA, 2004; ACIA, 2005) indicate that further warming will be seen in the entire Arctic until 2090. The average winter temperature is likely to rise by 3–5° C over the majority of landlocked areas. Arctic precipitation has increased by an average of about 8 per cent during the past century. Rain accounts for most of the increase, the biggest increases appearing in the autumn and the winter. Sharper increases are expected over the next 100 years, with a forecast 20 per cent rise in total annual precipitation over the Arctic in general before the end of this century.



©2004, ACIA / Map ©Clifford Grabhorn

Changes in sea ice coverage. The Arctic summer ice has already been significantly reduced and is expected to retreat even faster in future. As each century passes, the sea ice will move further and further away

from the Arctic coastal areas. Some model calculations show almost total absence of summer ice in this century. Source: ACIA (2004)

3.2 Effects

The Arctic is very vulnerable to observed and forecast climate change, and severe physical, environmental, social and economic changes can be expected. Signs are already visible of many of them. The most obvious effects of the forecast climate change as stated in the ACIA report (2004) are:

- reduced sea ice coverage, with subsequent negative impacts for ice-dependent species and potentially positive consequences as regards access to sea areas;
- increased drainage from rivers, resulting in greater inflow of freshwater into the seas, in its turn of significance to the circulation pattern of the sea;
- changes in the Arctic carbon cycle, i.e. the exchange of greenhouse gases between the atmosphere, the sea and the Arctic soil and sediment layer, which will then affect the global climate system;
- glacier and ice cap melting in Greenland and subsequent rise in sea level;
- changes in sea circulation pattern and subsequent impacts on regional and global climate patterns;
- change in migration patterns and prevalence of plants and animals and changed framework conditions, negative or positive, for natural resource-related food; and
- changed conditions for traditional cultures.

4 | The climate affects environmental pollutant transport and impact

Climate change affects the chemical pollution in complicated interaction. AMAP has comprehensively assessed why climate change will affect the supply and settlement of environmental pollutants (AMAP, 2003), and ACIA (2004) has drawn the conclusion that continued warming in the Arctic will most likely increase the amount of pollution transported to the region.

Above all, climate change contributes to a change in transport routes and times of environmental pollutants. For instance, more precipitation may increase pollution northward of the big rivers into the Arctic just as changed wind patterns will affect the supply of air pollution. Climate change can also affect environmental pollutants already settled in the Arctic. For example, for each degree the temperature rises, melting snow and ice will release more pollution into the melt water. Permafrost thawing can similarly mobilise environmental pollutants. In practice, this means that a warmer climate can release undesired substances, which again may have toxic effects on plants and animals – especially in water environments.

The interaction between climate change and chemical pollution can also affect the biota directly. Many POPs are fat-soluble and accumulate easily in the fat deposits of organisms. As long as the fat reserves remain considerable, environmental pollutants are prevented from affecting animal health. Under difficult conditions, e.g. conditions caused by climate change where animals are forced to break into their fat reserves, environmental pollutants are transported out into the body and affect the system. In the Arctic over the past decades, the polar bear has been observed to have smaller fat reserves than previously, and this is probably because the sea ice calves earlier and earlier and the polar bears then have to go on land fast for longer and longer peri-

ods (ACIA, 2004). This may lead to large amounts of environmental pollutants and metabolites being transported out into the polar bear's body.

Climate change is also likely to influence the structure of food chains. Physical changes in the environment may affect the time, place and composition of the different elements in the food chain. Changes in the lower levels can result in significant changes in the relative distribution of food and thus also in changed (stronger/milder) adverse impacts on the environment of environmental pollutants for animals and humans at the top of the Arctic food chain.

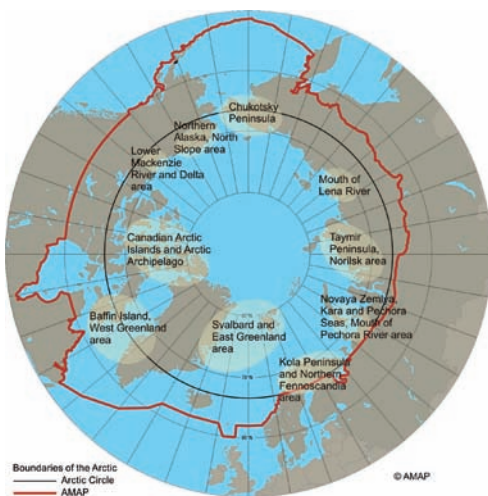
Widespread uncertainty surrounds the problems of how foreseen climate change will affect the transport, settlement and impacts of environmental pollutants, so targeted research and modelling initiatives across fields are required.

5 | Nordic strategy for the Arctic climate and environmental pollutants

5.1 Environmental pollutants

Objective: The Nordic countries will jointly increase and communicate knowledge about the occurrence and impacts of environmental pollutants in the Arctic environment and society for the purpose of reducing global discharge and emission of environmental pollutants.

Mapping out environmental pollutants in the Arctic environment has revealed relatively high levels of substances stemming from sources outside the Arctic. International work must be undertaken to limit the discharge and emission of such substances. The protocol on environmental pollutants under the European Convention on Long-range Transboundary Air Pollution (LRTAP) and the global Stockholm Convention are some of the key international treaties in this context. Enhanced cooperation under the auspices of the UN (e.g. SAICM) and the new EU chemicals rules (REACH) may also be of great importance. The Nordic countries hold special responsibility for communicating knowledge about environmental pollutants in the Arctic and their effects in international negotiations. Increased research and monitoring are also called for to disclose supply, limit values and impacts under Arctic conditions. Without such understanding, it will be difficult to establish whether the adaptation and management measures launched are adequate. It would be an advantage if the Nordic countries cooperate and coordinate their efforts in the Nordic relevant areas in AMAP's identified key areas and other areas where initiatives will provide valuable additional knowledge.



AMAP has identified 10 key areas for coordinated and harmonised monitoring and research. Source: AMAP

Areas of cooperation

The Nordic countries will work to:

- exploit their knowledge about environmental pollutants in the Arctic to boost the “Arctic dimension” in the development of EU positions in regional and global chemicals policy, the objective being to reduce regional as well as global discharge and emission of environmental pollutants;
- exploit their knowledge about environmental pollutants in the Arctic in their work to lay down EU policy/legislation (REACH, for example) related to the use, discharge and emission of environmental pollutants;
- exploit their knowledge about environmental pollutants in the Arctic to establish a globally binding instrument for regulation of mercury and other heavy metals within the UNEP framework;
- ensure that UNEP receives information about transport of lead and cadmium to the Arctic in connection with the work to assess the need for regulation of these substances (expected to be adopted by the UNEP Governing Council in 2007);
- ensure that SAICM implementation and development focus on knowledge about environmental pollutants in the Arctic to promote development of an international chemicals regime that is as ambitious as possible;
- contribute to the Arctic Council prioritising the work to reduce the adverse impact of environmental pollutants in the Arctic, e.g. by implementing and developing ACAP (Arctic Council Action Plan to Eliminate Pollution of the Arctic) and coordinating Nordic initiatives in this area;

Sub-objective EP1: to exploit knowledge thus encouraging international forums to reduce the use and discharge and emission of organic environmental pollutants and heavy metals.

The Arctic works as the “destination” of long-range environmental pollutants transported from more southern latitudes. This means that the results of scientific studies and monitoring processes in the northern regions are of pronounced scientific and political relevance in international forums where the problems of environmental pollutants are on the agenda. Hence, the Nordic countries need to concentrate on good communication of the results of such processes in the Arctic – especially the results of the AMAP work – to boost international knowledge about and understanding of the “Arctic dimension”, which again will contribute to rational decisions in international processes. The Nordic countries have traditionally been crucial contributors in international discussions about environmental pollutants and will continue this work through stronger focus on the “Arctic dimension”.

- contribute to the continued prioritisation of the Barents Euro-Arctic Council to limit the adverse impact of environmental pollutants from the sources in the Barents region identified in the NEFCO/AMAP Environmental Hot Spots List (2003) and to use the NEFCO financing instrument in this context as well as to coordinate Nordic initiatives in this area;
- achieve optimum coordination of global conventions for chemicals (including hazardous waste) and work to obtain as many synergy benefits as possible through secretariat functions, joint reporting, etc.;
- exploit the knowledge about environmental pollutants in the Arctic in development of global and regional environmental pollutants and chemicals conventions, e.g. in proposals for new environmental pollutants, and the work to increase support of these; and
- support sufficient and expedient implementation of international treaties and decisions nationally in the Arctic regions.

Projects

The Nordic Council of Ministers will give priority to projects in the areas of:

- targeted communication measures to underpin the objectives laid down to influence the international organisations and processes mentioned above, e.g. seminars or material communicating knowledge and raising the awareness of POP and heavy metal pollution in the Arctic; and
- development of a strategy for information in support of the political processes for decisions to include environmental pollutants in treaties on such pollutants.

Sub-objective EP2: to support the development of knowledge of the occurrence and impacts of environmental pollutants in the Arctic in key areas.

Improved knowledge about the occurrence and impacts of environmental pollutants is crucial to the continued work to limit adverse impacts. A higher level of map-

ping out and screening is required, and time series of new and old environmental pollutants must be maintained through continued sampling, sample storage and analysis as well as data comparison. Ongoing processes, such as AMAP, are important in this connection and new measures need to be coordinated with them. All relevant European, joint Nordic and other regional projects for environmental pollutants monitoring and screening should, to the greatest possible extent, comprise sufficient observations from the Arctic to ensure general understanding. The need to coordinate research efforts has been highlighted (see section 1.2.6). Knowledge about new environmental pollutants is also important to the work on the global conventions. To pave the way for retrospective studies of time trend analyses of new substances, plans need to be made for all relevant sample material to be stored expediently in sample banks.

Monitoring environmental pollutants: Standardised measurements or observations of identified impact variables over time, statistic trend assessment and status reporting.

Screening environmental pollutants: Intensive and short analyses whose purpose is to demonstrate environmental pollutants in the environment that are not monitored.

Areas of cooperation

The Nordic countries will cooperate to:

- focus on the problem of environmental pollutants in the Arctic in design of the EU research programme.

Projects

The Nordic Council of Ministers will give priority to projects in the areas of:

- studies examining the occurrence of particular prioritised substances in the Nordic Arctic environment (especially in humans and animals at the top of the food chain) which can be utilised for both development of monitoring programmes and monitoring policy. Substances that should be given priority are

known or potential environmental pollutants believed to be relevant to international regulation;

- projects whose purpose is to identify potential candidates for screening projects in the Arctic;
- limited screening projects for new environmental pollutants and their metabolites in the Arctic, either with Arctic samples being included in general Nordic screening studies or through preparation of separate Arctic screening projects; and
- planning and holding of meetings of experts to compare and make available knowledge about the impacts of and processes related to organic environmental pollutants (and their metabolites) and heavy metals from studies of humans and animals in the parts of the Nordic countries within the Arctic region.

Areas in need of greater initiatives

Areas with a special need for greater research and monitoring initiatives:

- We continue to see new environmental pollutants as brand new substances are put into use, but especially as substances used for a while prove to have environmental pollutant properties. Often, these properties have been established by the substances being rediscovered in the Arctic environment. So major screening studies must be planned to ensure general and continued assessment of the supply of new substances.
- Knowledge about the possible impacts of and processes related to the new environmental pollutants is often very limited so we need to complete projects to study the impacts of prioritised new environmental pollutants on health, e.g. the immune system, the hormone system, cancer development, reproduction and the ability to learn, etc. In this context, focus should be on the impact on humans (children's development in particular) and animals at the top of the food chain due to accumulation of environmental pollutants in the food chain. We must also set limit values for the impacts and concentrate on inter-disciplinary studies.

- Time series for mercury and selected organic environmental pollutants must be prepared and/or maintained by analysing suitable, available sample material that can provide a basis for a time series. Then, plans must be made to maintain the time series through sustained sampling and sample storage.
- Mercury is a special concern and great uncertainty still surrounds its occurrence, transport and settlement. To increase knowledge in this respect, support is needed for studies that, longer term, will make it possible to determine the mass balance of mercury in the Arctic. We will also need to examine the relative importance of various transport routes to mercury settlement and other environmental pollutants in the Arctic.

Sub-objective EP3: to focus on the effect of climate change on the distribution and impacts of environmental pollutants in the Arctic.

Climate change is likely to affect transport and settlement of environmental pollutants. How and the degree to which pollutants are transported by various media to the Arctic will change. A changed temperature and precipitation regime may also produce changes in the settlement patterns and hydrology, which again will influence chemical and physical conditions in both terrestrial and aquatic ecosystems. Climate change is set to influence food chain structure, resulting in changed (stronger/milder) adverse impacts on the environment of pollutants for animals and humans at the top of the Arctic food chain. The work on international climate and environmental pollutant conventions also needs to shed light on the above problems and highlight them as key elements in discussions. Targeted research and modelling initiatives across fields are required.

Areas of cooperation

The Nordic countries will work to:

- ensure that the Arctic Council prioritises and continues the work related to the effect of climate change on environmental pollutants and compares the

- results of the ACIA work with the distribution and impacts of environmental pollutants;
- further studies of the interaction between climate and environmental pollutants within the Arctic Council; and
- ensure that the European Monitoring and Evaluation Programme for long-range air pollution in the ECE area focuses on the effect of climate change on long-range pollution.

Projects

The Nordic Council of Ministers will give priority to projects in the areas of:

- completion of fact-finding projects contributing to identifying the monitoring required to capture the impact of climate change on the distribution and impacts of environmental pollutants;

- comparison and availability of new knowledge about the effects of climate change on the environmental pollutants produced since the AMAP report Influence of Global Climate on Contaminant Pathways (AMAP, 2003) was prepared; and
- projects aimed at developing new knowledge about environmental pollutants and their fate in the parts of the Nordic countries within the Arctic region seen in the light of climate change, including quantification of the effects of climate change on the distribution and impacts of environmental pollutants.

Areas in need of greater initiatives

Areas with a special need for greater research and monitoring initiatives:

- Long, quality-assured data series are crucial to monitoring trends in climate change impact on the distri-

Samples are collected from a tranquilized polar bear in Svalbard. Blood and tissue samples can, for instance, be used to measure the level of environmental pollutants in animals. We continue to discover new environmental pollutants – often as the substances are demonstrated in the Arctic environment. So major screening studies must be planned to ensure general and continued assessment of the supply of new substances. Photo: Andrew Derocher, Norwegian Polar Institute



bution and effects of environmental pollutants. It would therefore be a good idea to set up expedient and relevant monitoring in this context (see first bullet under Projects above).

- Invaluable benefit would come from developing and improving existing transport models for environmental pollutants by comparing them with different climate scenarios developed on the basis of improved regional climate models. Such models will be needed at both regional and sub-regional levels.

5.2 Climate

Objective: The Nordic countries must cooperate to increase and communicate knowledge about climate change in the Arctic and its regional and global consequences with a view to reducing global emission of greenhouse gases in keeping with the long-term goals of the Convention on Climate Change.

Changes in the Arctic climate, for instance caused by man-made effects, may be severe. These changes will not only be of great local and regional significance, but will also have repercussions far beyond the Arctic. So climate change in the Arctic deserves and demands the immediate attention of decision-makers and the public throughout the world. Due to their geographical locations, the Nordic countries hold special responsibility for communicating knowledge about climate change in the Arctic and its consequences. It will also be strategically important to narrow the knowledge gap to reduce uncertainty and strengthen the “Arctic dimension” in international climate work.

Sub-objective C1: to exploit knowledge about climate change in the Arctic thus encouraging international forums to limit emission of greenhouse gases in keeping with the long-term goals of the Convention on Climate Change.

The Arctic region is experiencing some of the fastest and severest climate change on Earth. This will have

serious regional and global consequences. The results of scientific studies and monitoring processes in the northern regions are of pronounced scientific and political relevance in international forums where the problem of climate change is on the agenda. The Nordic countries must attach importance to communicating results of the ACIA work and following up on this work to increase international knowledge about and understanding of the “Arctic dimension”. This will improve the foundation for necessary decisions in the international processes. The Nordic countries have traditionally been important contributors in the international climate discussions and will continue this work through stronger focus on the “Arctic dimension”.

Areas of cooperation

The Nordic countries will work to:

- ensure that the “Arctic dimension” constitutes an important foundation for discussions and arguments in negotiations under the Convention on Climate Change;
- ensure that the “Arctic dimension” becomes a central and visible element in the work on the fourth assessment report from the IPCC scheduled for publication in 2007, which will represent an important scientific foundation for upcoming climate negotiations;
- exploit their knowledge about climate change in the Arctic in the work to draw up EU positions for the international climate negotiations, and focus particularly on the consequences of climate change for Europe;
- exploit their knowledge about climate change in the Arctic in the work to devise the EU’s own climate policy;
- contribute to the Arctic Council carrying on the work to provide new and updated knowledge about the impacts of climate change and taking the initiative for measure-based solutions based on this work;
- ensure that the Arctic Council and other organisations such as the Barents Euro-Arctic Council launch initiatives to help reduce greenhouse gas emission in the member countries; and

The primary gases contributing to the greenhouse effect and climate change are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and fluorine gases. The use of fossil fuels such as oil, coal and gas constitutes a main source of discharge and emission. The concentration of these gases in the atmosphere is now at the highest level ever registered. PHoto: Photodisc.

- address the “Arctic dimension” in other current discussion forums complementing the official climate negotiations.

Projects

The Nordic Council of Ministers will give priority to projects in the area of:

- communication measures underpinning the objectives of influencing the international organisations and processes mentioned above, e.g. through seminars or materials communicating knowledge and raising attention of climate change in the Arctic.

Sub-objective C2: to exploit knowledge about climate change in the Arctic to support the adaptation work in the region.

The possibility of adaptation to climate change depends on the vulnerability of the natural systems and humans. The Arctic regions may in some parts be less robust than other parts of the Nordic region and vulnerable regions/sectors exist where adaptation will represent special challenges. There are few examples of proven adaptation strategies at national, regional and local levels, one reason being the lack of useful climate models with sufficient resolution to be able to assess impacts and vulnerability satisfactorily (see sub-objective C3).



Strategic focus on the issue of vulnerability and adaptation is important in the continued work on a general approach to climate challenges. The third IPCC assessment report (2001) underlined this necessity and the Arctic Council's Arctic Climate Impact Assessment Policy Document (2004) also highlighted it.

Areas of cooperation

The Nordic countries will work to:

- ensure excellent communication of knowledge about national adaptation strategies and experience in such strategies in the Nordic countries;

- ensure that knowledge about climate change in the Arctic is satisfactorily incorporated into the foundation used by the EU and EEA in national and European studies of impact, vulnerability and adaptation; and
- contribute to the Arctic Council and other regional organisations such as the Barents Euro-Arctic Council maintaining focus on the problems related to adaptation to climate change in the Arctic, for instance through their underlying working groups.

Projects

The Nordic Council of Ministers will give priority to projects in the areas of:



Knowledge gaps related to climate change must be filled in. For instance, we still lack new knowledge about feedback mechanisms between the Arctic and the rest of the global climate system, e.g. changes in sea currents and in the albedo effect of reduced ice coverage.
Photo: Sebastian Gerland, Norwegian Polar Institute



- assessment of vulnerability in i) traditional Arctic cultures in the Nordic region, e.g. in relation to Saami reindeer breeding and Greenland hunters, ii) local Arctic industry in the Nordic region, e.g. fishing, and iii) the natural environment;
- assessment of vulnerability in relation to extreme events;
- planning and holding of meetings of experts to exchange and develop knowledge, with focus on challenges of adaptation in vulnerable sectors/parts of the Arctic; and
- information initiatives (e.g. seminars, fact sheets, websites) addressing the groups involved.

Sub-objective C3: to support the development and communication of knowledge in key areas and long-term monitoring of prioritised environmental indicators.

The ACIA work has revealed that many knowledge gaps related to climate change in the Arctic still exist. The Convention on Climate Change and the Kyoto Protocol

commit the Nordic countries to knowledge building, research and monitoring. Narrowing these gaps is strategically important to reduce the uncertainty surrounding the input to the international processes. Particularly important is improved resolution of the climate models to produce safer foundation for projecting climate change and its consequences. The gaps are narrowed in the research environments, and it will be impossible to launch any major research projects within the framework of the strategic plan. However, the need to coordinate research efforts has been highlighted (see section 1.2.6). Long-term monitoring is also crucial for assessing the consequences of climate change, and it provides a basis for launching expedient management and adaptation measures.

Environmental indicator: selected component in or property of nature monitored over time as part of monitoring and which can give indications about the condition or development of important environmental aspects, the causes of changes and how society responds.

Areas of cooperation

The Nordic countries will work to:

- develop national monitoring and research programmes and strengthen national competence through communication of knowledge and information among the Nordic countries;
- maintain focus on and develop coordinated monitoring of climate change and the impacts of such change within the Arctic Council and its working groups;
- focus on climate change in the Arctic in the design of the EU research programme; and
- persuade member countries of the International Council for the Exploration of the Sea (ICES) to maintain and develop their monitoring of climate and impact parameters in the Arctic waters.

Projects

The Nordic Council of Ministers will give priority to projects in the areas of:

- comparison of knowledge about the impacts of climate change on i) ecosystems and the carbon cycle in the Arctic, ii) freshwater outflows, high tide and low tide and iii) sea current and ice coverage mechanisms and knowledge about the freshwater inflow into the sea;
- comparison of results of various Nordic climate change simulations, including extreme events;
- coordination and development of climate-related monitoring in the Nordic Arctic marine and terrestrial environments;
- focus on the global significance of Arctic climate change;
- development of Arctic climate projects targeted at the EU's 7th framework programme; and
- increased knowledge about changed living conditions for the people in the region and their possibilities of adapting to climate change.

Areas in need of greater initiatives

Areas with a special need for greater research and monitoring initiatives:

- It will be necessary to compare the results of the Nordic regional climate models describing the future development of the climate in the Nordic Arctic. The results of such work can be used as a tool to develop new and better models for analysing climate change in selected areas in the parts of the Nordic Arctic region.
- Climate processes in the Arctic affect both global and regional climates. Improved knowledge about the global significance of climate change in the Arctic will be important and provide documentation useful in the context of negotiation. It will be important to gain better overview of a number of processes where the lack of knowledge impairs the existing models' ability to handle detailed forecasts. Among these processes are feedback mechanisms between the Arctic and the rest of the global climate system, e.g. changes in sea currents and in the albedo effect of reduced ice coverage
- Climate change will cause geochemical changes that will affect the methane and carbon dioxide balances. These processes are little known, and the consequences of climate change for the carbon cycle in the Arctic environment should therefore have higher priority.
- Long, quality-assured data series are decisive in terms of monitoring climate change developments and improving the basis for scenarios of future climate conditions. Constant funding must be guaranteed for important measurement series of key indicators. Observations of historical trends and calculated climate change are important to distinguish between man-made climate change and natural climate variations.

APPENDIX 1

Terms of reference and composition of steering committee

The steering committee must devise a strategy for Nordic environmental initiatives in the Arctic in terms of climate and environmental pollutants, especially POPs and mercury. The strategy must focus on and give priority to the Nordic Council of Ministers' initiatives in the Arctic with respect to these problems and ensure that the Nordic initiatives are coordinated and specified in relation to the work of the Arctic Council, the Barents Euro-Arctic Council and other relevant forums.

The strategy must help meet the objectives of the Nordic Environmental Action Plan 2005–2008/2009–2012 and be in keeping with the overall Arctic programme of the Nordic Council of Ministers, which is being prepared and likely to be in force as from 1 January 2006. The strategy should also be based on the fundamental work performed in connection with the Nordic action plan for nature and cultural protection in the Arctic.

The strategy must address predicted consequences of climate change and environmental pollutants in the Nordic parts of the Arctic and how knowledge in this context can be exploited strategically by the Nordic Council of Ministers and the Nordic countries' work to limit greenhouse gas emission and reduce the supply of environmentally harmful substances to the environment.

The strategy must contain proposals for how the Nordic Council of Ministers in the most expedient manner can help increase knowledge about the predicted consequences of climate change and environmental pollut-

ants in the Nordic parts of the Arctic, not only for the environment and natural resources, but also health, food and infrastructure in the region. The results of Arctic Climate Impact Assessment (ACIA) and the Arctic Monitoring and Assessment Programme (AMAP) will constitute a key element in this respect.

The strategy must also assess how knowledge about the consequences of climate change and the occurrence and impacts of environmental pollutants in the Arctic can be disseminated and used in formulating policies in relevant areas and how such knowledge can be used in the work under the auspices of the current climate and chemicals conventions, the UN/UNEP work in these areas and the EU chemicals work.

Moreover, the strategy needs to assess the need for more targeted and coordinated actions on the part of the Nordic Council of Ministers and the Nordic countries in relevant forums such as the Arctic Council and the Barents Euro-Arctic Council in terms of climate and environmentally harmful substances. The spotlight needs to be on how the Nordic Council of Ministers and the Nordic countries jointly can influence the priorities and initiatives of the Arctic Council and help realise projects to complement and support the work of relevant working groups and action plans of the Arctic Council.

Areas of cooperation and current projects must be identified and prioritised on the basis of a general needs analysis. Such analysis must assess whether different areas of cooperation have already been sufficiently addressed by the existing environmental protection cooperation between the Arctic countries. The strategy must propose specific cooperation projects to be completed under the auspices of the Nordic Council of Ministers as well as estimate the costs of completing them.

The strategy must be presented as a report with recommendations and proposals for areas of cooperation and specific cooperation projects.

Project group members:

Atle Fretheim (manager), Ministry of the Environment, Norway
 Bogi Hansen, Faroese Fisheries Laboratory, Faroe Islands
 Cynthia de Wit, Stockholm University, Sweden
 Håvard Toresen, Ministry of the Environment, Norway
 Helgi Jensson, Environmental and Food Agency of Iceland, Iceland
 Rikke Holmberg, Danish Environmental Protection Agency, Denmark
 Hugl Ólafsson, Ministry for the Environment, Iceland
 Leif Bernergård, Swedish Environmental Protection Agency, Sweden
 Magnus Nyström, Finnish Environment Institute, Finland
 Maria Dam, Food, Veterinary and Environmental Agency, Faroe Islands
 Morten Skovgaard Olsen, Danish Environmental Protection Agency, Denmark
 Outi Mähönen, Lappish Environment Institute, Finland
 Per Schriver, Directorate of Environment and Nature, Greenland
 Birgit Njåstad (project secretary), Norwegian Polar Institute, Norway

APPENDIX 2

Relevant international cooperation processes and treaties

Global treaties

Climate**United Nations Framework Convention on Climate Change (UNFCCC)**

The ultimate objective of the convention is to stabilise greenhouse gas concentration in the atmosphere at a level that would prevent dangerous, anthropogenic interference with the climate system. (www.unfccc.int)

Kyoto Protocol (under UNFCCC)

The protocol imposes legally binding demands on industrial countries to reduce emissions of greenhouse gases.

Environmental pollutants**Stockholm Convention on Persistent Organic Pollutants**

The convention entails obligations to phase out 12 of the most hazardous persistent organic pollutants, e.g. PCB and dioxins. Longer term, more pollutants may be incorporated into the convention. (www.pops.int)

Basel Convention

The convention regulates cross-border transport and treatment of hazardous waste. (www.basel.int)

Rotterdam Convention

The convention regulates trade in hazardous chemicals. (www.pic.int)

Others**Convention on Biological Diversity (CBD)**

The convention's objectives are conservation of biological diversity, sustainable use and fair and equitable sharing of the benefits arising out of genetic resource utilisation. (www.biodiv.org)

Vienna Convention and Montreal Protocol

The convention and the protocol aim at preventing the use of substances that deplete the ozone layer. The majority of the substances (CFC, HCFC, halons, etc.) are also greenhouse gases, and the most common substitutes are strong greenhouse gases (HFC). (www.unep.org/ozone/)

Regional treaties**Environmental pollutants****Convention on Long-range Transboundary Air Pollution (LRTAP)**

Regional treaty in the ECE area. The convention limits and, as far as possible, reduces and prevents air pollution and long-range transboundary air pollution. Eight protocols have been prepared under the convention. (<http://www.unece.org/env/lrtap>)

LRTAP Heavy Metal Protocol

The protocol regulates mercury, lead and cadmium. (<http://www.unece.org/env/lrtap>)

LRTAP Protocol on Persistent Organic Pollutants

The protocol regulates 16 POPs (four more than the global Stockholm Convention). (<http://www.unece.org/env/>)

Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR convention)

Regional convention covering the North-East Atlantic, including northern waters. Has adopted the generation goal of eliminating emissions of hazardous substances by 2020 and a clear hazardous substance concept. (www.ospar.org)

Cooperation processes and organisations**Climate****Un Intergovernmental Panel on Climate Change (IPCC)**

Scientific panel under the World Meteorological Organization and the United Nations Environment Programme that assesses published, scientific information about climate change. Assessment reports, published about every five or six years, review thorough procedures of approval involving the authorities of most countries. (www.ipcc.ch)

Commission on Sustainable Development (CSD)

CSD is the UN body for follow-up on the Rio Conference and policy formulation at the point of intersection between the environment and development. Climate change is one of the focus areas of the CSD for the period until the 15th session (May 2007). (www.un.org/esa/sustdev/csd/csd.htm)

Environmental pollutants

Strategic Approach to International Chemicals Management (SAICM)

Negotiation on a global chemicals strategy adopted in February 2006. The strategy aims at ensuring fulfilment of the global 2020 goal adopted by the World Summit on Sustainable Development (WSSD). An institutional framework will be established, with a secretariat and regular meetings, etc. (www.chem.unep.ch/saicm)

International Maritime Organization (IMO)

UN shipping organisation, important to the regulation of anti-fouling systems and ship waste management. (www.imo.org)

North Sea Conference

Of historical significance, the first to adopt the generation goal for environmental pollutants, but of less importance today. May still be of political significance in a few areas.

Others

United Nations Environment Programme (UNEP)

UNEP works on many climate change themes (vulnerability and adaptation to climate change, measures to reduce greenhouse gas emissions, transfer of technology, capacity building, etc.). Holds principal responsibility in the UN family when it comes to assessing the environmental threat represented by environmental pollutants and measures launched. (www.unep.org)

Global Environment Facility (GEF)

Functions, for instance, as the funding mechanism for the UN Convention on Climate Change and manages several funds established under the convention. Global funding instrument for the Stockholm Convention, with the possibility of financing chemicals management in general. (www.gefweb.org)

Arctic Council

The most important multilateral cooperation forum for the Arctic part of the Nordic regions. The cooperation focuses on environmental protection, climate issues and sustainable development in the Arctic region.

Most important contributor in terms of mapping out the state of the environment in the Arctic, particularly through AMAP. (www.arctic-council.org)

Barents Euro-Arctic Council

Environmental protection and sustainable development are central issues in the Barents cooperation. The action programme for environmental protection in the Barents region lists energy and climate change as one of six main themes. (www.beac.st)

EU

Urges for an ambitious climate regime under the climate negotiations. Takes the lead in risk assessment and regulation of chemicals. (www.eu.int)

Nordic Council of Ministers

The cooperation body of the Nordic governments. Prioritises climate issues and environmental pollution, etc., in the Arctic cooperation. (www.norden.org)

Nordic Environment Finance Corporation (NEFCO)

The corporation's objective is to complete environmental projects in the adjacent areas of the Nordic region (particularly the Baltic Sea region and the Barents region), and the projects must have relevant environmental impacts. Water and air are prioritised areas. (www.nefco.org)

APPENDIX 3

References

ACIA

2004. Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge University Press.

ACIA

2005. Arctic Climate Impact Assessment. Cambridge University Press.

AMAP

1998. AMAP Assessment Report: Arctic Pollution Issues.

AMAP

2002. Arctic Pollution Issues 2002.

AMAP

2003. AMAP Assessment 2002: The Influence of Global Change on Contaminant Pathways to, within and from the Arctic.

AMAP

2003b. AMAP Assessment 2002: Human Health in the Arctic.

AMAP

2004. AMAP Assessment 2002: Persistent Organic Pollutants in the Arctic.

AMAP

2004b. Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North. Final Report. AMAP Report 2004:2.

AMAP

2005. AMAP Assessment 2002: Heavy Metals in the Arctic (in press).

AMAP-NEFCO

2003. Updating of Environmental 'Hot Spots' List in the Russian Part of the Barents Region: Proposal for Environmentally Sound Investment Projects. AMAP Report 2003:2.

Arctic Council

2004. Arctic Climate Impact Assessment Policy Document. Issued by the Fourth Arctic Council Ministerial Meeting, Reykjavík, 24 November 2004.

IPCC

2001. Climate Change 2001: Synthesis Report. Watson, R.T. and the Core Writing Team (Eds.) IPCC, Geneva, Switzerland.

Nordic Council of Ministers

2004. Nordic Environmental Action Plan ANP 2004:796. <http://www.norden.org/publikationer>

2005. Arctic cooperation programme 2006-08.

<http://www.norden.org/pub/miljo/naer/sk/US2005438.pdf>

Outridge, P.M. et. al.

2005. Trace metal profiles in the varved sediment of an Arctic lake. *Geochimica et Cosmochimica Acta*, Vol. 69, No. 20. pp. 4881-4894.

APPENDIX 4

Abbreviations

ACAP	Arctic Council Action Plan To Eliminate Pollution of the Arctic	OSPAR	Oslo and Paris Conventions (Convention for the Protection of the Marine Environment of the North-East Atlantic)
ACIA	Arctic Climate Impact Assessment (under the Arctic Council)	PCB	Polychlorinated biphenyl (synthetic chlorine compounds)
AIXG	Annex I Expert Group	PFOS	Perfluorooctane sulfonate
AMAP	Arctic Monitoring and Assessment Programme (under the Arctic Council)	POP	Persistent Organic Pollutant
BEAC	Barents Euro-Arctic Council	REACH	Registration, Evaluation and Authorisation of Chemicals (under the EU)
CBD	Convention on Biological Diversity	SAICM	Strategic Approach to International Chemicals Management (under UNEP)
CFC	Chlorofluorocarbon	UN	United Nations
CSD	Commission on Sustainable Development (under the UN)	UNECE	United Nations Economic Commission for Europe
EEA	European Environment Agency	UNEP	United Nations Environmental Programme
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (under LRTAP)	UNFCCC	United Nations Framework Convention on Climate Change (UN Convention on Climate Change)
EU	European Union	WMO	World Meteorological Organization
GEF	Global Environment Facility	WSSD	World Summit on Sustainable Development (under the UN)
HCH	Hexachlorocyclohexane (also known as lindane)		
HCFC	Hydrochlorofluorocarbon		
HFC	Hydrofluorocarbon		
IASC	International Arctic Science Committee		
ICES	International Council for the Exploration of the Sea		
IMO	International Maritime Organization		
IPCC	Intergovernmental Panel on Climate Change (under the UN)		
IPY	International Polar Year		
LRTAP	Convention on Long-range Transboundary Air Pollution		
NCM	Nordic Council of Ministers		
NEFCO	Nordic Environment Finance Corporation		
OECD	Organisation for Economic Co-operation and Development		

