# Finland's National Adaptation Strategy

An integral part of the National Energy and Climate Strategy

## PREPARATION OF FINLAND'S NATIONAL ADAPTATION STRATEGY

Preparation of the National Strategy for Adaptation to Climate Change began towards the end of 2003. The need to draft a programme for adaptation to climate change was identified in Parliamentary responses to the National Climate Strategy, which had been submitted to Parliament in March 2001.

The Ministry of Agriculture and Forestry coordinated the actual work, while representatives from the Ministry of Transport and Communications, Ministry of Trade and Industry, Ministry of Social Affairs and Health, Ministry of the Environment, Ministry for Foreign Affairs, Finnish Meteorological Institute and Finnish Environment Institute took part in the preparation process. The work used as its reference a set of existing scenarios of future Finnish climate and the Government Institute for Economic Research prepared long-term economic scenarios. Several top Finnish researchers in the field of climate change and its impacts, other experts and representatives of various sectors were involved in the work. The draft strategy was circulated widely for comment, and Finnish stakeholders and citizens had the opportunity to offer their comments on the Internet. The comments were duly taken into account in finalising the strategy.

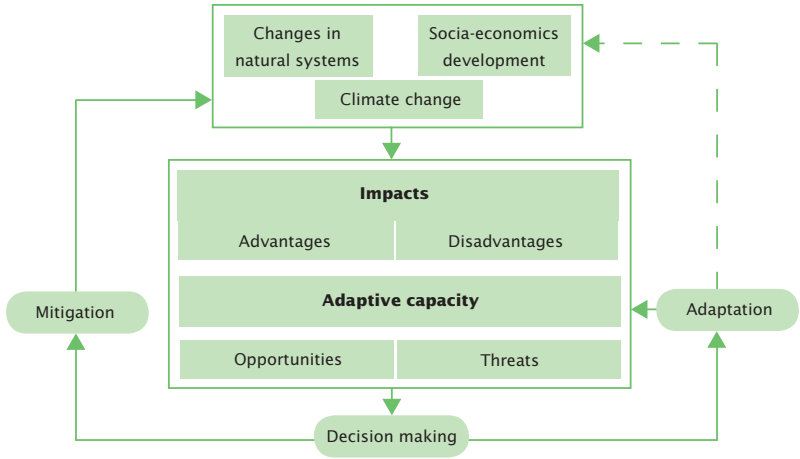
The Adaptation Strategy gives a detailed account of the impacts of climate change in different sectors and presents measures to be taken until 2080. The main elements of the strategy are also included in the National Energy and Climate Strategy, where the focus is on measures to be launched in the next 5 to 10 years. Priorities identified for increasing adaptation capacities include: (i) mainstreaming climate change impacts and adaptation into sectoral policies, (ii) addressing long-term investments, (iii) coping with extreme weather events, (iv) improving observation systems, (v) strengthening the research and development base, and (vi) international cooperation. It was recommended that work on adaptation



should be started immediately, because in most cases this would also benefit the different sectors under present climatic conditions. The complete strategy is available in English, Swedish and Finnish in www.mmm.fi/sopeutumisstrategia.

## MAIN ELEMENTS OF THE ADAPTATION STRATEGY

The objective of the Adaptation Strategy is to reinforce and increase the capacity of society to adapt to climate change. The strategy starts from the premise that increasing amounts of greenhouse gases in the global atmosphere, especially carbon dioxide content, are warming the Earth's climate. Adaptation to climate change refers to the capacity of nature and humans to adjust to the climate changes, either through minimizing the adverse impacts or by taking advantage of the benefits. The most important means of minimizing the impacts of climate change and thus the need for adaptation is to limit and reduce greenhouse gas emissions on the global scale as early as possible. However, current climate scenarios show no significant downturn in the current global warming trend for decades into the future, regardless of the mitigation measures taken in different scenarios. The Adaptation Strategy does not contain an assessment of the effect of possible future mitigation measures on climate change. Instead, it focuses on some of the challenges that lie ahead up to 2080, assuming a range of plausible long-term scenarios of the climate and economic development and a description of the likely resulting effects on natural systems and processes.




*Framework of Finland's National Strategy for Adaptation to Climate Change*

## CLIMATE CHANGE IN FINLAND

The Third Assessment report of the Intergovernmental Panel on Climate Change states that most of the global warming during the past 50 years is likely to have been caused by human action (IPCC 2001). The Earth's average temperature is estimated to rise by 1.4 to 5.8 ºC from 1990 until 2100, and the increase in the average temperature in Finland will be at least the same rate. In certain regions, such as the Arctic regions, the climate change may be stronger and/or more rapid than the global average. According to the Arctic Climate Impact Assessment (ACIA), the annual average temperature in the Arctic has increased at almost twice the rate of the rest of the world. Ice cover in the Arctic Ocean can be expected to decrease considerably during the present century, which means that most of the Arctic Ocean will be open during the summer. This is going to have great impacts on ecosystems, seafaring and utilisation of natural resources. Decreases in the extent of continental glaciers and snow cover in the northern hemisphere are expected to accelerate as well. The larger areas of (darker) land and waters that are revealed by retreating ice and snow, absorb more solar heat and, through this, reinforce the warming of the climate.

Globally, the sea level is estimated to rise by 0.09–0.88 metres between 1990 and 2100. In Finland the relative sea level is not expected to rise as much because of the land uplift relative to the mean sea level. The global hydrological cycle will become stronger and the average precipitation is projected to increase. However, there will be considerable variation in the magnitude of the changes between different regions. Over Finland, precipitation totals are projected to increase, especially in winter.

Most of climate scenarios developed for have focused on changes in average temperature and average precipitation. However, increases in the frequency or magnitude of extreme weather phenomena, such as heat waves and extremely cold periods, floods and storms, can be expected to have more significant negative impacts on different sectors of the Finnish economy and the functioning of society than gradual (and sometimes beneficial) average changes. In addition, the occurrence of extreme events may not change smoothly over time.

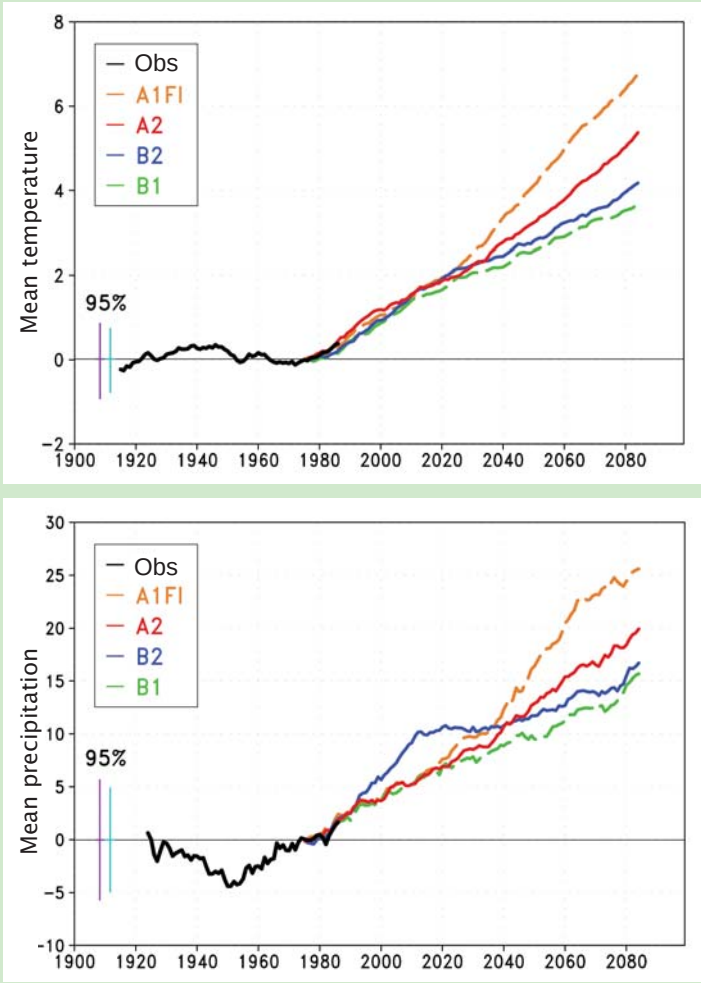
**During the period 2005–2010** climate change in Finland is projected to gain pace only gradually, and it is likely to be impossible to distinguish the changes from the natural climate variability observed at present. However, there are a number of trends which

may make the society increasingly vulnerable to weather and climate factors. For example, the growing share of built-over land area leads to a higher risk of damages caused by short duration, heavy rainfall. The electricity supply system is sensitive to disruptions due to extreme weather events such as storms, and any increase in frequency of weather-related disruption, coupled with society's growing dependence on electrical power.

**During the period 2010–2030** an increasing concentration of greenhouse gases is projected to reinforce the warming of the atmosphere. While scenarios for temperatures and precipitation indicate marked differences from the Finnish climate in 1961-1990, natural variation in the climate is still of the same magnitude as the anticipated changes. This means that the natural climate variation may still considerably reduce or conversely might reinforce the changes caused by the strengthening greenhouse effect. By 2025 the average temperature is projected to rise slightly over 2 °C relative to 1961-1990.

**Over the period 2030–2080** ever-increasing greenhouse gas concentrations are projected to change both the global and Finnish climate significantly. There are some differences in the magnitude of these changes, depending on alternative emission scenarios: in Finland the average temperature is projected to rise by 4 to 6 °C and average precipitation by 15 to 25 per cent by the 2080s compared to the period 1961-1990. Temperatures will rise the most in winter and precipitation also increases especially in winter. Total precipitation during the summer is not expected to increase as much as in the winter; some climate models even suggest that it could decline slightly.

Changes in mean temperature and mean precipitation in Finland relative to the average in 1961-1990. The curves represent 30-year moving averages. Observed changes (thick black curve) and the different FINSKEN scenarios (A1FI, A2, B2 and B1) as an average of four climate models. The vertical bars (purple and blue) represent natural variation between 30 year periods, indicating the 95% range of natural variation estimated by two different climate models.




*The uncertainty range for each emission scenario caused by the differences in the climate models is about ±1°C for the change in mean temperature and about ±5% for the change in mean precipitation at the beginning of the period and about ±10% at the end of the period. Source: Jylhä, K., Tuomenvirta, H. & Ruosteenoja, K., 2004. Climate change projections for Finland during the 21st century. Boreal Env. Res. 9: 127-152.*


## IMPACTS OF CLIMATE CHANGE

Climate change influences human welfare on the global scale through, inter alia, availability of food, fibre and water, health and the conditions regulating the existence and location of settlements. Agricultural crop yields are forecasted to increase in the high latitude regions (including northern Europe) as the climate gets warmer, but in subtropical and tropical regions (including parts of southern Europe) they are expected to decrease due to drought and high temperatures.

The climate is expected to change strongly in Arctic regions, and the impacts may be quite dramatic because many natural systems and species are considered particularly sensitive to changes in the climate in this region. However, in terms of human impacts, even if the temperatures are projected to rise the most at high latitudes, the damages will probably be greatest in the developing countries located in the subtropics and tropics. It is estimated that the adaptive capacity of the least developed countries is the weakest and the position of the poorest is going to be particularly difficult.

The tables summarise some of the anticipated impacts of climate change in Finland. It should be noted that the scale of the impacts are not equal.

### Impacts of the increase in extreme weather phenomena

Climate change is expected to increase the occurrence of extreme weather phenomena. Changes in their frequency, duration and strength may have serious negative impacts. Estimates concerning increased storminess in Finland involve a great deal of uncertainty, but winter storms and thunderstorms may occur more frequently.

**Floods and heavy rains**

- Damages to farming, water services, industry, energy supply, traffic, buildings, population centres and urban areas and health.
- Forecasting floods becomes increasingly difficult.

**Drought**

- Increased need for irrigation in agriculture.
- Growth of trees and other plants in barren areas weakens.
- Risk of forest and field fires increases and possibility of large fires increases.
- Hydropower production decreases in summer.
- Decrease in water level causes difficulties in water traffic.
- Groundwater resources diminish and the quality deteriorates.

**Storms and winds**

- Strong winds and the damages they cause e.g. to buildings and community infrastructure increase.
- Wind damages increase in forests, resulting in growing risk of insect damages.
- Sea level of the Baltic Sea rises and strengthens short-term variation in the water level, which may cause flood damages to industry, energy supply, traffic and buildings.
- Decrease in the ice cover in the Baltic Sea increases windiness and waves, which causes difficulties to sea traffic.
- Disturbances in the distribution of energy cause disruptions in other technical systems, such as distribution of water and heat, wastewater services and communications.
- Increase in damages to be compensated raises the insurance premiums.

**Frost damages**

- Even if the growing season becomes longer, frost still poses a risk to cultivation.
- Berry yields weaken.

## Impacts of reduced snow cover and changes in ground frost

In northern Finland the snow cover period is estimated to shorten by one month. In southern Finland a significant part of the rainfall in winter is water and the snow cover period shortens by about two months. Warming and changes in snow cover are also reflected in ground frost.

### Disadvantage

- Over-wintering of crops may weaken in southern Finland.
- Lower certainty of snow may affect the tourism and recreation opportunities especially in southern Finland.
- Decrease in ground frost may cause compaction of clay soil.
- Decrease in ground frost may weaken the anchoring of trees and increase the risk of wind damages.
- Decrease in ground frost causes difficulties in harvesting and transport of wood.
- Increased movement of deer may lead to higher risk of deer accidents on the roads.
- Winter season becomes darker when the snow cover period is shorter.

### Direction of the impact unclear or a simultaneous advantage and disadvantage

- As deer move more easily they cause less damage to tree stands locally but the damages affect larger areas.
- Need for frost protection of constructions may decrease.

### Advantage

+ Decrease in snow cover in southern Finland facilitates wood harvesting in winter.
+ Decreased in snow cover may stabilise small game and mammal populations.
+ Spring flooding may become less severe and seasonal variations in lakes and rivers may decrease.
+ There may be cost savings in the winter maintenance of road and rail networks and airports.
+ Land construction work is easier in winter when there is less ground frost.

## Impacts of increased precipitation

Annual precipitation in Finland will rise by 15–25% by the 2080s. Precipitation increases the most in winter. Total precipitation in summer changes very little, while according to the results of some models it may even decrease.

### Disadvantage

- Quality of crops deteriorates and harvesting becomes more difficult.
- Erosion increases and risk of nutrient leaching grows.
- It is more difficult for reindeer to find feed due to rains in winter.
- Hydropower becomes more difficult to anticipate.
- Decrease in the firmness and carrying capacity of the land cause problems for roads, buildings and construction.
- Peat production becomes difficult in rainy summers.
- Warming causes difficulties and additional costs to road and rail transport and maintenance of airports and navigation routes.

### Direction of the impact unclear or a simultaneous advantage and disadvantage

- Salinity of Finland's sea areas and flows of lakes and rivers change, leading to changes in e.g. abundance, distribution and mutual relationships of fish populations.

### Advantage

+ Growth of tree stand in the boreal forest zone and harvesting opportunities increase as a result of increased precipitation together with the rise in temperature and $CO_2$ content.
+ Risk of forest fires decreases.
+ Amount of energy produced by hydropower increases.
+ Amount of oxygen-rich water increases in lakes and rivers.

## Impacts of climate warming

Average temperature is estimated to rise by 4-6 °C by the 2080s. Temperatures will be higher in all seasons, but especially in wintertime.

### Disadvantage

- Agricultural and forest pests benefit from warmer climate and longer growing period.
- Risk of plant diseases grows and they appear earlier.
- Autumn hardening in trees may be delayed and frost hardiness may degrade prematurely.
- Populations of coldwater fish species decrease in southern Finland and fish farms may have production problems.
- Need for energy for cooling of buildings increases in summer.
- Algae blooming becomes increasingly common in warmer waters.
- Palsa mires in Lapland may be destroyed.
- Conditions and range of species of the northern ecosystem may change.
- Risk of slippery traffic conditions increases.
- Snow-related winter tourism suffers in southern Finland.

### Direction of the impact unclear or a simultaneous advantage and disadvantage

- Change in raw material basis may influence food processing.
- Quality of wood raw material and range of tree species changes.
- Interrelationships between aquatic animals and fish species change.
- There may be changes in the timing of the reproduction of animals and plants, length of the growing period and/or migration and movement of animals, distribution of species and population sizes and incidence of pests and diseases.

### Advantage

+ Growing season is longer and yields may grow especially in northern Finland.
+ Over-wintering of perennial plants may improve as the period of snow and frost cover is shorter.
+ Pasture season becomes longer.
+ Growth of forests and the amount of wood raw material obtained from them increase.
+ Growth of fish and returns on fish farming increase.
+ Warmwater fish species spread towards the north.
+ There is more feed available for reindeer in summer as the plant biomass production increases.
+ Living conditions of southern species improve as the growth and reproduction periods become longer and the winters are milder.
+ Shorter ice cover period saves on the costs of seafaring and maintenance of ports.
+ Demand for heating energy decreases in winter and seasonal variation in the demand for energy decrease.
+ Peat production period becomes longer.
+ Health damages decrease due to less frequent cold spells during winter.
+ Summer tourism and recreation period becomes longer.

## CROSS-SECTORAL ADAPTATION MEASURES IN 2005-2015

### Mainstreaming

A major objective is that a detailed assessment of the impacts of climate change should be incorporated into the regular planning, implementation and monitoring processes of the different sectors, in order to improve their preparedness on the basis of the National Strategy for Adaptation to Climate Change.

All sectors should improve their capacities in the assessment of impacts and development of adaptation strategies. They should enhance their use of research information and increase cooperation and coordination with different administrative sectors (sectoral authorities and regional and local authorities), institutes and other actors. In its first stage, the mainstreaming of climate change impacts and adaptation calls for the development of research and assessment methods. At the same time, relevant aspects of climate change may be incorporated into environmental planning, environmental impact assessment and risk management.

### Observation and warning systems

The development of national observation and warning systems should be carried out in the context of international cooperation, to ensure the compatibility of systems and their functioning in different countries and regions of the world. It is no longer sufficient to rely solely on past experiences in forecasting weather phenomena and their recurrence. Adaptation to climate change in Finland can be promoted by producing information on the functioning of the climate system and detailed impacts of the changes to be expected in the different sectors of society, taking account of the special national and regional conditions.

## Research and development

There is an obvious need to strengthen policy-relevant research and development relating to the impacts of climate change and adaptation. In addition to general research on future climate, on processes of climate change adaptation and on the costs of impacts and adaptation, sector-specific studies are also required.

A five-year research programme on adaptation is to be launched in Finland in 2006. It aims to reinforce adaptive capacity and help build a sufficient knowledge base to support practical adaptation measures. The programme is prepared co-operatively among government ministries during 2005, and its main objective is to produce information and methods that can be applied in practice. Research needs which have been identified in the Adaptation Strategy and relevant research programmes will be taken into account in the planning of the programme. The information obtained in the research programme will be used to further specify necessary adaptation measures in different sectors. The information will also be used for the revision of the Adaptation Strategy.

## SECTOR-SPECIFIC ADAPTATION MEASURES IN 2005-2015

The National Strategy identified the following sector-specific adaptation measures as important priorities:

### Agriculture and food production

- Attention to breeding, cultivation and production methods and regional aspects in setting the long-term objectives for agriculture
- Maintaining the preparedness of national food production to respond to changes in the demand for nutrition caused by global environmental changes
- Preparing for the growing frequency of extreme weather phenomena in agriculture

### Forestry

- Incorporation of climate change into the planning of national forest policy
- Development of forest management, wood harvesting and prevention of forest damages adapted to the climate change

### Fisheries

- Ensuring the production of fish species requiring cold water in fish farming establishments e.g. through oxidisation and availability of cool water.

### Reindeer husbandry

- Development of reindeer herding methods e.g. by improving pasture rotation.
- Improving the preparedness for extreme weather phenomena e.g. by developing emergency feeding systems.

### Game management

- Attention to the impacts of climate change in the management plans for game populations.

### Water resources

- Inventory of risk sites which suffer the most from floods and preparation of general plans for managing flood risks
- Further development of the preparedness for floods e.g. through anticipation, flood protection, adjustment of the construction norms and practices and revision of the water level regulation licences
- Ensuring the functioning of water services in emergency situations (floods, heavy rains, drought)

### Biological diversity

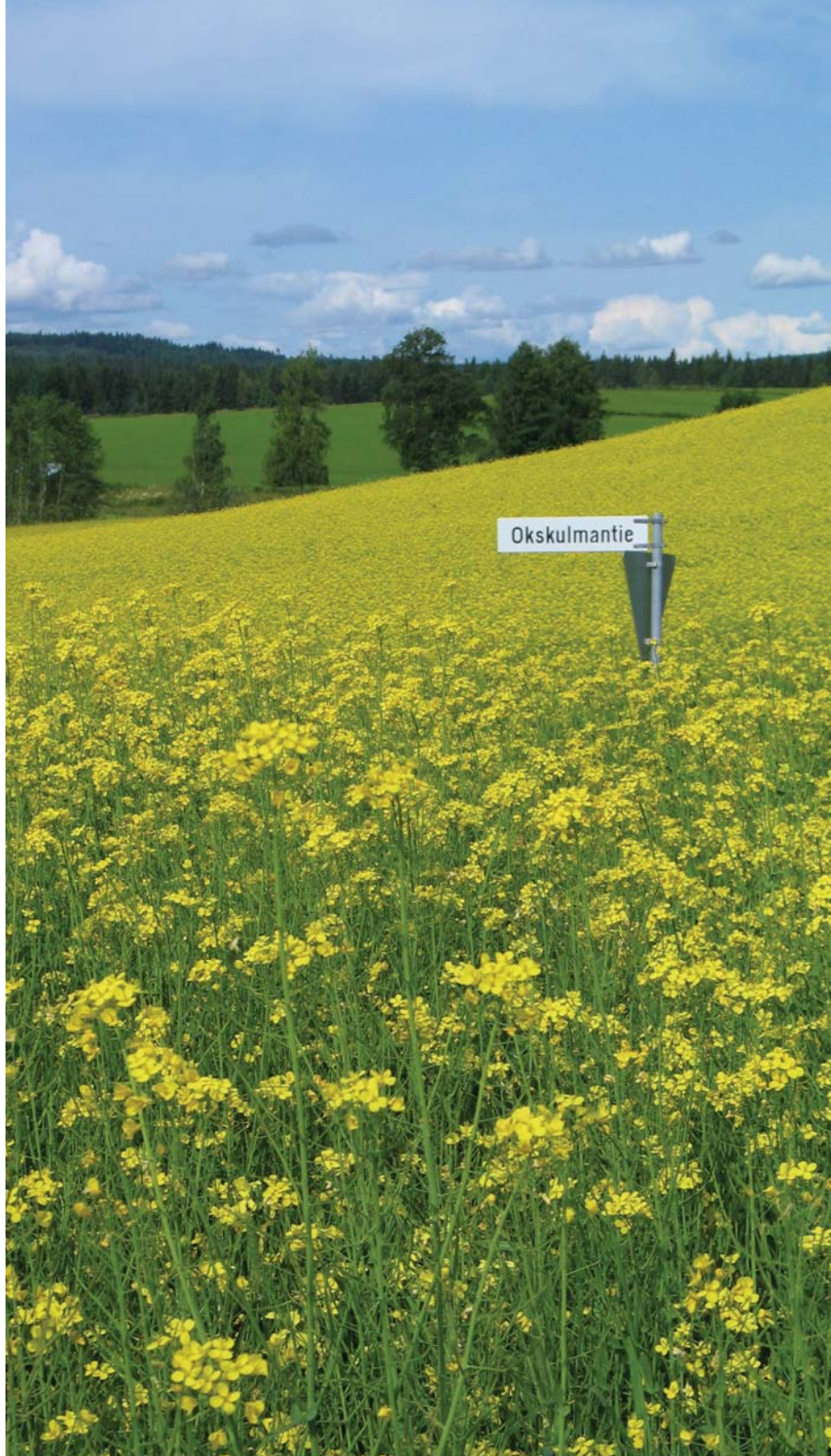
- Incorporation of the assessment and monitoring of the impacts of climate change into projects and programmes concerning the protection and management of biological diversity
- Evaluation of the coverage of the nature protection in changing climate conditions

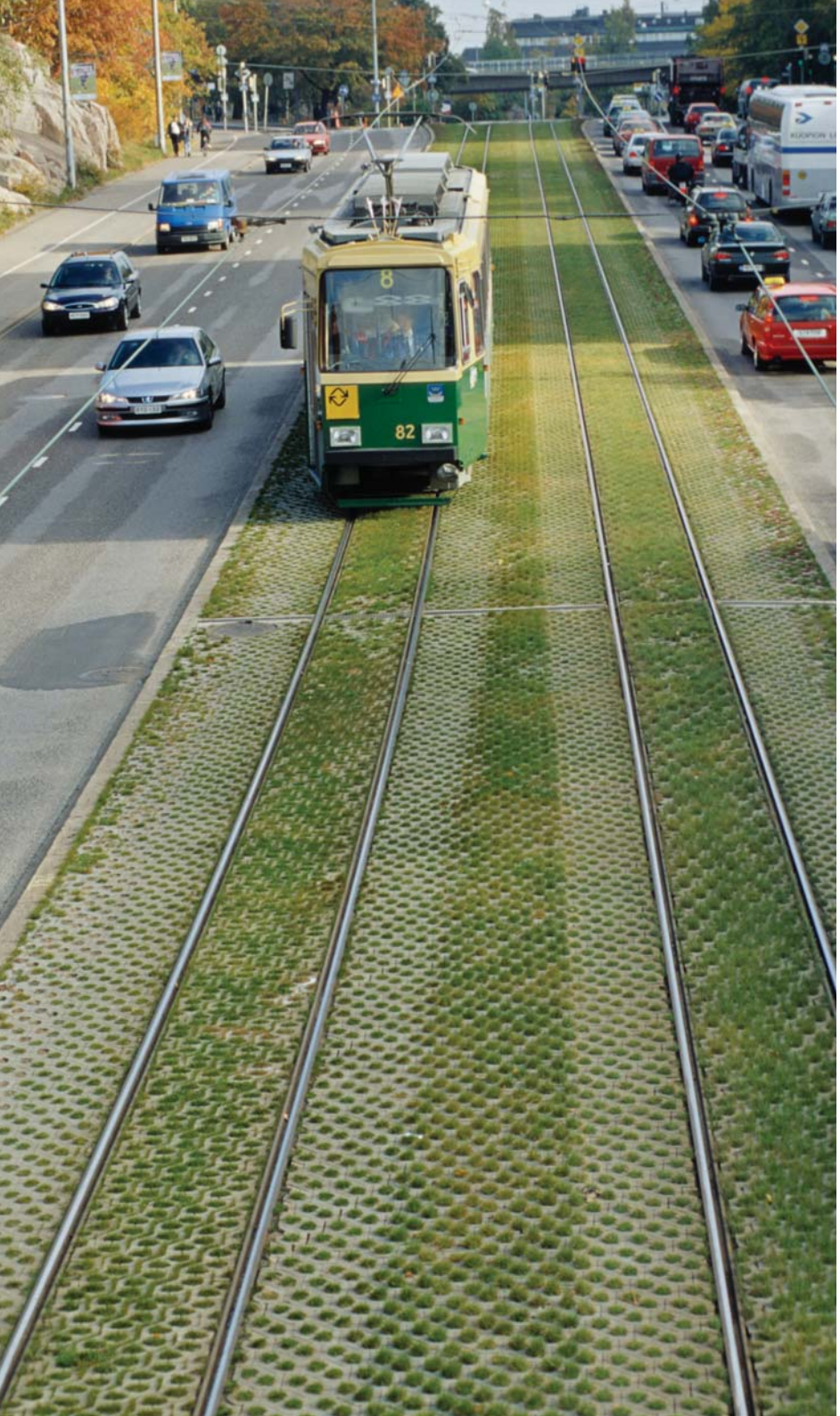
### Industry

- Incorporation of the adaptation to climate change into the long-term planning of different industrial sectors and main actors
- Study of the impacts of climate change in different sectors, the need for concrete adaptation measures and their type, scale, cost effects and possible implementation times
- Survey of the location of industrial plants to flood sensitive areas and areas where seawater may rise and preparation of the necessary flood protection instructions

### Energy

- Incorporation of the adaptation to climate change to long-term planning of the energy sector and main actors
- Further sector-specific study of the impacts of climate change, the need for concrete adaptation measures and their type, scale, cost effects and possible implementation times
- Ensuring the availability of energy, especially electricity, in extreme weather conditions (storms, floods, heavy rains, long frost






periods) e.g. by maintaining sufficiently diversified production capacity and preparing for raising the level of maintenance and the increased costs resulting from this

### Transport and communications

- Incorporation of the adaptation to climate change into the long-term planning of all actors in the transport and communications sector
- Assessment of the risks, disturbances and structural impacts caused by climate change in each form of transportation (road transportation, sea traffic, railways, air traffic, communication networks)
- Introducing the avoidance of flood-sensitive areas as one general principle into the planning of road and rail networks
- Study of the safety risks caused by extreme weather phenomena to air traffic and seafaring so that these can be taken into account in safety arrangements

### Land use, communities, buildings and construction

- Steering of land use planning to take the possibility of floods caused by heavy rains and other flood risks better into account in town planning
- Study of the vulnerability of municipal technology (energy and water supply, wastewater treatment) and improvement of risk management
- Incorporating climate change, including extreme phenomena, into long-term planning concerning the existing buildings and use of building materials and constructions as well as study of the need to revise the planning principles and building norms

### Health

- Continuation and development of the careful monitoring of infectious diseases to be able to develop flexible strategies for their prevention, where necessary
- Prevention of environmental health damages by ensuring the maintenance of technical infrastructure

- Securing the availability of electricity in all conditions and especially in special climate situations (heat waves, floods, storms, cold) to ensure the maintenance of the cold chain and supply of heat, energy, air conditioning and clean drinking water

### Tourism and recreational use of nature

- Study of the risks and opportunities for tourism due to climate change
- Development of supplementary activities to winter tourism to reduce the dependence on snow

### Insurance

- Development of the management of economic risks and mitigating the economic risk to insurance institutions through bonds and derivatives
- Development of insurance systems for damages caused by extreme weather phenomena
- Clarification of the division of tasks and responsibilities between public and private insurance

## ADAPTATION TO CHANGES TAKING PLACE IN OTHER PARTS OF THE WORLD

The capability of different countries to prepare for and adapt to climate impacts varies a great deal. In the developing countries, which are likely to face the most serious challenges in this regard, it may be difficult to make a distinction between the impacts of climate change and development problems, but climate change will obviously aggravate the existing problems. Situation in regions which suffer from drought may get even worse, causing the population to search for new residential areas and increase the number of environmental refugees. Problems may also get worse in many flood-sensitive regions, especially low-lying coastal areas.

In the poorest countries food production already suffers from adverse climate, and more attention should be directed to climate issues in development cooperation relating to water supply, agriculture and forestry. This implies further challenges for Finland's bilateral and multilateral (e.g. Global Environment Facility) development cooperation and funding. However, the need to adapt to climate change may also offer certain opportunities to poor countries if the effort to increase preparedness results in solutions which support the sustainable development of food production, energy supply and health care.

In the context of the implementation of the National Adaptation Strategy, different sectors and actors must assess the need for adaptation through various kinds of international linkages. For example, the agricultural policy of the European Union will continue to regulate Finnish agriculture as well, but the need for food in areas suffering from crop failures in the other parts of the globe may be reflected in European food production. Changes in food production volumes may be considerable in the long term.

In tourism the impacts of climate change may be reflected in consumer preferences and choices. Conflicts which may arise in areas suffering from drought and water shortage may be reflected as global security issues. If climate impacts aggravate the situation in the poorest countries even further, there is a growing need for international aid. Possible changes in the ice conditions of the North-East Passage may be reflected in seafaring in Finland. In the energy sector increased precipitation projected for Scandinavia will influence the opportunities for energy production and imports.

## IMPLEMENTATION, MONITORING AND REVISION

The National Strategy for Adaptation to Climate Change is being implemented between 2005 and 2015 primarily through actions in different sectors, such as sector-specific strategies and programmes. Citizens are also likely to respond to the changes through their own voluntary actions further in the future.

The implementation of the Adaptation Strategy will be evaluated within 6 to 8 years. By this time research and dissemination activities in different sectors will have produced new and more detailed information and views on climate change, its impacts, and the need and mean for adaptation. Very likely there will also be more information available on the mitigation of greenhouse gas emissions on the global scale as well as the pace at which the climate change is progressing.

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