



NORDREGIO
Nordic Centre for Spatial Development

Adaptive Urban Planning in Response to a Changing Climate

– Innovative practices from the Nordic Countries regarding Sea Level Rise and Precipitation

Aslı Tepecik Diş, Christian Dymén, Stefanie Lange

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Nordic co-operation

Nordic co-operation

takes place among the countries of Denmark, Finland, Iceland, Norway and Sweden, as well as the autonomous territories of the Faroe Islands, Greenland and Åland.

The Nordic Council

is a forum for co-operation between the Nordic parliaments and governments. The Council consists of 87 parliamentarians from the Nordic countries. The Nordic Council takes policy initiatives and monitors Nordic co-operation. Founded in 1952.

The Nordic Council of Ministers

is a forum of co-operation between the Nordic governments. The Nordic Council of Ministers implements Nordic co-operation. The prime ministers have the overall responsibility. Its activities are co-ordinated by the Nordic ministers for co-operation, the Nordic Committee for co-operation and portfolio ministers. Founded in 1971.

Nordregio – Nordic Centre for Spatial Development

works in the field of spatial development, which includes physical planning and regional policies, in particular with a Nordic and European comparative perspective. Nordregio is active in research, education and knowledge dissemination and provides policy-relevant data. Nordregio was established in 1997 by the Nordic Council of Ministers. The centre is owned by the five Nordic countries and builds upon more than 30 years of Nordic cooperation in its field.

Stockholm, Sweden, 2011

Contents

Preface	6
Förord	7
Introduction	8
Inledning	9
The Climate is Changing	10
Main Messages and Conclusions	12
Communicating with the general public	13
National and Regional Coordination	14
Importance of cooperation between municipalities, regions and states	18
Need for Long Term Integrated Climate Change Management	20
Using Local Potentials for Climate Friendly Innovations and Business Development	22
Appendix 1: List of participants	24
Appendix 2: Programme for the Seminar	25

List of tables & figures

Picture 1: Key note speech by Sten Bergström.....	11
Picture 2: Ole Damsgaard, Director of Nordregio, welcomes the participants	12
Box 1: Communicating to the general public, Rune Kloster Tvedt, The Norwegian Association of Local and Regional Authorities, Norway.....	13
Box 2: Water issues in the new Swedish Planning and Building Act, Martin Karlsson, the Swedish National Board of Housing, Building and Planning	15
Box 3: Water and everyday life in Bergen; Eva Britt Isager, City of Bergen.....	16
Box 4: Flooding and protection in Rovaniemi, Satu Himanen, City of Rovaniemi.....	16
Box 5: Coordination of sustainable climate change adaptation in Greve, Lars Fleng Vestergaard, Municipality of Greve, Denmark	17
Box 6: The case of the "New Slussen", Gustaf Landahl, Martin Schröder and Monica Granberg, Stockholm Municipality	19
Box 7: Adapting to changing water conditions, Gry Backe, Cities of the future, Norway	21
Box 8: Augustenborg – EcoCity for a changing climate, Louise Lundberg, Scandinavian Green Roof Institute, Sweden.....	23

Preface

Climate change is felt all over the world. In the Nordic countries, we have experienced warmer winters, stronger storms and greater precipitation, especially heavier rainfalls. Management of, and planning for, larger quantities of water, as well as adaptation of our territorial structures to climate changes are on everybody's agenda.

This report reflects a Nordic seminar, Adaptive Urban Planning Challenged by Changing Climate (Stadsplaneringens utmaningar i ett förändrat klimat), hosted by Nordregio in Stockholm on June, 8, 2011. The seminar was initiated by the Nordic Working Group on Urban Regions under the Nordic Council of Ministers.

The Nordic ministers with responsibility for regional policy have launched a Regional Policy Cooperation Programme for the years 2009-2012, promoting common actions that the Nordic ministers want to initiate within the field of regional policy and territorial planning. The Nordic Working Group on Urban Regions is part of the Programme.

One important task for the group is to contribute to the exchange of experiences between Nordic cities on climate change adaptation and to promote knowledge about planning for greater amounts of water.

Green growth is a priority for Nordic cooperation. Green innovation is an important component of regional development and will become even more so in the future. Thus, it is important to identify and exploit possibilities for local development resulting from innovations in handling greater precipitation and more water.

In many cases, climate adaptation concerns a geographical area different from the one delimited by the borders of municipalities or regions. Planning for adaptation to larger precipitation calls for cooperation of authorities within the drainage area. Thus, cooperation in planning across the boundaries of municipalities is needed, as is cooperation between relevant municipal and regional authorities. The geography of the solutions should match the geography of the challenges.

Cooperation also involves different levels of government. Coordination between local, regional and national policies is often necessary and should be done, respecting the tasks and duties of the various levels. The Nordic Working Group on Urban Regions recommends all stakeholders to consider how such processes of cooperation could be promoted.

Nordic Working Group on Urban Regions
Nordic Council of Ministers

Förord

Klimatförändringar gör sig märkbara över hela världen. I de nordiska länderna har vi upplevt varmare vintrar, starkare stormar och ökad nederbörd, framförallt mer skyfall. Hanteringen av, och planeringen inför, större mängder vatten liksom anpassningen av våra fysiska strukturer till klimatförändringar står på allas agenda.

Denna rapport återspeglar ett nordiskt seminarium "Stadsplaneringens utmaningar i ett förändrat klimat" anordnat av Nordregio i Stockholm den 8 juni 2011. Initiativet till seminariet togs av den Nordiska Arbetsgruppen för Stadsregioner under Nordiska Ministerrådet.

De nordiska ministrarna med ansvar för regionalpolitik har lanserat ett regionalpolitiskt samarbetsprogram för åren 2009-2012, i vilket de redogör för de gemensamma åtgärder de ämnar genomföra inom områdena regionalpolitik och fysisk planering. Den Nordiska Arbetsgruppen för Stadsregioner är en del av det programmet.

En viktig uppgift för arbetsgruppen är att bidra till erfarenhetsutbyte mellan nordiska städer om hur de anpassar sig till de utmaningar som kommer av klimatförändringar och främja utbyte av kunskap om hur man planerar för större mängder vatten.

Grön tillväxt är ett prioriterat område i det nordiska samarbetet. Gröna innovationer är viktiga komponenter i regional utveckling och kommer att bli ännu viktigare i framtiden. Det är därför viktigt att uppmärksamma och utnyttja de möjligheter till lokal utveckling som uppstår till följd av innovationer i hanteringen av ökad nederbörd och stora mängder vatten.

Behovet av klimatanpassning rör ofta ett geografiskt område som skiljer sig från det av kommun- och regiongränser avgränsade. Att planera för ökad nederbörd kräver samarbete mellan myndigheter inom avrinningsområdet. Det är därför nödvändigt med samarbete över kommungränserna likväl som samarbete mellan relevanta kommunala och regionala myndigheter. Lösningarnas geografiska täckning bör motsvara den hos utmaningarna.

Ett sådant samarbete involverar även olika nivåer av beslutsfattande. Samordning mellan lokala, regionala och nationella myndigheter är ofta nödvändig och bör genomföras med hänsyn till respektive nivåns plikter och uppgifter. Den Nordiska Arbetsgruppen för Stadsregioner uppmanar alla berörda parter att överväga hur sådant samarbete skulle kunna främjas.

Nordiska Arbetsgruppen för Stadsregioner
Nordiska Ministerrådet

Introduction

To address the issue of climate change adaptation – especially issues related to precipitation and sea level rise - in the Nordic countries, Nordregio hosted a seminar that took place on the 8th and 9th of June 2011. The purpose of the seminar was to create dialogue among Nordic practitioners responsible for physical planning and adaptation to climate change at different administrative levels. Further, the aim was to share knowledge among the Nordic countries concerning challenges and needs for new planning instruments at the local, regional and national level.

The seminar was introduced with a key note speech by Sten Bergström, Swedish Meteorological and Hydrological Institute (SMHI), on the meteorological and hydrological dimensions of sea level rise and precipitation. This was followed by four sessions. The first session focused on how the national level in Sweden and Norway deals with water related issues of climate change adaptation. The second session focused on challenges related to water in the planning and implementation phases of the “New Slussen” in Stockholm. After an introductory presentation, the participants had the opportunity to visit the area of Slussen, including the ongoing exhibition and public hearing of the “New Slussen”. The third session focused on innovative examples from local responses in Norway, Finland, Denmark and Sweden. The purpose of the first three sessions was mainly to exchange knowledge between practitioners from the Nordic countries. The fourth session was a

workshop where participants were divided into groups to discuss two specific questions: What are the challenges we face when it comes to dealing with increased precipitation, sea level rise and extreme weather conditions? (Vilka utmaningar står vi inför när det gäller att hantera ökad nederbörd, höjda vattennivåer och extrema väderförhållande?) The second question was: what are the needs when it comes to dealing with increased precipitation, sea level rise and extreme weather conditions in urban development? (Vilka behov finns när det gäller att hantera ökad nederbörd, höjda vattennivåer och extrema väderförhållanden i stadsutvecklingen?). The purpose of the fourth session was mainly to communicate local, regional and national practitioners’ experiences, needs and challenges, with the Nordic Working Group on Urban Regions but also with decision makers at local, regional and national levels.

This paper briefly summarizes the main messages and conclusions from the seminar. Practical cases and examples from the presentations are included in boxes to illustrate specific issues and topics. To access the presentations, please visit:

www.nordregio.se/Stadsplaneringens-utmaningar

The working paper has been worked out by, Christian Dymén, Asli Tepecik Dis and Stefanie Lange with assistance from Christian Fredricsson, Isabelle Monell and Veera Lehto.

Inledning

För att belysa frågan om klimatanpassning, framförallt frågor kring ökad nederbörd och höjda vattennivåer, i de nordiska länderna stod Nordregio värd för ett seminarium som ägde rum den 8 och 9 juni 2011. Syftet med seminariet var att skapa en dialog mellan nordiska praktiker ansvariga för fysisk planering och klimatanpassning på olika administrativa nivåer. Syftet var även att få till ett kunskapsutbyte mellan de nordiska länderna beträffande utmaningar och behov för nya planeringsinstrument på den lokala, regionala and nationella nivån.

Seminariet inleddes med ett öppningsanförande av Sten Bergström, Sveriges meteorologiska och hydrologiska institut (SMHI), om de meteorologiska och hydrologiska dimensionerna av höjda vattennivåer och nederbörd. Detta följdes sedan av fyra olika sessioner. Den första sessionen fokuserade på hur den nationella nivån i Sverige och Norge hanterar vattenrelaterade frågor i anpassningen till klimatförändringar. Den andra sessionen fokuserade på utmaningar relaterade till höjda vattennivåer i planeringen och implementeringen av "Nya Slussen" i Stockholm. Efter en inledande presentation hade deltagarna möjlighet att besöka Slussen-området och den pågående utställningen om "Nya Slussen", där allmänheten kan yttra sig över planförslaget. Den tredje sessionen fokuserade på innovativa exempel på lokala lösningar i Norge,

Finland, Danmark och Sverige. Det huvudsakliga syftet med de tre första sessionerna var att utbyta kunskap mellan praktiker från de nordiska länderna. Den fjärde sessionen bestod av en workshop till vilken seminariedeltagarna delades in i grupper för att diskutera två stycken specifika frågor: vilka utmaningar står vi inför när det gäller att hantera ökad nederbörd, höjda vattennivåer och extrema väderförhållande? Vilka behov finns när det gäller att hantera ökad nederbörd, höjda vattennivåer och extrema väderförhållanden i stadsutvecklingen? Syftet med denna fjärde session var huvudsakligen att kommunicera lokala, regionala och nationella praktikers erfarenheter, behov och utmaningar, till den Nordiska Arbetsgruppen för Stadsregioner men även till beslutsfattare på lokal, regional och nationell nivå.

Detta paper summerar i korthet huvudbudskapen och slutsatserna från seminariet. Praktiska exempel och presentationer finns med i boxar för att illustrera specifika frågor och ämnen. För att läsa presentationerna besök gärna:

www.nordregio.se/Stadsplanerings-utmaningar

Detta working paper har utarbetats av Christian Dymén, Asli Tepecik Dis och Stefanie Lange med assistans av Christian Fredricsson, Isabelle Monell och Veera Lehto.

The Climate is Changing

There is substantial scientific evidence indicating that climate change is occurring and that it is, to some extent, induced by society's GHG emissions. Nordic countries have been quick to take measures to tackle the issue of climate change. This response is usually divided into two complementary strategies, namely; mitigation and adaptation. Adaptation is defined by the United Nations International Panel for Climate Change (IPCC)¹ as "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." whereas mitigation is defined as "An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks..."

In general, climate change mitigation efforts were initiated long before adaptation came to the agenda. Issues related to a reduction in energy consumption mainly had an economic dimension early on, which then switched to a dimension of climate change mitigation. It was no longer only about reducing energy costs but also a question of reducing GHG emissions and future impacts of climate change.

Lately, climate change mitigation has been found insufficient to prevent climate change impacts in the short to medium term. Even if we make significant reductions in emissions today, the staggered effects of GHG emissions already in the atmosphere mean that we are 'locked in' to decades of climate change and centuries of sea level rise. Therefore, researchers, planners and policymakers have been emphasizing the significance of adapting to climate change. Adaptation is already being incorporated in urban planning in the Nordic countries to manage flood risks and new regulations are being developed to ensure the safety of urban areas in expectation of sea level rise as well.

Climate change already affects different regions in different ways. Coastal areas experience greater impacts from storms and erosion, whereas inland areas experience heat waves and droughts more frequently. Changes in precipitation regimes

challenge not only regions but sectors, such as agriculture.

In his keynote speech, Sten Bergström, Professor at SMHI, provided a comprehensive overview of the challenges of dealing with the water related issues of climate change adaptation. He further emphasised the relevance and importance of climate change as a topic to be taken up within the political debate, especially climate change adaptation, which has become more and more of a reality, but is not popular due to the uncertainty of its impacts.

Bergström pointed out two main problems related to climate change adaptation, namely the melting of ice sheets and sea level rise. The IPCC predicts around 18-59 cm sea level rise by 2100. This will cause problems for many countries in Europe (e.g. the Netherlands) and globally (e.g. Asia). The IPCC furthermore argues that "Dynamical processes related to ice flow not included in current models but suggested by recent observations, could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude." In other words, sea level rise could exceed 59 centimetres. But is this rise taking place only due to melting ice sheets? There are several reasons for changes in sea level. These include:

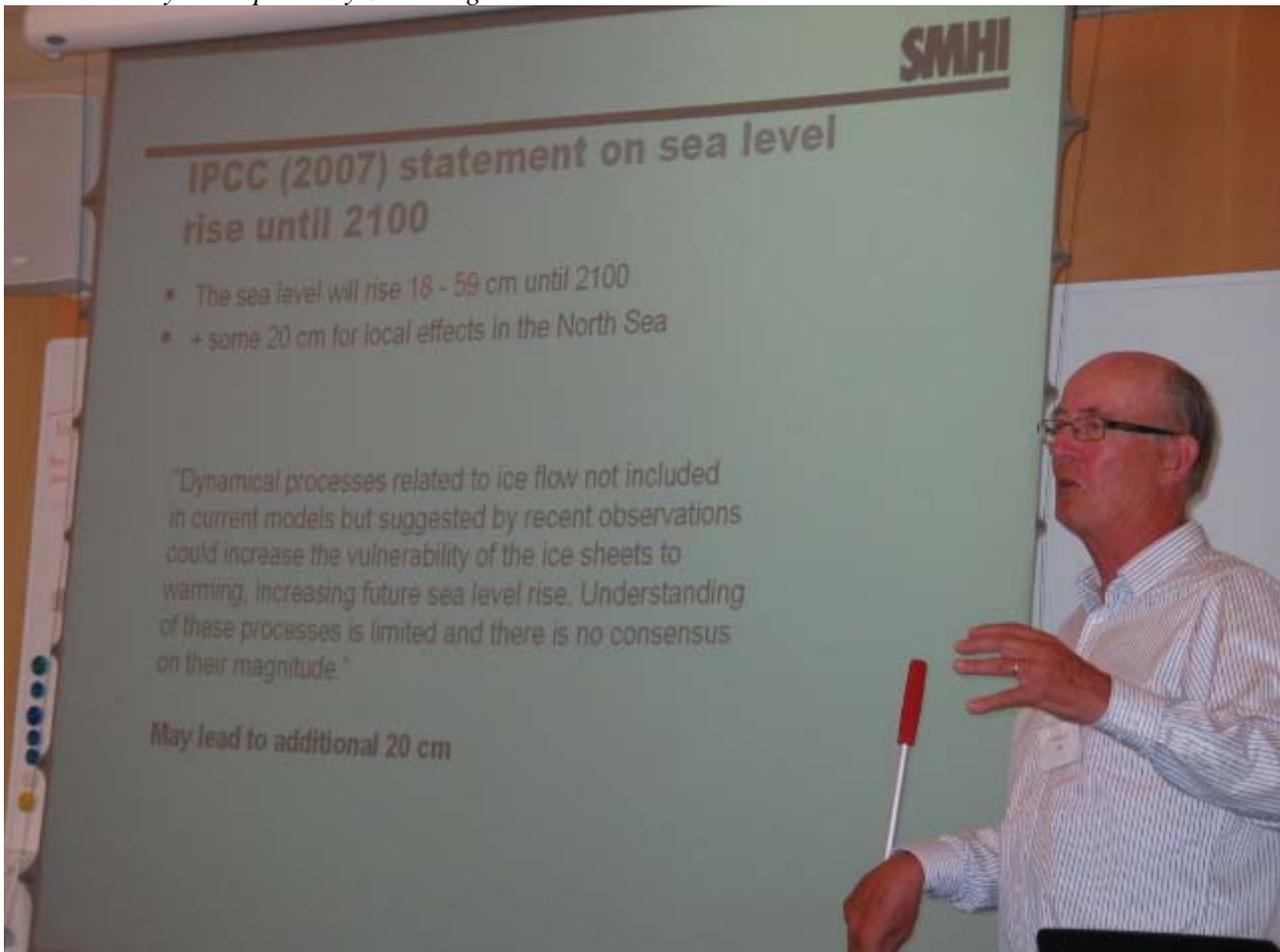
- ⇒ The tide,
- ⇒ Air pressure, wind and storms (local effects),
- ⇒ Tectonics (elevation of the land and sinking of the land),
- ⇒ Warm air expansion,
- ⇒ Melting or growing glaciers, especially in Greenland and Antarctic,
- ⇒ Snow, earth moisture and other water reservoirs on the continents,
- ⇒ Changed force of gravity when big ice covers melt (regional effects) and
- ⇒ Salinity and temperature (local effects).

¹ IPCC (2007) Fourth Assessment Report. www.ipcc.ch

The fact that more and more people are moving to cities that are located near the coast line is a particularly important challenge. In 1950, there were eight so called mega cities in the world while the prediction for 2015 is around 40, of which almost all are located on the coastline. In 1950, 30% of the world's population lived in cities whereas the prediction for 2030 is 60%. In Sweden, the land uplift will not solve all impacts that come along with sea level rise. Bergström mentioned for instance Hammarby Sjöstad in Stockholm and the city of Kalmar in Sweden as examples where houses have

been built directly on the shore with relatively small margins for sea level change. This is most likely a challenge throughout the Nordic countries and the world, where luxurious neighbourhoods are constructed along the sea line. However, challenges in the Nordic countries do not only relate to sea level rise but also extreme events such as short term precipitation shocks which may cause flooding, erosion and landslide. For Sweden, it is expected that precipitation will increase in the whole country, mainly in winter. This, in combination with more extreme events is a challenge.

Picture 1: Key note speech by Sten Bergström



Main Messages and Conclusions

In this section, we present the main conclusions and results from the seminar. These conclusions are primarily based on the workshop session where the participants had the opportunity to share their knowledge on water related issues of climate change adaptation. The conclusions are also based on discussions that occurred in relation to the presentations. To exemplify and illustrate these messages and conclusions, boxes with concrete

examples of how different cities in the Nordic countries deal with water related issues of climate change adaptation have been used. These boxes are primarily based on the presentations.

Picture 2: *Ole Damsgaard, Director of Nordregio, welcomes the participants*



Communicating with the general public

Participants at the workshop concluded that climate change adaptation needs much more attention than just technological innovation. Communicating to the citizens of a community is crucial in different ways. First, it is important to facilitate transparency between decision makers and citizens. Second, to help citizens make informed and evidence based choices when influencing - directly or indirectly through elections - the local, regional and national politicians. Third, to encourage citizens to change their behaviour in a manner that facilitates climate change adaptation. Let us give an example to illustrate the challenge. A large number of our urban areas are located along coastlines and other water

reservoirs. It is popular to settle near the shoreline, which has led to a strong demand for sea front housing that can generate substantial revenue for housing and construction companies. In such a case, it is important to be able to mediate with citizens and other actors and explain the consequences of such a housing policy regarding for instance sea level rise. In such a way, citizens and other stakeholders will be able to make informed decisions about their behaviour and choices. Maps, GIS and easy visualization can be helpful in such communication. Local newspapers can also be used to disseminate information about on-going developments as well as up-to-date research.

Box 1: Communicating to the general public, Rune Kloster Tvedt, The Norwegian Association of Local and Regional Authorities, Norway

In his presentation, Rune Kloster Tvedt focused on issues related to communication with citizens and the general public.

What to communicate is a challenge in itself. The flow of information on climate change is difficult to handle since the possible scenarios of our future climate are built on the latest information available and not on an absolute truth. Therefore, the officials working with climate change have to provide flexible information and guidelines by taking the most recent information into account. There should be substantial political support for this work to create legitimacy amongst the general public.

How to communicate is also a challenge. In some municipalities, it is seen as the duty of the officials and policy makers to present information such as vulnerability assessments, in an open fashion. In other municipalities, information is spread more carefully to avoid creating rumours and spreading false information. For instance Norway, on a national level, has actively chosen a strategy where the general public is continuously kept informed and all new data is presented online. Also in Sweden there is an openness regarding for instance flooding maps which are uploaded on the Swedish Civil Contingencies Agency's (MSB)'s homepage. Furthermore, in Norway and Sweden authorities are open to collaborating with the insurance sector. This does not seem to be the case in Denmark where the authorities are more careful in order not to spread panic and incorrect information.

Communicating with the general public is also about acknowledging that climate change adaptation is not solely a technical issue but also a so called "soft" challenge. While, technology allows solutions to climate change; if people do not react and change their attitudes and behaviour accordingly, no substantial result will be achieved.

National and Regional Coordination

A central observation from discussions between participants at the workshop is the demand that the national and regional level should take more responsibility for coordinating and creating unity between different players when it comes to water related issues of climate change adaptation. Given that climate change adaptation, including the resolution of challenges resulting from sea level rise, affects large areas, it is crucial that political decisions are made across municipalities, regions and states. During the workshop, it was urged that the national level should not only take more responsibility in coordinating work across municipalities, regions and states but also across different sectors. One such example where coordination across sectors becomes important is the management of housing related issues, which is highly relevant for climate change adaptation. A problem in Sweden for instance, is that housing-related responsibilities are divided into four ministries: Ministry of Industry, Ministry of Environment, Ministry of Culture and Ministry of Health through the National Board of Housing, Building and Planning. This creates difficulties in terms of the management of housing issues, where rules related to the Environmental Code might conflict with regulations outlined by other ministries. For more information about how the National Board of Housing and Policy works with climate change adaptation, please see box 2.

Moreover, one idea that was discussed at the workshop was the implementation of a National Centre of Excellence or even a Nordic Centre of Excellence that would gather and generate knowledge on climate change adaptation. This centre could also provide information on whom to contact concerning the issue of climate change adaptation in each of the Nordic countries. A contact would be appointed in each country. As already existing good examples, we can mention the

County Administrative Boards in Sweden and the State Regional Authorities in Finland, who act as hubs for climate change adaptation.

In addition, participants at the workshop discussed the need for a greater exchange of information and best practices especially at the local level. A conclusion from the workshop is that the regional level could help in coordinating local experiences and interests – for instance through strong regional strategies - as well as inspiring municipalities in their work. Even though these issues were raised by participants from several of the Nordic countries, it is important to find solutions that suit the different governance systems in the different countries. In Denmark for instance, a participant highlighted that the regional level mostly has an advisory function, rather than an authoritarian mandate, whereas in Sweden the regional level has to some possibilities to dictate conditions to the municipal level. In Finland the National Land Use Guidelines have a strong status, and include guidelines for adaptation issues. These have to be taken into account in regional land use plans, local land use plans and in the work of other state authorities, for example. In Norway the situation is similar to Denmark. The regional level has an advisory role; however a green paper – NOU 10:2010 – suggests that the regional level should be stronger in relation to adaptation. The question will be discussed more in 2012.

In Boxes 3, 4 and 5 you can read more about the work done in the municipalities of Greve, Rovaniemi and Bergen. These illustrative examples emphasize that municipalities and other organizations involved in water management have an urgent need to reduce flood risk, and that the regional and national level are crucial in such efforts.

Box 2: Water issues in the new Swedish Planning and Building Act, Martin Karlsson, the Swedish National Board of Housing, Building and Planning

The National Board of Housing, Building and Planning, Boverket, is a central Government agency with a wide range of activities and responsibilities in the field of land use planning, construction and housing. Martin Karlsson works specifically with land use planning and climate change. In his presentation, he gave an overview of how climate change adaptation issues can be considered in the planning and construction processes.

A new Planning and Building Act was recently introduced in Sweden. It came into force on May 2nd 2011 and includes a number of new requirements regarding climate change. For example, planning authorities now must take into account the effects of climate change in all of their decision-making, from strategic planning decisions through to development control and the issuing of building permits. Other changes to the system introduced through the new Act include a requirement on local authorities to reach a decision on building permit applications within 10 weeks of receipt.

In 2007, the final report from the Swedish Commission on Climate and Vulnerability was presented. The report, called – Sweden Facing Climate Change- Threats and Opportunities, emphasised the importance of including both mitigation and adaptation measures in all stages of the planning process. Based on the findings of that report, and others, the Planning and Building Act was amended in 2008 and the role of the municipality in planning activities relating to climate change adaptation was emphasised. Municipalities were explicitly required to take the risk of future landslides, erosion and natural disasters as result of climatic changes into account in their decision making. The County Administrative Boards were given the responsibility and authority to call-in and revoke a municipal plan if it did not consider these risks. The relevant articles were transferred from the old Act to the new and hence, are still in force. The county Administrative Boards are the link between the national and the municipal/local level. All County Administrative Boards were given the task, by the national government, to coordinate climate change adaptation work in their respective areas between 2009-2011. This was one of the actions taken by national government to emphasise the importance of working on adaptation issues at all levels of society. Furthermore, a number of central government agencies have been commissioned to work more actively with specific aspects of climate change and adaptation, relevant to their specific areas of expertise. For example, Boverket has been working with specific studies on how climate change will affect the built environment and how the planning system and the national building regulations can be used to contribute to climate change adaptation. In addition, the annual survey on planning and construction which is sent out annually to the counties indicates that climate change adaptation issues have gained in importance at the local and regional level.

In 2009, Boverket presented a study on how the Planning and Building Act could be used in adapting to climate change issues. Boverket summarised that the requirements in the Act provide the local and regional level with an effective framework to deal with climate change adaptation concerning new buildings on undeveloped land. The requirements imposed by the Act can also be applied to avoid negative consequences of climate change in cases of additional construction, e.g. regarding densification of developed land. However, the Act is not considered a good tool when it comes to handling the impacts of climate change on existing buildings. Climate change questions have been strengthened through the introduction of the new Act, but it is a rather blunt instrument when it comes to the adaptive intervention of existing buildings. Another more detailed study in 2010 looked at climate change adaptation work in Sweden and internationally. The study showed that Sweden has developed a sectoral approach to climate change adaptation and that there is no overarching strategy at the national level. The study also showed that Sweden has no specific authority or governmental department with an overall responsibility for the issue.

Box 3: Water and everyday life in Bergen; Eva Britt Isager, City of Bergen

In her presentation, Eva Britt Isager gave an overview of how the municipality of Bergen deals with flood risk and water management. "Rain city" has been Bergen's trademark.

Bergen will be hit hard by rising sea levels as a result of climate change. This rise might cause extensive damage to roads, tunnels, sewage systems, power grids and other infrastructures in Bergen and the surrounding region. In order to address this issue, an initiative has been taken up with MARE (Managing Adaptive Responses to changing flood risk) - an international project with an inter-municipal perspective and implementation mandate. "The overarching aim of the project is to enable widespread implementation of local adaptive measures to reduce and adapt to flood risk. MARE is developing and demonstrating a transnational approach to local Flood Risk Management through... parallel areas of activity" (www.mare-project.eu). The areas are: learning and action alliances; climate proofing toolbox and guidance; demonstration.

In addition, a regional climate panel has been set up with representatives from the City of Bergen, the regional council, municipalities in Hordaland and the Bergen Business Region. This panel is the driving force behind the region's climate adaptation work, and is intended to identify regional challenges and present them so that the municipalities can include them in their work. A regional climate network is being developed to provide information about the work from the MARE project and efforts at adaptation to climate change. MARE is a part of the municipality's collaboration with "Cities of the Future"(see box 7).

One example of an actual planning challenge related to climate change is the construction of a new, climate smart food market that is located only 1,65 m above sea level. In terms of engineering and building techniques, several preventative measures were taken including the placement of all of the building's pipes and cable trays in a watertight culvert that is secured with a sump. Further, the food market is situated on a waterproof foundation with an internal sump for water drainage if water gets into the foundation. Finally, there are waterproof penetrations in construction. Sockets and other electrical installations are located high on the walls.

Furthermore, the City Council has decided to investigate the construction and financing of a relief tunnel upstream. The estimated cost is about 60 million Norwegian Kroner (NOK) and funding sources must still be clarified. In the meantime, a research project, funded by Innovation Norway has been initiated to clean up the fjord (Byfjorden) and to test new methods in terms of economic and environmental development. The municipality is generally very interested in cooperation and is keen to contribute to research projects. Guidelines for storm water management in Bergen can be obtained via www.bergenvann.no.

Box 4: Flooding and protection in Rovaniemi, Satu Himanen, City of Rovaniemi

Satu Himanen from Rovaniemi presented some of the predicted impacts of climate change in Rovaniemi, discussing how snow amounts will decrease and the snow cover season will be shorter. Conversely, precipitation is estimated to increase, especially in the winter. Summers will be 2-3 degrees warmer and winters 4-5 degrees warmer by the end of the century.

One of the main issues for the city of Rovaniemi is to deal with flooding from the Kemijoki and Ounasjoki rivers. In 2008, it was considered that the primary flood protection alternative for the city was the Kemihaara Pool Construction. It was seen as the most economical and efficient alternative to flood risk reduction in Rovaniemi. The pool could reduce the discharge of the Kemijoki by 1,000 m³/s in Rovaniemi during a 10-day extreme flood, and thus decrease the water level in Rovaniemi by approximately 1 metre. Moreover, it has additional benefits in terms of hydropower potential. Other alternatives focus on preparedness, communication and temporary solutions:

- Developing a flood risk management plan as well as developing "target cards" which are based on practical experiences from the previous floods.

- Temporary flood protection structures which are fast to assemble and useful in sudden floods. They can prevent the flood from spreading to specific areas.

- Developing flood communication. Saarenkylä is a pilot community in the international research project URflood (Understanding Uncertainty and Risk in communicating about floods) at the Finnish Environment Institute. The goal of the project is to improve flood risk planning, the flow of information to the residents of the risk areas, and communications between officials and citizens.

In 2009, a General Plan was initiated for limiting damage caused by floods in the suburban areas of Rovaniemi. Measures for large floods have tentatively been planned, but few of them have been implemented.

Rovaniemi participated in The Clim-ATIC research project (2008-2011) aiming to identify impacts of climate change especially in northern peripheral areas. For more information about the Clim-ATIC project please visit www.clim-atic.org.

Box 5: Coordination of sustainable climate change adaptation in Greve, Lars Fleng Vestergaard, Municipality of Greve, Denmark

In his presentation, Lars Fleng Vestergaard, gave an overview of climate change adaptation work in the municipality of Greve, particularly related to water. The municipality works with climate change adaptation in three areas: planning, operation and preparedness. These three units cooperate closely in areas relevant to flooding.

Greve is a municipality with just under 50,000 inhabitants. It is located south of Copenhagen and faces the bay of Køge in the Baltic Sea. The built area was mainly constructed in the 1960s and 1970s and is situated in the southern part of the so called “Fingerplan” (Strategic physical planning document) from 1947. Two big flood events in 2002 and 2007 occurred in the municipality and led to the establishment of the climate change adaptation group. The work of the climate change adaptation group includes the development of different terrain models and elevation maps to identify flood-prone areas. In some cases, these maps are not communicated to the general public, since it would create too much public concern. This relates closely to the discussion in box 1. The group has also developed a municipal plan with local flooding solutions. One example is that several football fields can be temporarily reorganised to function as flooding pools in case of heavy rains.

In general, the climate change adaptation group aims at achieving a common understanding around climate change adaptation issues by including a broad range of experts in their work. Within the group, there are representatives from the planning and building departments, the environmental department as well as experts from the transport infrastructure, sewage and landscape departments.

An important climate change adaptation project is being developed in Langagergård. Langagergård is a green area that will be planned and developed for 650 new housing blocks, new institutions, a recreational park and public transport. Flood preparedness is heavily integrated in the development of Langagergård. This is especially evident in the water pools and channels will contribute to flooding preparedness. So far, geographical analysis has been done to identify the need for water pools and water flows in the terrain. The housing blocks will be placed on so called Islands (more elevated areas) whereas water channels and pools are placed in lower areas.

Importance of cooperation between municipalities, regions and states

At the workshop, participants concluded that the organisational structure of climate change adaptation is rather “fragmented” in the Nordic countries. One interpretation of this is that the present organisation of climate change adaptation is difficult to handle for practitioners, since it crosses sectors, municipalities, regions and states. As such, the need for cooperation between municipalities, regions and states as well as across sectors was discussed during the workshop that. As stated above, the regional and national level should take more active roles to restructure what the participants at the workshop stated as “a fragmented structure”.

To illustrate the challenge of a strong regional lead, the example of the “New Slussen” (Box 6) should be an interesting case, since regional coordination is a constant challenge in this domain. Who should pay the costs for regulating water levels in Lake Mälaren? Is it the responsibility of the central government or is it something that all municipalities around Lake Mälaren should contribute to? To what extent should coastline developers contribute to covering the costs? These are issues that have to be considered. In September 2010, the central Government gave Ingemar Skogö, County Governor at the County Administrative Board of Västmanland, the task to investigate how costs should be divided between municipalities, the government and other stakeholders.

Highlighting the term “other stakeholders” has a purpose here. A conclusion from the

workshop was that developers should take more responsibility in terms of the consequences of their work and the impact on the environment. There is a strong need for a shift from short-term economic targets to long-term, more sustainable and adaptive targets that cover all three pillars of sustainability. In populated areas, plans and changes in regulations should be used accordingly.

Moreover, a conclusion from the workshop was that neighbouring municipalities should collaborate more by initiating common platforms for climate change adaptation, since what happens in one municipality would most likely affect the other. It is however important to remember that these cooperation platforms depend heavily on how active the regional level is in planning issues and how strong general guidelines and regulations are. Nevertheless, cooperation across municipalities has the potential to foster planning and land use zoning as useful instruments in climate change adaptation. In other words, planning on one side of the border should not counter act the purposes on the other side. One illustrative example is the issue of sea front housing. If sea front housing is strongly regulated in one municipality but not another, developers are likely to settle in the one with less strict regulations. In such a situation, it can be tough for the municipality with stronger regulations to argue for environmental concern rather than short term economic profit.

Box 6: The case of the “New Slussen”, Gustaf Landahl, Martin Schröder and Monica Granberg, Stockholm Municipality

Gustaf Landahl, Martin Schröder and Monica Granberg presented water related challenges in relation to one of the biggest urban planning projects in Stockholm, the “New Slussen”.

In the future, precipitation will vary more over the seasons. It is probable that the winters will become more humid whereas the summers will be dryer in Stockholm. In general, there will be less snow but more rain. There is also the risk that the sea level will rise. In the case of sea level rise, one urgent matter is Stockholm’s Old Town, particularly its subway station, which was already very close to being inundated in the year 2000. The city of Stockholm has developed maps that show 100-year-floods including wind stress. The map shows which areas could be inundated in case of sea level rise. Several of the city’s important functions would face the risk of inundation if the sea level rises. In worst case scenarios, they would permanently lie under the water level.

One important project in relation to water issues is the development of the “New Slussen”. Slussen is a historical meeting place which connects the southern and northern parts of Stockholm. It has always been a focal point for many different types of traffic. It is costly to maintain Slussen as it is now. The yearly costs for renovation and maintenance are very high. It has therefore been decided that Slussen will be completely re-planned and constructed. The City of Stockholm has entered the final phases of the planning process. The process in itself is very complex since many stakeholders are involved at different stages. The expertise from the City of Stockholm is complemented by the County Administrative Boards, the Swedish Meteorological and Hydrological Institute, the Swedish Board of Agriculture, The Food Travel Experts, the National Maritime Museum and several technical consultancy companies. The process concerning the development of the “New Slussen” started in 1991 with an architectural competition, followed by a second one in 2004. Between 2007 and 2011 the formal planning process took place with a series of public and expert hearings. In parallel, a process regarding the regulation of Lake Mälaren began. A reference group was established and several hearings have been undertaken.

Three parameters are particularly important to consider when planning and building the “New Slussen”: traffic, water, and city life. The city of Stockholm will grow by 10 000 inhabitants per year. This puts a lot of pressure on developing good infrastructure and attractive public spaces.

One of the main challenges is to regulate the level of water in the lake Mälaren. In total, there are 6 counties and around 40 municipalities that are affected by Mälaren. Today, Mälaren is a regulated lake and the water level is regulated through water gates. The city of Stockholm has a lawful right to regulate the lake. Risks related to flooding are significant and the capacity to take care of excess water is poor. With the development of the “New Slussen”, the capacity to regulate water flows in Mälaren will increase. As a consequence, risks of flooding will decrease.

A few questions are relevant to discuss in the development of Slussen and Mälaren: Should all areas be adapted to climate change immediately or should there be space for future adaptation as well? In other words, it is perhaps preferable to plan and construct the “New Slussen” in a way that facilitates successive changes. The “New Slussen” is an incremental development project, where changes will be made throughout the life of the new development. These step-wise changes will be based on new calculations and new models of climate change around Mälaren. Another important question is: What level of water should be the baseline for flooding safety? The “New Slussen” has an expected length of life of 100 years with a construction phase between 2013 and 2020.

For more information please visit www.stockholm.se/slussen.

Need for Long Term Integrated Climate Change Management

During the workshop, it was asserted that work on climate change adaptation and mitigation should be integrated to avoid conflicts and foster synergies. For example, building a dense city can foster reductions in green house gas emissions but can imply a challenge for more adaptive measures. The challenge arises mainly in the potential conflict between green areas and their possibilities to absorb water and the dense city's need for solid concrete surfaces, such as roads. In other words, a dense city with solid concrete surfaces is more vulnerable to flooding, compared to a less densely populated area with a penetrable ground. Furthermore, a dense city could be challenging when it comes to "Heat Islands"². A synergy that could contribute to both mitigation and adaptation is the installation of green parks with trees in a densely built city. Parks with trees are usually cooler than areas with solid concrete surfaces³. Furthermore, green parks contribute to a reduction in the risks of flooding because of their absorption capacities. From a mitigation point of view, trees work as sinks for greenhouse gases and the densely built city has the potential to reduce green house gas emissions. The challenge of finding synergies between adaptation and mitigation should nevertheless be broadened to include potential conflicts between social and economic development and climate change adaptation. Here, the example of sea front housing is once again worth considering (see the section *Communicating with the general public*).

Climate change adaptation and mitigation is related to several overarching challenges, including the influence of long and short term political interests and the inclusion of decision makers and stakeholders from different sectors and different territorial levels⁴. The participants at the workshop highlighted that the short-term political interests - political responsibility that lasts until the next election - needs to be challenged to preserve discussions within parliamentary terms since the discussions on environmental issues should always be alive and not depend on short term political mandates.

To illustrate, Biesbroek et al (2009)⁵ and Goklany (2007)⁶ argue that a challenge in integrating adaptation and mitigation measures is the conception that they are disconnected in time, administrative level and in regards to the stakeholders involved. While this separation can be true in many cases, it is important that policy makers and scientists do not reinforce the dualistic thinking, since climate change response is much more complex than what is expressed with a dichotomy. To exemplify, it can often be the case that decisions related to climate change adaptation, such as reducing the risk of flooding, are dealt with in the short to medium term. Interventions primarily involve stakeholders at the local level. On the other hand, institutions at the national and international levels (such as the UN) are strong players when it comes to climate change mitigation and the reduction of GHG emissions. Decisions taken at the local level often derive from policy agreements at the national or international level, since emissions in one country most likely will impact the climate in another country. Furthermore, results of such decisions might not become manifest for perhaps 20 years or more.

As a conclusion, the integration of adaptation and mitigation efforts needs political decision making in the short, medium and especially long term. By reflecting on the challenges described by Biesbroek et al (2009) and Goklany (2007), decision makers might be provoked to focus on the long term dimensions where synergies are found between adaptation and mitigation, in addition to the short term, often economic, dimensions of climate change. One example of long term strategic thinking including the integration of climate change adaptation and mitigation is briefly presented in box 7.

² Oke, T.R (1978) *Boundary layer climates*. Halsted Press

³ Ibid.

⁴ Biesbroek, R et al. (2009) The mitigation-adaptation dichotomy and the role of spatial planning. *Habitat International*, 33

⁵ Ibid.

⁶ Goklany, I.M. (2007) Integrated strategies to reduce vulnerability and advanced adaptation, mitigation and sustainable development. *Mitigation and adaptation strategies for global change*, 12(5)

Box 7: Adapting to changing water conditions, Gry Backe, Cities of the future, Norway

The National program “Cities of the future” was initiated by the White Paper on “National Climate Policy”, adapted by the Norwegian Parliament (Stortinget) in 2007. The Government there invited the largest cities to cooperate on reducing local emissions, especially those from road traffic, heating and waste management. At the same time, the cities had to prepare for climate change and to develop sustainability and resilience plans.

“Cities of the Future” is a collaboration between the Government (4 Ministries on Environment, Transport, Energy and Housing and building) and the 13 largest cities in Norway, and 3 main organizations for private enterprises and financing. The cities are located in 8 regions and make almost 50% of the population. The program will last from 2008-2014, and it is coordinated and led by the Ministry of Environment.

This initiative is taken on the basis that emissions from large cities are considerable and the potential for reduction is significant. The 429 Norwegian municipalities have means and instruments for influencing 20 % of national emissions. The main emissions sources for the cities have made it necessary to have 3 areas of focus: - on Land use and transport, Energy and buildings and Consumption and waste. The fourth area of focus is Climate change adaptation.

The purpose of the National program is to help and encourage the largest cities in Norway to:

1. Reduce their greenhouse gas emissions through urban planning and housing development
2. Counteract negative effects of climate change and to improve the urban environment

All actors have agreed to a letter of intent on common goals and visions where they have to make joint efforts to reduce emissions from transport, buildings, consumption and waste, and adapt to climate change. They have also made mutual binding agreements on implementation, based on every city’s action plan on each area of focus. The cities, regional and national authorities and private businesses work together in networks for the four priority areas, and sub network for specific topics.

Agreements and areas of collaboration are:

1. Visualizing climate change, KlimaGIS
2. Mapping vulnerability to climate change
3. Regional network
4. Climate projections
5. Sea level rise
6. Urban flooding,
7. Integrate climate change adaptation in other networks

One example of visualizing climate change is KlimaGIS. It is a tool to visualize the physical impacts of climate change based on GIS technology and dynamic simulation used to visualize changes that result from climate change, including future sea level rise, simulation of urban flooding, wind, risk and vulnerability analysis, thematic maps for emergency planning and crisis management, visualization and presentation in 3D. The work was initiated by the City of Stavanger, Sandnes municipality, Norkart GeoServices and Powersim Software AS.

To get more information about Norway’s work with climate change adaptation, please visit

www.klimatilpasning.no and www.framtidensbyer.no

Using Local Potentials for Climate Friendly Innovations and Business Development

It was often argued during the workshop that a considerable amount of resources today are allocated to adapting new housing and construction to climate change. Adapting construction and building design is about managing the unavoidable impacts of climate change, but what we have to remember is that most of the built environment that needs to be adapted already exists and will be there for many years. Efforts have to be made to acknowledge local knowledge, which is useful and absolutely crucial in renovating old structures. A good example is the city of Stavanger in Norway where new buildings have to be coupled to the existing sewage system. This puts pressure on the developers to find innovative solutions that minimise the environmental impacts from the construction of new buildings.

Furthermore, a common argument is that climate change response, both adaptation and mitigation, are costly. However, existing built environments retain economic and social capital and therefore have the potential to contribute to economic profit and social development. Actually some of the examples presented during the seminar – for instance Augustenborg (box 8) and Rovaniemi (box 4) - demonstrate that climate change response also can generate business development. Based on these examples, we draw the conclusion that an important factor in the successful implementation

of more long term efforts to adapt to and mitigate climate change is to find synergies with more short term business opportunities.

In Augustenborg, the implementation of the Eco City has not only created synergies between adaptation and mitigation but also between climate change response and local business development. Long term efforts to reduce emissions and to adapt to climate change have a short term local dimension in stimulating business, as well as greater comfort and safety for citizens. The handling and recycling of local waste is one area where climate change measures can also have a positive economic impact. Moreover, the fact that the area is visited by national and international guests every year contributes to business development. The so called Green Roof Institute attracts planning professionals from all over the world.

Another example of business development is found in Rovaniemi, where water retention in basins contributes to economic benefits through the production of hydropower. However, it can be a challenge to ensure that the economic profits stay within the local community. Local communities in sparsely populated areas are often adversely affected by instalments of renewable energy, such as wind power and hydro power, and therefore expect to take part in the business potentials.

Box 8: Augustenborg – EcoCity for a changing climate, Louise Lundberg, Scandinavian Green Roof Institute, Sweden

Louise Lundberg, who is working with ecological questions in Augustenborg, gave a presentation about the water related impacts of climate change in urban planning. Augustenborg is an area in Malmö with approximately 3500 inhabitants. The area was built primarily between 1948 and 1952. As the years passed, the area became less popular with empty and cheap apartments, high unemployment rates and criminality. In the beginning of the 1990s a vision for the area was adopted by the municipality of Malmö to restructure Augustenborg into a more socially and economically sustainable neighbourhood.

Ekostaden Augustenborg is one of Sweden's largest urban sustainability projects. It was supported by the national government's Local Investment Programme and also financed by key local partners within the City of Malmö and the MKB housing company. Today Augustenborg counts more than thousand visitors every year and is a flagship model for eco-friendly development.

The most impressive issue with Augustenborg, compared to for instance Västra Hamnen in Malmö, which is also well visited, is the fact that the built environment is relatively old. Most areas that were built between the 40s and 60s are not adapted to today's ecological urban planning thinking. There is however a high potential for regenerating older areas, which also has a greater effect than only focusing on newly established areas. Involving inhabitants in the conversion process has been an important part of the project in Augustenborg.

The area is not located close to the sea but needs to be able to handle rather large amounts of rain. The former water system needed to be "updated" to today's standards and needs. Earlier flooding of basements happened rather often, 3-4 times per year. The water system was too small to maintain a possible increase in the amount of water which indicates that the planners had not taken account of such an increase in the amount of water. Today, ponds and channels take care of large amounts of rain ensuring that around 90% of the water stays within the cycle of Augustenborg. Green roofs take half of the rain and channel the other 50%. There is even a "rain garden" which is built as a "natural flooding basin". The rain garden can handle a major flooding event.

For more information about Augustenborg, please visit www.ekostaden.com.

Appendix 1: List of participants

Participants	Organization
Bue Nielsen	Danish Nature Agency, Denmark
Unn Ellefsen	Ministry of the Environment, Norway
Sten Bergström	Swedish Meteorological and Hydrological Institute, Sweden
Gry Backe	The Directorate for Civil Protection and Emergency Planning, Norway
Martin Karlsson	Swedish National Board of Housing, Building and Planning, Sweden
Gustav Landahl	Stockholm municipality, Sweden
Martin Schröder	Stockholm municipality, Sweden
Eva-Britt Isager	Bergen municipality, Norway
Satu Himanen	Rovaniemi municipality, Finland
Louise Lundberg	Scandinavian Green Roof Institute, Sweden
Lars Fleng Vestergaard	Greve municipality, Denmark
Rune Kloster Tvedt	Norwegian Association of Local and Regional Authorities, Norway
Monica Granberg	Stockholm municipality and Structor, Sweden
Lone Jansson	Danish Nature Agency, Denmark
Fredrick Lind	Institution Stonehedge Technologies
Karen Margrethe Bak	Ballerud Municipality, Norway
Elsa Grip	Swedish university of Agricultural Sciences, Sweden
Kerstin Mossed	WSP, Sweden
Antti Parjannen	Finnish Environment Institute, Finland
Hugo Kind	Stavanger municipality, Norway
Lise Muurholm Storås	Stavanger municipality, Norway
Philip Thörn	Swedish Environmental Research Institute, Sweden
Anna Berlina	Council of the Baltic Sea States
Therese Sonehag	Swedish national Heritage Board, Sweden
Morten Wasstøl	Rambøll, Norway
Louise Rabilloud	Keep Sweden Tidy, Sweden
Asli Tepecik Dis	Nordregio
Christian Dymén	Nordregio
Ole Damsgaard	Nordregio
Klaus Georg Hansen	Nordregio
Isabelle Monell	Nordregio
Christian Fredricsson	Nordregio
Veera Lehto	Nordregio

Appendix 2: Programme for the Seminar

Adaptive Urban Planning Challenged by Changing Climate – Innovative practices from the Nordic Countries regarding Sea Level Rise and Precipitation

Wednesday 8 June

12.00 -13.00 Lunch

13.00 – 13.10 Welcome. Bue Nielsen, chair in the Nordic working group and Ole Damsgaard, Director Nordregio

13.10 – 13.25 Introduction. Klaus Georg Hansen, Deputy Director Nordregio, Senior Researcher and moderator for the seminar

13.15 – 13.45 Key note speech. Climate scenarios for Urban Regions. Sten Bergström, Swedish Meteorological and Hydrological Institute

Session 1 – Challenges for urban planning in a changing climate: The national share

13.45 – 14.15 Adapting to changed water conditions. Gry Backe, Future Cities, Norway

14.15 – 14.45 Water issues in the new Swedish Planning and Building Law, Martin Karlsson, the Swedish National Board of Housing and Building

14.45 – 15.00 Questions and comments

15.00 – 15.15 Coffee

Session 2 – Practical example: Stockholm and Slussen

15.15 – 16.30 The case of the “New Slussen”, Gustaf Landahl, Martin Schröder and Monica Granberg, Stockholm Municipality

16.30 – 17.15 Walk or boat trip to Slussen from Nordregio. Exhibition at Slussen.

19.00 Dinner, restaurant Hasselbacken, Djurgården

Thursday 9 June

8.30 – 9.45 session 3 – Dealing with precipitation and sea level rise in physical planning: Innovative examples

Water and everyday life in Bergen, Eva-Britt Isager, Bergen Municipality, Norway

Flooding and Protection in Rovaniemi, Satu Himanen, Rovaniemi, Finland

Augustenborg – Eco city for a changing climate, Louise Lundberg, Scandinavian Green Roof Institute, Malmö, Sweden

9.45 – 10.00 Coffe

10.00 – 10. 20 Koordinering av en hållbar klimatanpassning i Greve, Lars Fleng Vestergaard, stadsplanerare och arkitekt, Greve kommun, Danmark

10.20 – 10.40 Communicating to the general public, Rune Kloster Tvedt, The Norwegian Association of Local and Regional Authorities, Norway

10.40 – 11.00 Questions and comments

11. 00 – 12.45 Interactive Workshop

Nordic urban planning in a changing climate: Future challenges and needs

Moderators: Asli Tepecik Dis, Christian Dymén, Klaus Georg Hansen

Rapporteurs: Christian Fredricsson, Veera Lehto och Isabelle Monell

12.45 – 13.00 Conclusions. Klaus Georg Hansen, Nordregio

13.00 Lunch at Nordregio



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