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CERCMA

Cultural Environment as Resource in Climate Change Mitigation and Adaptation

Contents

Preface

This publication is a result of the project CERCMA - Cultural Environment as Resource in Climate Change Mitigation and Adaptation.

CERCMA joined cultural heritage administrations of Nordic countries, accompanied with universities of Aalto, Turku, Tampere and Lund, Finnish Meteorological Institute, The Institute of Archaeology Iceland, Gaia Arkitekter Oslo, Alvar Aalto Foundation, Realdania and Norwegian Institute for Cultural Heritage Research.

CERCMA focused on the positive influence of cultural environment protection for climate change mitigation and adaptation. The project dealed with building conservation, planning of built heritage areas and management of cultural landscape. The main questions were,how heritage solutions may help in adaptation to climate change and future risks; how traditional planning density and scale as well as the preserving of historic green areas may contribute to sustainable community planning; and how existing buildings can be resources in climate change mitigation. These topics were discussed in a Nordic expert meeting in Helsinki, at March 2014, assessing the friction points between cultural environment protection and mitigation and adaptation measures and assessing eventual or imminent damage to cultural environments by climate policies as well as the effectivity of mitigation involving cultural environments. The results are disseminated in this project report.

The project has primarily been financed by the Nordic Council of Ministers through the Terrestrial Ecosystem Group (TEG). Project received additional funding from the Ministry of the Environment Finland, the National Bureau of Antiquities Finland, Finnish Meteorological Institute, University of Turku, The Directorate for Cultural Heritage in Norway and The Swedish National Heritage Board.

The following experts have participated at the Nordic Expert meeting and produced this report:

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1. Introduction

Maunu Häyrynen

The Nordic CERCMA – Cultural Environment as a Resource in Climate Change Mitigation and Adaptation project took place in Autumn 2013 – Spring 2014. The participants were Nordic cultural heritage agencies with the University of Turku as the lead partner. The financing was provided by the Terrestrial Ecology Group (TEG) of the Nordic Council of Ministers as well as by the Finnish Ministry of the Environment and other national sources. The aim of the project was to provide information for Nordic decision makers about the need of harmonising climate change mitigation and adaptation measures with the protection of cultural environment. For this purpose a Nordic expert seminar was organised on 26 and 27 March 2014 in Helsinki. The results are published in this report.

Industrialism and consumerism, that lay behind anthropogenic climate change in the first place, are culturally founded. Culture is also decisive for the success or failure of climate policies. Eventually, culture itself is likely to be profoundly reshaped both by the climate change and the measures related with it. As a specific domain of culture, cultural environments are deeply and multiply affected by both climate change and its mitigation or adaptation measures. However, attention has so far been mostly paid to the direct impacts of climate change and mitigation on cultural environments. In the context of cultural environments as elsewhere, mitigation is often presented as overriding goal, sidetracking cultural or social issues.

As professor Markku Rummukainen states in this report, climate change and its effects are already manifesting themselves in several ways. Uncertainty only prevails about their full future extent, but the likelihood of mitigation efforts to make a significant difference is growing smaller as time is passing. All the consequences or their time frame may not yet be foreseen, but there will be irreversible effects worldwide. In case mitigation fails, the global mean temperature rise will reach 4°C, leading ultimately to one metre rise of global sea level by 2100. Even with a more modest rate the sea level will rise, the seasonal and precipitation patterns will change and extreme weather phenomena will happen more frequently. In the Northern regions this will inevitably entail at least increases in annual downpour, storm damage, flooding of coastal areas and watercourses as well as dramatic changes in vegetation.

John Urry has in his influential book Climate Change and Society (2011) brought up the need to study environmental change in connection with human systems. Climate change is socially and culturally anchored in the society created in the 19th and 20th centuries, based on consumption and mobility and supported by technological innovation. The so-called developing economies are now striving for a similar achievement at the cost of the environment. Disengaging from a carbon-based way of life is difficult due to its deep and socially layered rootedness. In spite of the convincing scientific data, the appearingly slow pace of climate change still makes it politically too risky to replace old narratives based on energy -driven growth by new ones.

Urry considers alternative narratives by means of scenarios, of which one is a utopian perspective building on alternative cheap energy – basically an echo of the current coal-based discourse. Another narrative is characterised by new modesty, envisaging

a scarcity-oriented society that must return to locally focused Gemeinschafts. A more dystopian view is offered by the "Mad Max" scenario, sketching a world of island-like regional fortresses which will be able to retain enough technology for sustaining relative welfare in an otherwise impoverished, dilapidated and conflict-ridden world. Finally, the narrative of smart resource optimisation enabled by a total digitalisation of society and decentralised innovation is closest to Urry's view of post-carbonist society that would be needed to break resource dependence. Interestingly, he regards car-based mobility as a key issue, suggesting its modification rather than total anti-car policy. The latter would in his view undermine political support for mitigation by disrupting too profoundly the contemporary way of life.

Urry's notion on the need of reconsidering narratives bears heavily on the cultural heritage sector that has the main responsibility for the protection and managing of cultural environments. Cultural heritage sector forms a part of a carbon-based society and will be hit by scarcity as the rest of it. As a matter of fact many of the cultural environments protected by current criteria are produced by and dependent on carbon economies and may be threatened by mitigation measures. Cultural heritage sector will need to reposition and rejustify itself, which cannot happen without redefining the value structure of cultural environments.

There are at least four questions that the creation of a new narrative to justify the future protection of cultural environments should address.

- How are cultural environments differentiated by climate change and its mitigation?
- What kind of roles may cultural environments play in climate change mitigation?
- How do cultural environments relate to the general political discourse on climate change?
- What new value models, prioritations and strategic choices are expected from the cultural heritage sector?

Evidence that built heritage is a resource for climate change mitigation has been brought to the fore also in this report. Following this, cultural heritage sector ought to be active in promoting positive models derived from traditional cultural environments as resources for present-day sustainable planning and building. However, research backup for such conclusion is not yet conclusive. Besides this, promoting certain types of cultural environments as basis for sustainable development would render other categories as less sustainable – the buildings, areas and infrastructures that are the legacy of carbon dependency.

Cultural environments may have a complex influence on climate attitudes and policies. As Kari Norgaard maintains in her book Living in Denial: Climate Change, Emotions and Everyday Life (2011), the main obstacle preventing action for mitigation is emotional passivity and denial rather than lack of environmental awareness. Cultural environments are important elements of collective identities. When their values are seen threatened by mitigation measures, such as windpower development in cultural landscape areas or energy repairs of historic buildings, this may backfire on climate policies by causing resentment. On the other hand, the message about the urgency of climate change may be reinforced by the damage it causes to cultural environments.

In the future, cultural heritage sector may face a situation in which both the cost of protecting some cultural environments will rise and the resources available for pro-

tection will diminish. Value choices would need to be made on what kind of cultural heritage should be focused on – key monuments protected at all costs, cultural environments specifically threatened and in need of expensive measures, or cultural environments deemed unsustainable. Such choices would demand a solid research base, wide encompassing discussion and valuation models incorporating different sectorial approaches. Contingency and risk preparedness plans of certain cultural environments already take climate factors into account, but the models and risk assessment methods used for them are still not properly formulated.

Previous TEG projects

There are several Nordic project reports published by the TEG dealing with climate change and cultural environments, among them Signs of Climate Change in Nordic Nature (2009), Climate Change and Cultural Heritage in the Nordic Countries (Kaslegard 2010) and Nordic Nature – Trends towards 2010 (Pylvänäinen 2010). Together with the reports of the Intergovernmental Panel on Climate Change IPCC, they convey an alarming scene of a wide number of changes already taking place on multiple scapes and affecting every aspect of biodiversity from genetic to landscape level. In consequence also cultural environments will change.

Nordic cultural environments are particularly susceptible to climate change for a number of reasons. Wood is a common material in the Nordic countries and will be exposed to an increased risk of rot and pests. Additional stress will be placed upon all building exteriors because of multiplying zero point passes and salt crystallisation. Flood risk concerns most acutely cities and structures, especially those by coast or watercourses. From the mitigation point of view a cause of concerndevelopment is the application of the EU Energy Performance of Buildings Directive (EPBD 2003) to historic buildings . The directive does not cover officially protected historic buildings, in case minimum energy performance requirements would require unacceptable changes in them, but historic buildings without official designation must comply with it.

Apart from built heritage, archaeological remains are threatened in various ways by increasing overgrowth and erosion, salt damage, loss of permafrost and the possible introduction of pileworm to the Baltic Sea. Cultural landscapes will be altered by the changing seasonal patterns, shifting vegetation zones, disappearing or invading species, loss of pastureland and forest blow down occurring more frequently. In addition both afforestation and wind power construction as mitigation measures may have an impact on cultural landscape. Increasing downpour and extreme weather already have proven problematic in cities with plentiful hard surfaces.

Recommendations from SuHiTo project

The Nordic project Sustainable Historic Towns (SuHiTo) 2011 – 2012 published the report Urban Heritage – Good for the Climate! (Reinar & Miller 2012), the goal of which was to explore cultural environments as a resource for climate change mitigation. In the project old building stock was presented as a carbon sink by itself. Built heritage was also seen as a repository of sustainable building traditions based on an economy of scarcity, evident in the use of local materials and production, in low energy consumption and in thorough utilisation of material properties. Similar recommendations have

been made on a global scale for instance in the ICOMOS-ICORP background paper Heritage and Resilience, Issues and Opportunities for Reducing Disaster Risks (2013). The report highlighted in general the continued use or adapting of old buildings and maintaining of building skills, whereas bypassing of EU energy regulations should be enabled in historic buildings. More research was called for on the actual energy properties of historic buildings, taking into account their entire life cycle and their functioning in a wider urban context. Planning tools drawing from historical models, adopted for different scales, were advocated in the report.

CERCMA expert seminar in Helsinki: Framing talks

The discussions that took place in the CERCMA seminar and workshops witness the emerging of a new narrative among the Nordic heritage sector. There was a relative consensus among the participants on the need to integrate cultural heritage values in climate policies and on the importance of built heritage as a resource for mitigation., Opinions were more divided on how to proceed with Modern built heritage. Research on the relation between cultural heritage and climate measures was deemed inconclusive at this stage. The promoting of certain cultural environment categories as positive models also seemed to profile other categories as unsustainable.

The expert seminar was divided in two parts, a public seminar with framing talks succeeded by expert workshops. The framing talks were started by a keynote on the IPCC 2013 report by a member of the panel, professor Markku Rummukainen from the University of Lund. After that followed the introduction by the project coordinator Maunu Häyrynen (University of Turku, Finland) and presentations on the situation of national cultural heritage sector in regard to climate change in each Nordic country by Mikko Härö (National Board of Antiquities, Finland), Marte Boro (Riksantikvaren, Norway), Kaj Thuresson (National Heritage Board, Sweden), Uggi Ævarsson (Minjastofnun, Iceland) and Poul Klenz Larsen (National Museum, Denmark).

Mikko Härö problematised the relative absence of cultural environments in Finnish national climate strategies and policies, partly blaming the general silo mentality in the administration, partly the lack of interest in the cultural heritage sector on climate change and elsewhere in the administration on heritage. He called for a new valuation system that would merge together climate and heritage considerations. While some signs for this had shown in Finland, Härö identified eco-efficiency regulations on buildings and visual impact of wind power plants as main challenges to cultural environments. These concerns were shared by Marte Boro, who however ended up in an optimistic note on the compatibility of cultural environment values and energy saving measures. Poul Klenz Larsen maintained the importance of wide public involvement to prevent climate change and presented cases of energy saving in historic buildings.

The urgency of current situation was highlighted by a number of alarming cases in different countries, but the relative invisibility of change was also pointed out. National policy emphases varied, Sweden and Norway leading the way in climate-related research of cultural environments and historic buildings. Swedish Heritage Board was also preparing an action plan for climate change in regard to built heritage. The degree of cross-sectoral collaboration between government agencies and the level of EPBD implementation in old building stock also appeared to differ somewhat from country to country. Combination of cultural environment data with projected sea levels and

flood prevention measures in regional planning or zoning is taking place in several countries. Iceland faced particular problems linked with insensitive mitigation policies relying on afforestation and hydropower development.

Workshops and wrap-up session

Of the three expert workshops the first was led by Kaj Thuresson on heritage solutions in adaptation to climate change and future risks, the second by Maunu Häyrynen on heritage-based sustainable town planning and the third by Marte Boro on existing buildings as resource for mitigation

The first workshop set out from the fact that the effects of climate change and the connected risks divide Nordic cultural environments into different categories. Sites already popular and well visited will be at less risk than the less frequented and monitored ones. The need for risk assessment for cultural environments will rise in general. The Nordic societies are relatively well equipped to deal with the risks but even they may have to comply with decreasing resources. Adaptation measures as well as changing patterns of tourism may have both positive and negative influence on cultural environments. Preservation of built heritage may however be the best option from the mitigation point of view as well.

The workshop looked for adaptation solutions and future risks from altogether five directions. The first among them was the need for more collaboration between agencies, administrative sectors, disciplines and NGO bodies, the second the developing of Nordic cultural heritage databases into a more uniform whole and to combine them with climate data. The increased use of GIS would be important also in view of qualitative data and the power of cultural heritage visualisations ought to be harnessed for concretising the effects of climate change. A third solution would be offered by the wide promotion of long-term risk assessment, followed by re-evaluation of cultural environments and new protection and management priorities. The two last points suggested learning from the past, since few of the adaptation issues would be genuinely new, and the use of traditional building methods as a source of innovation.

The second workshop noted the diversity of urban heritage, from which follows that cities and cultural environments will be exposed to climate change and its mitigation in a variety of ways. Instead of either energy- or heritage-driven panaceas, one should strive for scale- and context-sensitive solutions and overall flexibility of planning. Urban heritage could offer both good and bad examples of resource use. In general the preservation and readaptation of historic structure with minimal intervention could be recommended, which would require a more relaxed application of legislation and building regulations. Human scale in planning that provides for walkability and liveable public spaces would be crucial even for the sake of mitigation.

The only actual planning restrictions supported by the workshop were the discouraging of high-rise buildings and that of car traffic. In parallel with the built environment, the importance of multifunctional, well-designed green and blue infrastructure was stressed. The workshop called for multiple disciplinary framing to tackle the questions of how to change human behaviour towards sustainability and how to reconcile different value systems. The take of the workshop on values was that neither energy nor heritage values should be looked at in isolation. Cultural ecosystem services were seen to provide a possible direction for constructing new value models.

The third workshop approached existing buildings as mitigation resources from two directions, as already constructed buildings embodying energy and as a knowledge base for sustainable development. The group noted the complexity of modelling the values of an historic building. This contrasts to the use of simple calculation modes for energy performance, which in turn may lead to the lack of adjustment for historic buildings and the risk of losing their values due to energy repairs. User behaviour was seen as central, subtle ways to redirect it by "nudging" being the best course of action.

The third workshop shared the view of the SuHiTo report of historic buildings as records of a scarcity-based technology that could find new application in climate change mitigation. Flexibility was seen as their important characteristic. The proposals of the group were to create a properly working tool for carbon dioxide emission calculation for old buildings, to study the links between user behaviour and energy consumption and to map out the traditional knowledge incorporated in historic buildings.

In the joint wrap-up session of the workshops several common insights came up. Built heritage was seen as anchoring point for the engagement of different policy sectors and for general awareness raising. Each workshop identified a knowledge gap concerning the complex relationship between climate change and cultural environment protection and stressed the importance of multi- and interdisciplinary research and discussion to fill it. Built heritage was held by all as a crucial but incompletely realised potential for mitigation and innovation. Public engagement throughout and wide dissemination of knowledge were seen decisive for gaining support for both climate and cultural heritage policies. For getting across the message, special attention should be paid to GIS and visualisation.

2. The (un)avoidable climate change

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Introduction

Our climate has always varied and undergone changes. We know of ice ages and periods of warmth in the geological past. During the last 10,000 years, since the most recent so-called glacial phase characterized by extensive continental ice sheets terminated, the global climate has been fairly stable. There has of course been some climate variability during the historical period, not least regionally distinct periods of relative warmth and relatively cool periods. These variations have been of natural origin. Studies into them provides invaluable information on the climate system and its sensitivity for forcing, be it solar variability, orbital forcing, changes to the atmospheric concentration of greenhouse gases, or by some other factor.

The ongoing global-scale climate change, also coined "global warming, is, however, of human making. In addition to the already observed changes, the future prospects are of further climate change during the 21st Century and beyond. Impacts of a warming Earth are widespread and concern most aspects of the modern society, as well as the natural environment. In terms of cultural heritage, a key takeaway message is that future climate conditions will differ from the historical ones during which the cultural heritage originated and under which it has persevered. Information about the future is thus something that needs to be considered when caring for the cultural heritage.

Global climate change

The world is warming. According to observations, the global mean warming over the 1880-2012 period amounts to about 0.9 degrees Centigrade. In addition to a rising temperature worldwide, many other changes have been observed, which are consistent with the increasing temperature. The global mean sea level is rising, glaciers are melting around the world, the Arctic sea ice cover is undergoing significant reductions in its extent and thickness, and the ocean has become more acidic. These trends have been especially distinct over the last 50-60 years. We are experiencing a global warming and an overall climate change (IPCC 2013).

The reasons for our modern era climate change are reasonably well understood. The main driver of the observed warming is human influence via the use of fossil fuels, and land use change. Half of the resulting annual carbon dioxide emissions end up in the terrestrial biosphere and in the ocean. The other half accumulates in the atmosphere, which enhances the natural greenhouse effect. The climate system responds with a warming trend, which in addition to the temperature rise leads to sea level rise, melting snow, glaciers and sea ice, and so on.

The current level of carbon dioxide in the atmosphere is around 400 ppm (parts per million). This is well above the highest known levels over at least the last 800,000 years (around 280 ppm), and probably also in a much longer past perspective. When also

accounting for the effect of other anthropogenic emissions of greenhouse gases such as methane and nitrous oxide, as well as the increased amount of small particles in the atmosphere also caused by human activities, the effective level in the atmosphere is around 430 ppm carbon dioxide equivalents, which is about 50% larger than the pre-industrial carbon dioxide level. The attribution of the observed changes to this human influence on the climate system is robust. Studies which underline this result have also considered solar forcing and other possible drivers of the climate system.

The observed global warming trend has not been uniform in time or equally large in all world regions. An important reason for the former is that the term "global mean warming" refers to the near-surface air temperature, not the mean for all the elements of the climate system. Indeed, most of the warming due to more greenhouse gases in the atmosphere has gone into the oceans. The exact amount varies slightly from year to year, due to large-scale variations in the interaction of the ocean and the atmosphere, which overlays the long-term warming trend. As to the regional-scale warming, land regions are warming up faster than ocean areas. The Arctic region is, however, an exception, as it shows a large warming trend both over land and over the ocean.

Future prospects

The full effect of the historical greenhouse gas emissions, to date, emerges over time, rather than instantly. This is not least due to the ocean heat uptake which slows down the atmospheric warming response. Another reason for why the full climate effect of the emissions lags the emissions is that our emissions of sulphur dioxide simultaneously increase the amount of small particles in the air. These particles have a cooling influence on the climate and thus can mask some of the warming influence of greenhouse gas emissions. There is an important difference, however. While emitted carbon dioxide stays a long time in the atmosphere even after emissions cease, particles have a much shorter lifetime. When their underlying emissions cease, their cooling effect also vanishes. This will allow the full warming impact of greenhouse gas emissions to come through. This means, overall, that the amount of climate which has so far been observed is smaller than the long-term change we are already committed to. In addition, the global greenhouse gas emissions continue increasing, which adds to the final warming tally further ahead in time.

There are scientific uncertainties surrounding the response of the climate system to forcing. One concerns the future efficacy of the terrestrial and ocean uptake of carbon dioxide from the atmosphere. As mentioned above, around half of the annual global anthropogenic carbon dioxide emissions accumulates in the atmosphere, while the rest is taken up in the biosphere and the ocean. However, these uptakes are to some extent climate-controlled and may become less effective in a warming world. Thus, a larger fraction of future emissions may stay in the atmosphere. Another important uncertainty surrounds the so-called climate sensitivity, which is a measure for the amount of long-term warming due to an increase of greenhouse gases in the atmosphere. While it is relatively straightforward to calculate the direct radiative response of the climate to greenhouse gases, an initial warming sets additional changes into motion. A warmer atmosphere holds more water vapour, cloud properties can change, and so on. This is known as climate feedback, which adds to the direct climate effect of emissions. There

are both negative (counteracts warming) and positive (enhances warming) feedback, but the overall the net feedback is positive. All in all, continued emissions continue to warm the climate with a significant amount.

The single most decisive factor that regulates the amount and the pace of future climate change is the development of global greenhouse gas emissions, especially carbon dioxide. Other greenhouse gas emissions are also important, as is land use in other ways, but the sheer amount of carbon dioxide compared to for example methane makes it the most important factor.

Unavoidable, and avoidable, climate change

Continued climate change is by now unavoidable. Considering the emissions so far and their present trends, we are no matter what committed to a long-term global warming of over 1°C. This implies also continued sea level rise, further glacier and sea ice melt, and also changes in precipitation patterns and so on. Emissions also cause an acidification of the oceans, which is caused by the uptake of carbon dioxide in the waters. These changes do not only apply to average conditions, such as annual mean temperature, but also to higher warm extremes and more intensive heat waves, milder cold extremes and in many regions more intensive high precipitation (e.g., Orlowsky and Seneviratne 2012; Rummukainen 2012, 2013).

A higher warming than 1-2°C is possible. If the global carbon dioxide emissions continue to increase over the coming decades, the global mean temperature could well increase further by around 4°C by 2100. The global sea level rise could reach 0.5-1 metre by 2100. There would also be more and more widespread glacier melt and Arctic sea ice loss, and possibly an onset of the Greenland ice sheet melt.

However, it is also possible to constrain the amount of the long-term climate change. The climate system responds to the cumulative emissions. Curbing future emissions lessens the warming as well as the other changes. The basic relationship is simple. Smaller emissions imply smaller climate change, while larger emissions mean larger climate change. In order to limit the long term global warming to less than two-degrees Centigrade (known as the two-degree goal, adopted under the United Nations Framework Convention on Climate Change, the UNCCC), the global emissions would need to be levelled out during the next few years and thereafter be reduced by around 3 percent per year. (In contrast, the global carbon dioxide emissions have increased, on average, by 2.2 percent per year since 2000, which is faster than the high rates of increase during the late 20th Century.) This should eventually lead to zero net emissions sometime during the second half of the century. This is a challenge, but one that is possible to meet (IPCC 2014) – an ever larger climate change is avoidable. It is, however, for the time being rather unclear how the future emissions evolve and thus where we end up with the climate.

This implies that while global mitigation (efforts to reduce emissions) is key to stabilizing the climate, also adaptation to climate change requires attention. One complicating factor for the latter is that we do not yet know how much climate will change over time (it depends on inter alia future emissions). Rather, there are different possible outcomes, and these will have different specific impacts. A risk approach that combines assessed likelihoods of different magnitudes of changes and the corresponding severity of the subsequent impacts may be warranted.

Mitigation and adaptation are global challenges. Nevertheless, both have also important regional and local characteristics. Different sectors, regions, localities, systems, and so on have different vulnerabilities for climate change. A low-lying coastal stretch, for example, is more threatened from sea level rise than a steeper coastline. Milder and wetter winters can favour pests and mould in areas where cold winters have earlier been the norm. Likewise, different sectors and regions have different mitigation potentials. Both mitigation and adaptation can involve measures in physical planning, renovation of existing buildings and other infrastructure, changes to transport and energy systems, waste management, balancing land use for agriculture, biofuels and protection of the natural environment, changes to consumption patterns, mobility and so on. Thus, when considering specific decisions on either mitigation or adaptation, one may need to consider several perspectives which involve multiple stakeholders. One needs to access information on both relevant climate change aspects and the systems and actors concerned.

The Nordic region

There are several regional-scale scenario studies which encompass the Nordic region (e.g., Christensen et al. 2001, Rummukainen et al. 2003, Rummukainen et al. 2007, Nikulin et al. 2011, Jacob et al. 2014). The Nordic region is projected to warm up more than the global mean temperature rise. For example, for a two-degree global mean temperature rise, the Nordic warming would be higher, perhaps around 2.5°C in the annual mean (Vautard et al. 2014). A further typical result for the Nordic region is that the regional warming is larger in winter than in summer. Also, the spring will start earlier and the autumn later, which implies a longer growing season and larger temperature sums, which affects the natural vegetation as well as the conditions for managed ecosystems. Precipitation is projected to increase especially in winter, with consequent changes to groundwater levels, river runoff and soil moisture. Summertime precipitation changes are less obvious. Milder winters imply also a milder snow conditions over time, with both a shorter snow season and smaller maximum snowpack thicknesses. Results of the scenario studies so far do not indicate significant changes to the regional wind climate or major alterations of the regional storminess. Heavy precipitation is, however, projected to increase.

The regional sea level will also rise, which in parts of the Nordic region is to some extent counteracted by the still ongoing land uplift (since the last glacial maximum). In Southern Scandinavia, land uplift is insignificant, but it increases towards the region around the northern Bay of Bothnia. Regional sea level rise will for most regions differ from the global mean sea level rise. Emerging patterns suggest that, for the Nordic region, the seasonal sea level rise will be lower than the global mean around Iceland, but more than the global mean in the North Sea region (e.g. Slangen et al. 2012).

The basic Nordic patterns of regional-scale climate change are thus about milder winters and warmer summers, higher wintertime precipitation, effective sea level rise at least in the southern reaches of the region, and also more northwards for a larger amount of global warming. The changes emerge over time (e.g., Kjellström et al. 2013).

What happens with the global emissions is of first-order importance not only in the global mean, but also for the Nordic region. The basic relationship is simple also here. Smaller emissions imply smaller global climate change and thus smaller regional

changes compared to larger emissions. Ever larger changes are, thus, avoidable provided world-wide emission reductions. At the same time some future climate change is already in the pipeline and thus unavoidable not only on the global scale, but also for the Nordic countries.

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3. Situation in the Nordic countries

3.1 Norway

The direct and indirect effects of climate change for the Cultural Heritage in Norway

Marte Boro, senior advisor, Directorate for Cultural Heritage, Norway

The effects of climate change

The effects of climate change manifest themselves in several ways. We have at all times had damages due to sudden events, but now we see that such events happen more often. We have in recent years had several examples of such damages.

This winter, 2014, there were large fires along the coast of central Norway. In Flatanger, 60 buildings were destroyed. In Lærdal, 40 buildings were destroyed, including one listed property. The fires occurred after prolonged drought in a period that is usually very humid with heavy rain. The fires spread very quickly in the bone-dry vegetation and strong winds. The increased growth of the surrounding vegetation, due to change in the use of the land, was also an important reason for the rapid spread of the fires.

Damages and changes that emerge over time are difficult to observe. We know that the sea level will rise along much of the Norwegian coast. We expect a rise in sea level along the south and west coasts of between about 20 and 80 cm by the end of this century.

In a new report on this topic, "Cultural Heritage and Sea Level Rise", CIENS-report: 1-2013, one of the main findings is that there is a lack of knowledge, how both nationally and locally heritage data relates to data on future changes in sea level. Consequently, there is a lack of analyses and studies on vulnerability and resilience of the potentially affected cultural heritage sites.

A wetter climate will also cause more rot in buildings. We will also see more frost damages in certain parts of Norway.

Adaption to climate change

We have only partially begun to face up to the need for adaptation to climate change. There is a certain focus on reduction of damages due to floods and avalanches, often only after these occur. The adaption to the projected rise in sea level has been a topic in local zoning plans. The municipalities are making climate- and energy plans, but measures to avoid loss of cultural heritage is seldom a topic up for discussion.

Little has been done in the cultural heritage field. We see that there is a need for better maintenance of buildings when the climate impact increases. We do inform owners about this, but we have no additional grants to assist owners of listed buildings. We will in the future be forced to prioritize harder among the cultural heritage objects and use more resources on maintenance and risk-reduction and damage limitation measures.

Climate change mitigation

The greatest impact of climate change so far are the measures for climate change mitigation and development of stricter building regulations.

Saving energy in old houses is a challenge, but if it is done properly it is possible to improve energy performance of such houses to a considerable extent without endangering cultural heritage values and causing damages. Development of stricter energy performance demands in the Planning and Building Act is a challenge in the management of listed buildings. There is no distinction in the law between new and existing buildings, but there are possibilities to some extent for exceptions from energy demands for valuable historic buildings. There is a lack of understanding that reduction of climate gas emission is the main goal, not saving energy. Accepted use of environmentally friendly energy sources as compensation for higher energy use will very often be a more environmentally friendly solution than extensive upgrading. The strong focus on energy efficiency in buildings means that some owners implement comprehensive measures in older buildings, but mainly buildings without legal protection. These can still be buildings with historical value and qualities that are worth preserving.

Some of the measures to increase production of environmental energy have negative effects on the experience of the cultural heritage environment. An obvious example of this is the establishment of wind parks in landscapes with cultural values. In addition to a high visual impact, such installations require large infrastructural installations.

There is a tendency that the challenges related to climate change are not taken seriously in practice. But there is some public debate on questions linked to climate change such as oil production, the use of electric cars and development of public transport. The recently elected government has only in a small degree presented their own or new policy for climate, buildings or cultural heritage.

However, we do see today a tendency to a greater emphasis on environmentally friendly buildings and an increased understanding of the reduction of climate gas emissions as a main goal instead of the one sided focus on energy efficiency.

Figure 1. Flooding has caused damage to older buildings and excavation of a medieval cemetery in Gudbrandsdalen. At Listad the old cemetery was partly destroyed by a mudslide. Foto: Oppland fylkeskommune.

Figure 2. The fire in Lærdal destroyed many buildings including these listed buildings. Foto: Åse Bitustøl © Riksantikvaren.

3.2 Denmark

Situation in Denmark

Poul Klenz Larsen, senior adviser, National Museum of Denmark

In December 2013 Denmark was hit by a storm. In combination with a high tide the water level rose in several towns, including Roskilde. The museum of Viking ships was in danger of flooding. Temporary protection prevented the old boats from floating again. But future storms and rising sea levels will endanger the cultural heritage because most towns are located at the coast in Denmark.

There is an increasing understanding that all parts of society must contribute to prevent climate change. Listed buildings are exempt from most energy regulations and building codes. The majority of historic buildings in Denmark are not listed but only protected in the sense that they cannot be demolished without authorization from the local council. These are only exempt from energy regulations if they form a part of a preservation zone defined by the local council – typically historical centers of provincial towns. In this case the rules governing the preservation zone may weigh stronger than energy regulations.

The following three projects represent different aspects of energy saving in historic buildings:

Student houses - psychology and behavior

The project involves four historic student houses in central Copenhagen. The institutions and the buildings are old, some more than 400 years. The houses are quite densely populated, and comfort heating is needed during the winter. Not much can be done to the buildings' structure and fabric in order to improve thermal insulation. The energy consumption in the houses is related mainly to the way the students behave. It is the need of people who live or work in the building that defines the use of energy. Energy for mechanical ventilation, lighting, cooking, washing etc. is in focus. Psychology and behavior is an integrated part of the project, and the use of "nudging" may help reducing energy use. This is the use of a gentle, indirect push towards favorable or appropriate behavior of the individual.

Royal palaces – politics and decision

Some of the royal palaces are infrequently used. The Gråsten palace is inhabited 1-2 weeks each summer at the most. Nevertheless it has been heated to comfort temperature all year for decades. The Fredensborg palace is a summer residence for the queen, but has also been heated all winter. These houses were never meant to be heated to 22 degrees by central heating. High winter temperature is a hazard to the preservation of the furniture, because the relative humidity drops below 20 %RH in winter. The obvious solution to save energy and preserve the objects better is to reduce the winter heating. The concept of conservation heating is not new, but this project promoted the political decision to adapt this strategy in the royal palaces.

Churches – materials and tradition

Denmark has around 1700 medieval churches. They are by far the oldest buildings, and most are still in use. They have a long history of alterations. Vaults were erected in the 13th century, and larger windows were installed much later. The vaults make up a large part of the exterior surface. Their thickness is only 15 cm, so the heat loss is large. Thermal insulation was until recently not permitted. It was also difficult to do because of the double curved geometry. In an ongoing project we have developed a method to apply a lightweight plaster on the top side. This will reduce the annual heat loss from the church by 30%. The plaster is a mixture of perlite, an expanded lightweight glass, and slaked lime. These are traditional materials used in a new way to meet a recent demand of improved energy efficiency.

Figure 3. Application of thermal insulation plaster on a medieval church vault (photo: Poul Klenz Larsen)

3.3 Sweden

A national overview of climate change effects on cultural heritage in Sweden and adaptation and mitigation within the cultural heritage sector.

Kaj Thuresson, chemist, Riksantikvarieämbetet

Sweden lies between latitudes 55° and 70° N, and spans about 1 500 km from south to north. The country has three general types of climate zones. The southern part has more of an oceanic climate; the central part of Sweden has a humid continental climate, while the northern part has a subarctic climate. These zones may well dislocate due to climate change in the future.

As Sweden consists of such varied climate zones, it will face all the different effects of climate change that threaten the Nordic region. Climate change effects in the south of Sweden will correspond to effects in Denmark, with for example greater risk of flooding. The mountain regions of Sweden will face greater risks of landslides and will be comparable to similar regions in Norway. The threat of storms to forested parts of Sweden will be the same as in Finland, in comparison. There is therefore a need for Nordic collaboration within this field of research.

Effects of climate change on Swedish cultural heritage

The observed climate change effects on cultural heritage that are given most attention in Sweden today are naturally of a more dramatic kind. Examples of these climate change effects are heavy downpours or snow loads and an increased frequency of flooding and storms causing damage to cultural heritage. These types of dramatic effects often act on a local regional level. On the other hand, there are also more general long term "slow" effects such as increased damp, mould and vegetation that threatens cultural heritage in larger areas of Sweden.

In 2012 a pre-study was performed at the Swedish National Heritage Board investigating threats to cultural heritage from climate change, in a national Swedish perspective(1). One of the conclusions of this report was that, in general, built heritage faced a serious risk from future climate change. Threats of increased vegetation, pests and mould on built heritage were stressed in the report. Another conclusion was that heritage at the northern coast line of Sweden (Höga kusten), the lowlands in the south and the mountain regions of the inner part of Sweden were predicted as most vulnerable to climate change effects, such as sea level rising, flooding and landslides.

National actions of adaptation to climate change, with regards to cultural heritage

An expressed focus has been made on establishing collaboration between the different governmental bodies in Sweden. Since climate change is affecting society as a hole, the Swedish National Heritage Board is emphasizing the implementation of cultural heritage in other governmental organisation strategies and plans regarding

climate change. Another focus of action has been on the development of standards and routines concerning the adaptation to climate change. The challenge of collaboration is to have a friction free flow of information and knowledge, both up and down, from governmental agencies to regional and municipal levels. A good example of national collaboration concerning the adaptation to climate change between several national agencies is the Swedish portal for climate change adaption(2), initiated by the Swedish Meteorological and Hydrological Institute (SMHI). On this web page information about climate change is published and cultural heritage is included in this information.

During 2013 a project has been carried out at the Swedish National Heritage Board that aims to produce a plan of action for climate change to built heritage environments. It takes off from where the pre-study of 2012 ended and will be finished during the spring of 2014. The plan of action will focus on built cultural heritage and "slow" effects due to climate change. One part of the project is trying to combine national climate-models with cultural heritage databases. Another part deals with the effect of climate change mitigation and energy efficiency. Some preliminary results are predictions of large risks to cultural heritage buildings with wooden structure in the northern part of Sweden due to long term effects such as dampness, moulds and pests. The main conclusion is that climate change effects needs to be integrated in maintenance programs for cultural heritage. There is also an urgent need for long term sustainable maintenance of built cultural heritage.

Another example of national actions for cultural heritage and adaption to climate change is the flood risk assessment investigating a region in the west of Sweden called "Göta älv"(3). The novel approach in this assessment has been to try and evaluate cultural heritage in monetary terms, with several types of methods, in order to evaluate actions of adaptations against flooding.

Yet another example is an assessment for sea level rising in the region of "Skanör-Falsterbo", in southern part of Sweden(4). In this assessment it has been possible to combine the National geographic height model with cultural heritage databases at the Swedish National Heritage Board in order to produce maps describing heritage at risk. By overlaying regional plans for building protective banks, consequences to cultural heritage have been evaluated. This is the first time this type of heritage data has been run together with such a model in Sweden.

Research on climate change mitigation effects on cultural heritage

In Sweden an important part of the research on effects of climate change mitigation on cultural heritage has been focused on cultural heritage buildings and energy efficiency. The Swedish National Heritage Board has been involved in the EU-project Co2olBricks. It focused on brick buildings from the Hanseatic period, in the Baltic sea region. The project Co2olBricks (2011 to 2013) resulted in eight publications, about 20 minor studies and a large body of educational texts.

Another example of research on climate change mitigation effects to cultural heritage buildings and energy efficiency is the project "Spara och Bevara"(5) (Eng. Save and Preserve) It is run in the form of a national research programme concerning energy efficiency solutions to cultural heritage buildings. This program has been running from 2007-2010 and 2011-2014, in two separated periods with a budget of 40 million SEK

for each period. The programme is now in an evaluation phase and the results will be presented in an upcoming conference in 2015.

1. http://samla.raa.se/xmlui/bitstream/handle/raa/6495/Rapp%202014_2.pdf?sequence=1
2. www.klimatanpassning.se
3. http://www.swedgeo.se/upload/Publikationer/Gota%20alvutredningen/GAU_delrapport_24.pdf
4. https://www.msb.se/sv/Produkter--tjanster/Publikationer/Publikationer-fran-MSB/Riskinventering-med-stod-av-nationell-hojdmodell--sammanfattande-rapport-for-fyra-effektstudier-av-havsnivahojningar-och-en-tillampning-vid-riskinventering-av-vag
5. http://www.sparaochbevara.se/

3.4 Finland

Mikko Härö, Director of Department, Museovirasto

Finland's position in climate change policies is adapted to international end EU commitments. The starting points are the implementation of Kyoto Protocol to the UN Framework Convention on Climate Change as well as EU climate and energy package (policy). The overall goal is to reach a low (if not) non carbon economy by the year 2050. The measures chosen concentrate on the economics, markets and application of new technologies. The latter (clean tech) is seen also as a driver in benefiting economically from the mitigation of and adaption to climate change (green economy).

Finland has had national strategies and programs on mitigation and adaption to climate change through the 2000's. The latest updates were discussed in the Parliament is of 2013. The key words and/or areas of action are low carbon, energy efficiency, renewable energy sources, private consumption patterns and profiles, clean-tech, agriculture and food plus mitigation and adaption. Finland's National Strategy for Adaptation to Climate Change in being revised 2011-2014.

National strategy for sustainable development "Towards sustainable choices - A nationally and globally sustainable Finland" was revised in 2013 and a new concept "Society's Commitment to Sustainability" has been launched. The idea is that the government and the administration with others pledge to promote sustainable development in all their activities. The brand new indicators for the follow-up of this commitment do not hint that heritage or landscape would be of any relevance in sustainability context.

All these national strategies and programs - which are rather more numerous than the examples mentioned here - offer at least in principle an open and wide platform for rethinking cultural environment protection. The various aspects of heritage (landscape, built heritage, archaeological heritage) are so far nonvisible at this stage. Why so? One of the reasons might be the strongly sectorized administrative tradition – even within the Ministry of Environment responsible both for the environment, nature conservation and cultural environment. The other reason might be the lack of participation and interest from the heritage sector in dealing questions of climate change – it's still a more or less unknown territory? And a third reason might be the narrow view that the others sectors (administrators and experts) have on the heritage and heritage conservation?

Climate change and cultural heritage (cultural environment, historic environment) are intertwined via two sets of major questions. Firstly; how to use the existing environment resource-wisely, in a manner where the requirements of sustainability and safeguarding of historic continuity go hand in hand. Secondly; how to actively participate in and regulate the unavoidable change of our environment, for example via value assessments that take into account also the sustainability aspect. To oversimplify: how to evaluate the changes through green eye glasses, how to turn the necessity of mitigation and adaption into a virtue even from the heritage point of view?

Some first steps towards a targeted, goal-oriented action have been taken. National Land Use guidelines were updated 2008. This latest version is a strong commitment to develop a more sustainable community or urban structure and infrastructure. The

guidelines as a whole themselves are due to their nature contradictory – the idea being that in the regional and local land use planning processes the various contrasting interests would be synthetized into a balanced whole. From the heritage point of view the most important aim is to guarantee a balanced land use planning in the Historic Environments of national importance, the listing included in the guidelines.

A preliminary national analysis on the topic was the report Climate Change and the Cultural Environment – Recognized Impacts and Challenges in Finland. (Publication series and number The Finnish Environment 44/2008). It was produced jointly by the National Board of Antiquities and Metsähallitus (National Forest Agency) as part of a wider Nordic cooperation in the years 2007-2008 (Effekter av klimaendringer på kulturminner og kulturmiljö), led by the Norwegian Heritage Agency. Follow-up action is still missing though.

National portal Climateguide.fi presents different aspects of climate change; change in general, Finland´s changing climate, its impacts plus the mitigation of and adaption to changes. In the frame of impacts and built environment even sociocultural, heritage and landscape topics are discussed.

Two special issues have so far been dealt with more thoroughly also by the heritage professionals. The first one is eco-efficiency and energy consumption in buildings. This - if not carefully studied - is easily contrasting historic values and features in single buildings. Adaption to EU -policies and requirements has been fairly easy as they give room for exceptions in the case of protected buildings. This possibility has been taken into account in Finland at least on the theoretical level, as we do have a strong tradition of over reparation of our building stock.

The second issue is the impact on wind power plants in the landscape. The Ministry of Environment has published guidelines for the land use planning connected to wind power and also the heritage administration in its every day routines keeps a close eye on where to accept and where not the major changes in the landscape brought along by the mills. The national heritage administration has quite a liberal policy when it comes to renewable energy sources – they are accepted and even promoted if no major collisions with the most important historic environments are foreseen.

To sum up: as all human action and its impacts are connected to our cultural roots, heritage and existing cultural environments are at the heart of climate change mitigation and adaption. This calls for more explicit action and participation in mitigation and adaption policies – a shift from reactive to proactive heritage policies.

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3.5 Iceland

The national situation of climate change, mitigation and adaptation

Uggi Ævarsson, Cultural Heritage Manager of Southern Iceland,
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It has to be said that Iceland is rather behind the big Nordic countries when it comes to mitigation and adaption to climate change. The discourse of climate change exists of course but normally it gets muffled by loud arguments about industrialization of nature vs. unspoiled nature. The discourse has a tendency to get undermined by opposite extrems: if the minister of environment was to the left in politics then she was blamed for being a tree-hugger who stood in the way of development and if the minister was right-winged then she was said to be an old fashioned capitalist who only thought about earning as much money – and as quickly – as possible. So, it is quite clear that the issue of climate change is – at least in Iceland – political.

After the elections in 2013 the Ministry of Environment – which was quite new – was put under the Ministry of Natural resources: fisheries and agriculture. The tradition of this ministry is quite utilitarian, the emphasis has been on how to exploit natural resources whereas the former, independent, Ministry of Environment, took the role of broadening the picture, the role of defending the environment against this attitude of cashing in on nature. Does it make sense to combine two ministries, one that is driven by the demand of economical growth and by utilizing the natural resources (fish, agriculture, geo-thermal and hydroelectric energy to some extent) and the other that is supposed to take side with nature and sustainability?

How do the effects of climate change appear in the cultural environment?

The average temperature in Iceland has demonstrably increased since the mid-19th century. At the same time, the sea level has risen, and glacial retreat is clearly evident.

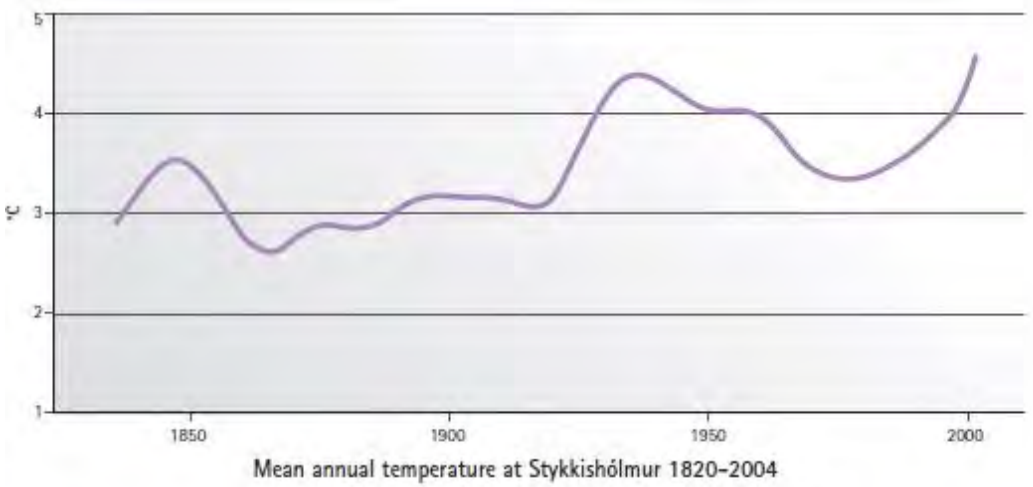
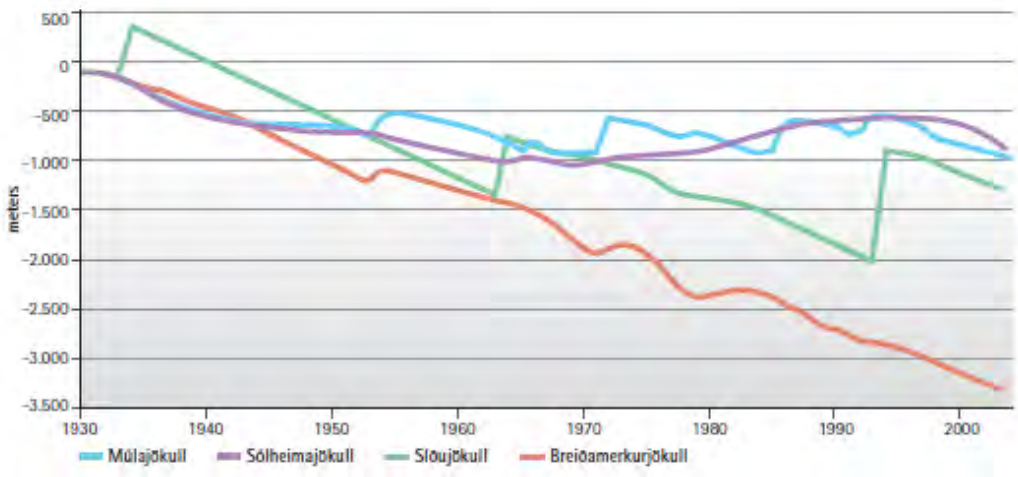


Table 1.

The rising temperature of the Atlantic Ocean changes the marine ecosystem in Iceland's waters, and fish stock migrate further north. The opening up of trade routes north of Iceland will also bring increased traffic, which will influence both the marine ecosystem as well as the cultural environment of Iceland, particularly the north of the country through increased trade.



Retreat of four selected outlet glaciers, 1930–2004

Table 2.

The warmer climate leads to longer growing seasons. Self-seeded woodland has begun to spread much faster than before, and the potential effect on Iceland's archaeological heritage is dire. The overwhelming majority of archaeological sites in the country are constructed from turf, and root action significantly quickens the disintegration of buried turf structural remains.

Increased extremes in weather hasten soil erosion. Iceland's society has always relied on the sea for sustenance; large numbers of sites sit by the shore, mostly either farm mounds or fishing stations. Many of these are under grave risk from erosion caused by the ocean, and this process is exacerbated by the increased frequency of extreme weather.

Which actions of adaptation are underway or planned (flood protection, humidity, storm damage etc.)

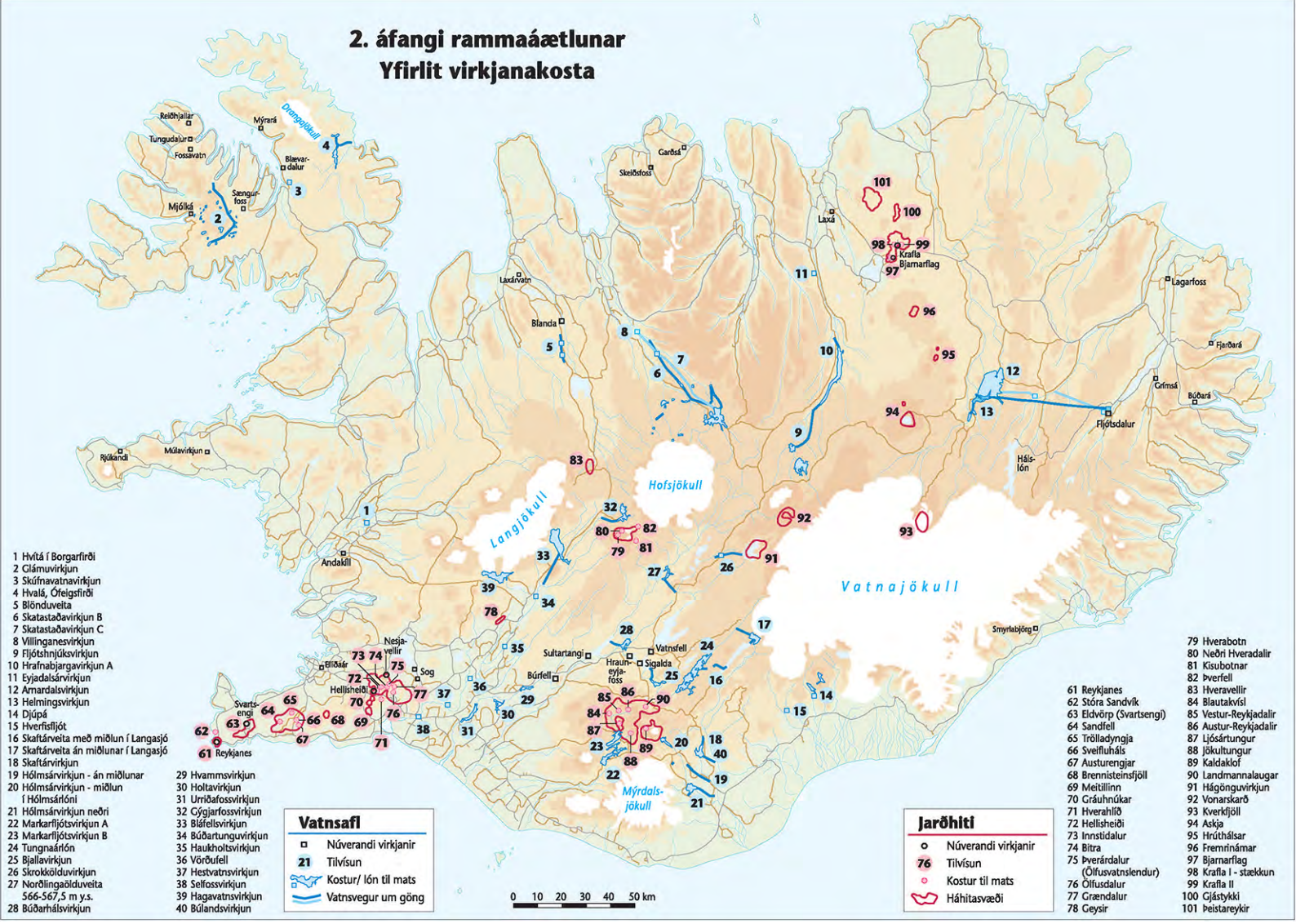
The recent publication on Iceland's strategy to combat climate change mitigation and adaptation gives a detailed account of adaptation measures taken (Umhverfisráðuneytið, 2006). There is little emphasis placed on Iceland's cultural heritage, however. In fact, there is no account of the effects of climate change on archaeological remains. This governmental inertia is troubling, and Iceland must look to other Nordic countries for guidance on effective responses to these issues.

How does climate change mitigation effect on cultural environment?

If anything, current governmental policy on climate change is hazardous to Iceland's archaeological heritage. A large emphasis is placed on revegetation and afforestation (ibid, p. 57), with no demonstrable concern for the effects on buried archaeological remains. Care must be taken to avoid the damage caused by afforestation on Icelandic archaeological remains. As these sites are overwhelmingly made of turf, the damage caused by root action can be severe and there are many instances of irreversible damage by afforestation, both self-seeded and planted. The two are linked in Iceland, as the National Forestry commission both actively plants as well as facilitating the spread of self-seeded forests.

Over 70% of Iceland's energy consumption is based on renewable energy sources, and hence the country does not suffer from the same emission reduction issues that other countries suffer from. These methods of renewable energy production are not without fault, however. Hydropower plants require the submersion of large areas under water reservoirs. While the immediate impacts on material remains are assessed in the planning process, long-term impact assessments on heritage assets from harnessing geothermal and hydroelectric power are not carried out. The effects of such extensive changes to the landscape must be monitored to fully understand the impact of energy harnessing on Iceland's landscape. It is also advisable to carry out impact assessments on less tangible aspects of heritage, in line with the European Landscape Convention and UNESCO's Convention on Intangible Heritage (Faro).

Figure 4. The damage caused to the farm mound Stóraborg from wave action led to its total excavation in the 1990s. Photo: The Institute of Archaeology, Iceland.



1 Hvítá í Borgarfirði
2 Glámuvirkjun
3 Skúfnavatnavirkjun
4 Hvalá, Ófeigsfirði
5 Blönduveita
6 Skatastaðavirkjun B
7 Skatastaðavirkjun C
8 Villinganesvirkjun
9 Fljótshnjúksvirkjun
10 Hrafnabjargavirkjun A
11 Eyjadalsárvirkjun
12 Arnardalsvirkjun
13 Helmingsvirkjun
14 Djúpá
15 Hverfisfljót
16 Skaftárveita með miðlun í Langasjó
17 Skaftárveita án miðlunar í Langasjó
18 Skaftárvirkjun
19 Hólmsárvirkjun - án miðlunar
20 Hólmsárvirkjun - miðlun í Hólmsárlóni
21 Hólmsárvirkjun neðri
22 Markarfljótsvirkjun A
23 Markarfljótsvirkjun B
24 Tungnaárlón
25 Bjallavirkjun
26 Skrokkölduvirkjun
27 Norðlingaölduveita 566-567,5 m y.s.
28 Búðarhálsvirkjun
29 Hvammsvirkjun
30 Holtavirkjun
31 Urriðafossvirkjun
32 Gýgjarfossvirkjun
33 Bláfellsvirkjun
34 Búðartunguvirkjun
35 Haukholtsvirkjun
36 Vörðufell
37 Hestvatnsvirkjun
38 Selfossvirkjun
39 Hagavatnsvirkjun
40 Búlandsvirkjun
61 Reykjanes
62 Stóra Sandvík
63 Eldvörp (Svartsengi)
64 Sandfell
65 Tröllladyngja
66 Sveifluháls
67 Austurengjar
68 Brennisteinsfjöll
69 Meitillinn
70 Gráuhnúkar
71 Hverahlíð
72 Hellisheiði
73 Innstidalur
74 Bitra
75 Þverárdalur (Ölfusvatnslendur)
76 Ölfusdalur
77 Grændalur
78 Geysir
79 Hverabotn
80 Neðri Hveradalir
81 Kisubotnar
82 Þverfell
83 Hveravellir
84 Blautakvísl
85 Vestur-Reykjadalir
86 Austur-Reykjadalir
87 Ljósártungur
88 Jökultungur
89 Kaldaklof
90 Landmannalaugar
91 Hágönguvirkjun
92 Vonarskarð
93 Kverkfjöll
94 Askja
95 Hrúthálsar
96 Fremrinámar
97 Bjarnarflag
98 Krafla II
99 Krafla I - stækkun
100 Gjástykki
101 Þeistareykir

Figure 5.

The general effects of climate change on cultural heritage in Iceland. Mitigation and adaption

The natural environment in Iceland can probably be described as harsh, the whole interior is pretty much a desert. That's why it is not easy to state if the wind erosion has changed over the last decades. Throughout the settlement history of the country both historical and archaeological records show that in certain areas farms were constantly moving about and the reason being the sand that ate up the grazing areas and the homefields. Life in Iceland has been – up to recently – a constant fight against the elements. The weather has been Iceland's army – and war.

On the scale of cultural remains, the effects of climate change, appear in Iceland in more erosion because of lack of frost in winter time: the ground surface is not frozen solid which makes it more vulnerable to erosion, by wind, freshwater and sea on the coast and inland. Landslides are getting more common in spring and early summer; Retreat of the glaciers help to raise the sea level which has become a problem and will only get worse. Another side – effect is that the glacial rivers do get more powerful in springtime and summer which means they erode away the banks faster; extreme weather: more wind and precipitation; weather is less stable: freezing and thawing treats vegetation and the surface – soil worse than a solid block of snow. It goes hand in hand with climate change, the will of Icelanders to cover the land with trees and the

reduction of sheep – farming in the country which means more vegetation that is not necessarily good for the archaeology.

In 2013 Minjastofnun Íslands – The Cultural Heritage Agency of Iceland – was established with new and wider role within the Heritage sector. The new Agency is working on a policy, both on cultural remains that are in danger because of the elements and because of human impact. In this policy – making it will be a priority to make an infrastructure that takes on problems concerning climate change. Hopefully we manage to build into the infrastructure an active way to mitigate and adapt to climate change. A possible solution is that the Agency would priorities applications for funding and excavation permits if the projects involve endangered cultural landscapes because of climate change. Another possibility for the Agency is to hire systematically qualified staff to do research work, survey the endangered cultural landscapes, and to excavate where it is necessary, etc.

4. Workshop results

4.1 Heritage solutions in adaptation to climate change and future risks.

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Reija Ruuhela, Finnish Meteorological Institute, Finland
Gísli Pálsson, Institute of Archaeology, Iceland
Uggi Ævarsson, Minjastofnun Islands, Iceland
Elisa Heikkilä, National Board of Antiquities, Finland

Introduction

Climate change has already begun to affect the Nordic countries, and the effects are anticipated to increase gradually in the future. As a response to climate change, societies of the different Nordic countries need to adapt to the new type of climate that will develop in Northern Europe. Impacts of climate change in other parts of the globe may have implications also in Nordic countries for example via economy. The Nordic countries have basically good capability for adaptation due to advanced technology and relatively wealthy societies. However, in order to implement adaptation measures, there is need to understand the significance of impacts of climate change on cultural heritage. On the other hand, the potential of cultural heritage for adaptation in general should be recognised.

Throughout history, humans have adapted to life in different climate zones and varying weather conditions in the globe, as well as adapting to changes in living conditions and natural habitat. There is therefore a possibility to use our cultural heritage as a base of knowledge when developing solutions of adaptation to prevent future problems. This workshop aims to investigate if cultural heritage can be used as a source of knowledge and/or inspiration in the process of adaptation to climate change.

Cultural heritage, as a part of modern society, is at risk due to climate change effects. Climate change impacts for cultural heritage and changing risks are often exemplified with increasing precipitation, humidity, milder winters and rising sea level. Because of an anticipated faster growth rate of vegetation, maintenance of heritage sites will become increasingly important. Popular and well visited cultural heritage will in general be at less risk, due to constant monitoring and public support, but less known, rarely visited sites are at a larger risk when they will not be monitored as regularly. There will become a greater need for risk assessment for cultural heritage sites in general, where it is unavoidable not to prioritize between different cultural heritages. Prioritization is in a larger extent expected to be a monetary evaluation between alternatives. There is also a risk of decreased resources due to climate change, for instance through damage due to droughts, increased flooding and erosion.

In Nordic countries temperature will increase more than the global average. The Nordic challenge therefore lies in adapting to the particularly high rate of climate change and its impacts. The changes engendered by climate change in Nordic countries

will be both negative and positive; however, the most severe effects of climate change will be felt elsewhere in the world, particularly in developing countries. Besides adapting to the direct impacts of climate change at home, Nordic countries also need to prepare for global changes that have indirect impacts in Nordic countries, for instance through global economy and international trade and the resources available to the countries. As an example, tourism in Mediterranean might suffer because of hotter and drier summers and the reduction of snow in the Alps may reduce winter tourism; thus, tourism in Nordic countries might witness a relative increase. Increasing tourism will exert pressure on heritage assets, leading to more need for monitoring. The increased load of visitors will cause a greater risk for wear and tear on sites, but in the same time generate economy for maintaining and preserving the cultural heritage. Heritage assets may be both more vulnerable to climate change effects due to its degraded state, or more robust than modern built constructions.

There is a divergence between the efforts of adaptation to climate change in general and the cost of adapting and trying to preserve cultural heritage. The adaption efforts may in itself be a threat to the preservation of cultural heritage, if performed with modern materials and technology in a non-conservation ethical way. In the same time adaption measurements performed with traditional techniques with historical perspectives may well strengthen the preservation of a particular cultural heritage.

But there will be several benefits in preserving older structures and adapting our cultural heritage, in comparison to building new, not just the monetary waste but also the cultural values that will be saved.

Solutions

There are several ways for the cultural heritage sector to meet the future challenges of climate change and participate in the development and implementation of climate change adaption.

1. Collaboration

To meet the challenges that will come with climate change there is a great need for collaboration between different sectors and regions. There is a point in collaboration on a Nordic level compared to national or European-wide collaboration. The countries share many traits of culture and cultural heritage, and to a large degree we face the same challenges in the context of climate change. By collaborating on a Nordic level we can have more influence on global policy than if we act only on the national scale.

Cooperation between Nordic and also Baltic countries has long traditions. So far they have not actively targeted climate change and cultural heritage, but the networks do already exist, e.g. the working group of senior heritage experts, the Baltic Sea Monitoring Group on Heritage Cooperation as well as Nordic group for castles and ruins etc. These existing networks may well be used in order to communicate and develop new research platforms for climate change adaptation.

In order to meet the challenges of climate change there is a need for increased multidisciplinary collaboration. The heritage sector needs to participate and learn how to use the language and knowledge of external institutions and how other sectors engage with the public to increase awareness of climate change issues. One good example of

multidisciplinary collaboration between agencies in Sweden has been the formation and development of Cultural Landscape Parks, in regions where conservation interests of several agencies overlap. By developing a joint program for the Swedish national Cultural Landscape Parks, a three 'way collaboration between the Heritage Board, the Environmental Agency and the Agency for Accessibility was developed successfully. There are today some good examples on collaboration between Nordic countries and National agencies, but the communication and collaboration from state-level down can be developed further.

National actions on high enough-levels will be necessary for meeting the challenges of climate change effects to cultural heritage. An example of national high level action is Finland's new cultural environment strategy; witch can help to motivate more collaboration work within the country. The Finish strategy was approved by the Government in March 2014, and it points out five sections:

- Cultural environment is a resource
- High quality of the legislation related to the cultural environment and its application
- The importance and value of the cultural environment is recognized
- Strength from cooperation
- The information on the cultural environment is sufficient and of high quality

Trough collaboration between the Nordic countries on a national strategy level, the countries could learn from each other. The combined effect of strategy planning might benefit adaption of cultural heritage to climate change in the Nordic region.

Another important collaboration partner for the heritage sector in adaption to climate change are NGOs (both within the heritage sector and others, like environmental NGOs), as well as other institutions external to the heritage sector.

2. Use of cultural heritage databases in climate change adaptation

The cultural heritage sector has a huge database of knowledge that could be applied to research in climate change adaptation. Databases that concerns cultural heritage are often of a very diverse nature, however, and often don't consist of purely quantitative data. Cultural heritage databases may contain, for example photographs, written documents, books, or may consist of object in collections or at specific cultural heritage sites. This type of database may not be suitable for statistical analysis, and that may cause problems when applying and running cultural heritage data together with climate data from meteorological or geological data bases. There is therefore a large need for research and to develop methods that will digitalize and make cultural heritage databases accessible for climate change modulation and adaptation research. GIS-based databases show the importance of visualizing heritage data and increasing accessibility for other authorities, scientists and the public, using the common language of numbers and GIS-science to communicate heritage knowledge and data. There is a large amount of data that is not digitally available, and decisions need to be made about the value of those data to others, and ways of making them accessible. Even if all data in cultural heritage data bases is not accessibly as numerical values and comparable to climate change data, cultural heritage has one great advantage in communicating climate

change effects. It is possible to use this large database to visualize the numbers, by using these databases, often of photos, to visualize climate change.

There are several national cultural heritage databases in the Nordic countries that could be used (and to some extent already have been used) in climate change research and adaptation strategies. Examples of these databases are:

Sweden: Fornsök (FMIS). A web-GIS server showing archaeological sites and investigations. In this data base there is information on more than 1.7 million cultural heritage sites at about 600 000 individual geographic places. The information comes from field investigations and archaeological diggings, both on land and below the sea, in Sweden. The data base is continuously updated with information on a daily bases. Another example of cultural heritage data base in Sweden is The Strategic Environmental Archaeology Database (SEAD). It is a national data base for archaeology research and an international standard database for environmental archaeology data. Environmental archaeology uses scientific methods in order to study past environments I relation to human activities. Research is undertaken through the use of proxy analysis methods and cross-comparison of the archaeological record. Research can be made on a wide variety of spatial and chronological scales, and the system allows the online storage, extraction, analysis and visualisation of data on past climates, environments and human impacts.

Finland: In Finland there are several nation-wide site registers of the cultural environment, which are maintained by the National Board of Antiquities and environmental administration. The register of antiquities, the register of Built environments of national significance and the register of Buildings under the provisions of the Building Protection Act and government decrees, among some others, form the large data resource of cultural environments including also GIS-data of the sites.

Iceland: There are three databases in Iceland in the field of cultural heritage. Sarpur is run by the National Museum; Ísleif is privately own by the unit Institute of Icelandic Archaeology; Minjastofnun Íslands (The Cultural Heritage Agency of Iceland) is building a new database which will be GIS compatible and available online; Ísleif will also soon be made available to browse and query online.

3. Making long-term risk assessments in light of expected changes to the climate

Creating long-term climate risk and consequence assessments to cultural heritage are of necessity in order to preserve our Nordic cultural heritage. Climate change adds yet another parameter to the maintenance plans and risk assessments for society as a whole, and to cultural heritage. The response to this is a well-developed plan for adaptation and a long term focus. But the expected cost of adapting society and cultural heritage to climate change will be high. This rises the question if the heritage sector must face tough decisions about 'abandoning' sites under threat – sites that are in regions that will very likely be destroyed by rising sea level and other climate change effects. There is also the question of toning down discourses of 'priceless heritage assets' and make monetized assessments of places, with the possibility of abandoning even nationally significant heritage sites.

Heritage assets must be assessed, evaluated and prioritized. There is a substantial problem communicating value and significance of cultural heritage because the use of terms like 'priceless'. Therefore there is a priority to develop methods for communicat-

ing cultural heritage values using monetary value. Blanket protection is an inflexible tool and not suited to adapting to a changing climate. The question must be asked: Is everything as significant?

Heritage significance must be assessed in the context of climate change, and resources must be prioritized in light of the changes brought about by climate change.

In Finland the cross-cutting theme of the revised national climate change adaptation strategy is climate risks assessment and management in all the sectors of society. Cultural heritage is not discussed as a separate sector in the strategy. However, many issues relevant to cultural heritage are discussed under other sectors such as spatial planning and building. Thus in adaptation of cultural heritage to climate change the risks identified by other agencies can be utilized and a composite risk assessment guideline could be created.

4. Learning from past experience to adapt to future climate change

It is important to notice that very few new risks for cultural heritage will appear because of climate change in the Nordic countries. Instead, the frequency and intensity of the already existing adverse impacts may change because of climate change. Therefore learning from past experiences and good practices in cultural heritage may be feasible in practical adaptation measures. It's important to study and learn from how societies have reacted to these events historically. Learning from history can help us to understand historic processes and make informed judgements about how things will change in the future. Furthermore, historic sources can help us to adapt to present and future risk. For example, studying and reinventing previous methods of adaptation that has demonstrably worked before, and may very well work again. It is not always necessary to reinvent the wheel, but it may be necessary to employ previous adaptation methods in innovative ways.

It is not only climate change and cultural heritage scientist that can benefit from cultural heritage data. There is also now an opportunity for other scientific communities such as biologists and agricultural science that can use cultural heritage data in their adaptation research and measures.

There is also a good opportunity for the cultural heritage sector to get involved in the passing of information about climate change to the community together with other factions of society, fields of science, governmental organisations, etc. The heritage sector has a great advantage of being able to visualize the effects of climate change and can use this cultural heritage information in climate change communication.

5. Using traditional methods

It is likely that heritage solutions of adaption to different types of extreme weather and harsh climate may be more sustainable. These solutions have passed the test of time. Heritage solutions may also be more environmentally friendly, if construction details or technical solutions are made of traditional materials. Therefore it is important to encourage traditional craft and promote and develop the active and innovative use of methods that have been proven to be effective, sustainable and locally accepted. There may be a winning concept in local and traditional knowledge and it would be a shame if we did not use it in our efforts to adapt to climate change.

Since global change will gradually change the climate zones, also across the borders, we have to be willing to incorporate other cultural heritage traditions and adapt them to our local traditions. It is important to inform the society in order to gain acceptance for new cultural traditions that may be needed to be incorporated, in order to adapt. In particular, we should share adaptation methods across the Nordic countries. Traditional methods from southern Sweden and Denmark may prove valuable in Finland, northern Sweden and Norway as the climate there changes to become similar to that, later in the century. It is also important to ensure that regulations and legislations do not hinder the innovative use of these traditional adaption methods.

It will become important to actively encourage the Nordic community to use climate change adaptation methods by promoting solutions in cultural heritage events and in everyday life. For example, this can be done by providing platforms for restoration experts of built heritage to showcase traditional building methods.

Only using old methods will most likely not be enough to adapt our society to the grand effects of climate change. The traditional methods extracted from cultural heritage knowledge must also be used in innovative ways. This is an interdisciplinary field of research that must develop in order to solve the future problems with adapting to climate change. An example from Iceland is the increased use of turf in contemporary construction. While traditional turf houses have been used and maintained for museums in the past few decades, it has not been seen as a suitable material for contemporary design until recently. With initiatives such as Íslenski Torfbærinn and the AAAA workshop on traditional material in design, there appears to be a good foundation for increasing the use of sustainably and locally sourced building material in Iceland.

Another way of looking at traditional methods is within the maintenance sector. In the western world we trust in technological solutions to monitor and preserve our society, were cultural heritage is a part. This is done in order to lessen costs and work hours, but the climate change effects may cause us to re-evaluate this strategy in the future. When it comes to monitoring cultural heritage the Nordic countries spend a lot of money on monitoring systems – cameras, remote sensed systems, etc. But there is a risk that this strategy will not be cost efficient in comparison to letting monitoring be performed by employees. The problem within the maintenance planning is that equipment and staff has two different types of budgets. There is a risk that the result is an overreliance on a 'technical solution' for problems that are better solved by actual people taking care of the heritage site. As a consequence to climate change effects it may therefore be wise to promote the use of human labour rather than automated technological solutions.

6. Cultural heritage can inspire

In order to meet the challenges of a changing climate in the Nordic region, society and people need to be engaged in the adaption process, and there is a need for scaling the efforts through community engagement and voluntary work. In this context cultural heritage has a task in engaging and encouraging, and filling the future work with value. In order to do this the heritage sector will need to tear down the walls between 'high' and 'low' culture. For example looking to vernacular 'history' fairs as an opportunity to explore and innovate traditional building methods, and engaging with those who are interested in history.

Cultural heritage may also provide and inspire to a different type of solution of adaption to climate change – e.g. in lifestyle and values. The cultural heritage sector has a responsibility to share and communicate the historic knowledge in order to inspire a sustainable future society. By communicating a sustainable and energy efficient life style with a cultural heritage perspective to the public, there is a possibility to invoke environmental friendly behaviour within the communities, and to build a general awareness of both heritage- and environmental values.

7. Looking forward – future project ideas

- National Board of Antiquities in Finland has good experience of using online idea-banks where the staff of NBA has provided some headlines for future research projects. This model can be utilized to promote multidisciplinary research for adaptation to climate change within the scope of cultural heritage. The suggestion is to investigate this further.
- There is a great need for focused research in order to link different types of data bases (Nordic cultural heritage databases – open climate data etc.). Research and method development within this sector would be very useful for the heritage sector, as well as for the climate change research. Some progress in this research field has been done nationally, but the suggestion is to further develop these systems on a Nordic level.
- Nordic collaboration projects on climate change adaptation between cultural heritage and climate change researchers should be promoted in order to find good new solutions and learning good practices from other Nordic countries. There are already existing networks, both on Nordic and a Baltic level sharing knowledge within the different research fields. The suggestion is to promote a platform for both cultural heritage and climate change with focus on solutions and good practice.
- Within the cultural heritage sector there is a great deal of monitoring data produced on a national level, in the Nordic region. There may be large benefits if this data could be shared and evaluated on a Nordic level. The suggestion is to find forums to share monitoring data between the Nordic cultural heritage institutions, and to use this information to cultural heritage adaptation solutions. This should be promoted and investigated further.

4.2 Heritage in climate change mitigation; sustainable landscape and town planning

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Introduction

The workshop touched upon issues raised in recent debate on condensation of urban areas and fill-in development as means for climate change mitigation. It also commented on the recommendations of the Sustainable Historic Towns project report (2012), advocating carless city centers, mixed functions, flexible plans, low and dense built fabric and preservation of green space as planning lessons to be learned from historic cities.

The heterogeneity of urban heritage was noted in the outset. While the SuHiTo recommendations were largely based on an "economy of scarcity" evident in pre-industrial wooden cities, many of the urban features now deemed in view of energy consumption are linked with 20th city planning. These may comprise Functionalist town plan with functional space division, first car suburbs, roadscapes, early high-rise building and wide unstructured green zones in connection with urban sprawl. The question was brought up, whether climate change mitigation will lead to a re-evaluation of industrialist and Modernist urban heritage, dismissing certain elements and layers as unsustainable while promoting others – such as the Garden City – as models for contemporary planning, and should this be accepted.

It was noted that urban heritage as such does not guarantee or prevent climate change mitigation. It was rather seen as an enabling structure adaptable for current needs as well as an archive of traditional planning tools that could serve contemporary planning. This would however require a better understanding of how historic cities of different age really perform in terms of energy consumption. This should not be looked at in isolation but ought to be combined with other factors such as urban runoff management, as well as heritage and biodiversity values and the conservation of agricultural land. Especially the integration of heritage values with other planning considerations was seen to require more data.

The workshop maintains that different periods have each their specific advantages and flaws in terms of sustainability. For instance, the premodern cities offered starting points for the planning of relatively small carless areas with adaptable small-to-medium scale plans and small-sized, intensively designed open space. Moving into a larger scale, the densely built compact city ideal together with more extensive green areas might prove more useful. It was however agreed that there will be no return in the future to Functionalist and car-based planning, calling for a re-adaptation of much of the postwar urban fabric and infrastructure.

In this workshop three main topics were identified. The first topic was to enhance the mixed use of areas, which promotes living within walking distance from public services, culture services, nature and commercial services. The second was planning in human scale, which would highlight the value of cultural environments as such and pay attention to human spatial qualities and space management. The third topic stressed the importance of green and blue infrastructure. In general it was seen possible to learn from historical urban patterns and apply this knowledge to modern sustainable planning.

The state of knowledge is generally good, but there is a need for multiple framing of urban heritage to combine different value approaches with one another. There is also a clear demand for better participation processes, where the heritage sector could contribute. One should study from all the relevant angles before taking action, covering cultural and social aspects in addition to "hard" scientific data.

Mixed use of towns/areas/villages

When integrating cultural heritage values, promoting new uses and/or retrofitting of old structures are in a key position. In execution the flexible use of old buildings and structures is needed. Preservation objectives need to be fitted in new uses and new regulations, such as energy saving renovations, need to be reconciliated with preservation objectives.

Mixed uses are likely to promote attractive environments and help to find new uses for old buildings. Bringing in services, culture and business to residential areas would encourage car free living. Remembering the scale is however important; mixed use is different in big city vs small city. In various scales encouraging a local sense of community promotes the use local services and enhances their viability. Conserved structures create continuity between generations and eras, reminding the present and forthcoming generations about local history and supporting local identities.

Cultural heritage should also serve as positive or negative educational examples. The key questions - Was it sustainable at the time it was built? Would it be sustainable now? – are helpful when tracking out tradition which can be innovative in climate change mitigation.

Such examples could be found from the garden city model, urban quarters, the street, public squares, the Medieval city etc. More research is however needed.

Recommendations

Historical towns are often originally based on mixed use. All the key functions of a sustainable town can be found in them, for example active streets with public functions, which promotes walkability. One-time scarcity of materials, costs and efforts in transportation have created austere practices in construction, food production, mobility and consumption, encouraging and enforcing people in the sustainable use of materials and services.

The use of existing infrastructure instead of building new for current functions, promotion of new uses of old buildings and retrofitting of old infrastructures may be beneficial also from the economic and socio-cultural point of view.

Encouraging adaptation and facilitating positive flexibility in regulations and legislation is essential for this objective.

Figures 6 and 7. Old Rauma has maintained mixed functions of housing, services and traffic. Main streets are renovated for modern traffic, housing streets are paved with cobble stones for bearing capacity and surrounding streets are still graveled. Photo: Laura Puolamäki.

Human scale

Sustainable urban patterns from the individual structures and blocks to regional networks should relate to human scale, where historic cities could provide working models. It would also be worthwhile to pay attention to the principles of the architect Jan Gehl concerning private to public space management in order to create activity on the street level, to find spatial qualities that enhance public spaces and to promote pedestrian use by using human scale.

The workshop reminds that the cultural environment has a value in itself. It is a living document of both human and environmental history. Built environment entails regional characteristics that are adaptations of the human life into the changing local climate and resources When searching for justification of historic preservation, climate debate around historical towns and cultural environments may however easily become reduced into mere calculations of embodied energy in built heritage.

Figure 8. In Old Rauma the two main streets are a part of historical road network, and commercial services are been established along them. To enable the mixed use of the town in the future as well, the municipality of Rauma has decided to renovate the main streets to meet the challenges of maintenance and business traffic, and reserve other streets for pedestrian and residence use. Photo: Laura Puolamäki.

Recommendations

Sustainable human scale patterns should be brought from blocks to town and city scale. High-rise building should be avoided as it discourages contacts between people. In order to combine energy effectivity with good microclimate, for instance a Siedlung-type urban pattern consisting of 5 – 6 storey buildings and public open spaces in between or solutions inspired by British townhouse would be recommendable, both putting an emphasis on the intensive and high-quality design of open spaces. Promoting walkability and discouraging car use would allow for more density and increase human contacts in the vein of the "Compact City" of the 1970s. No parking should be allowed inside the blocks and no undefined space should be left. Maximal preservation of existing urban fabric and minimizing of intervention would constitute a resource-wise approach.

Effects of climate change to existing building stock in Finland

Jukka Lahdensivu

Cultural environments from post 1950´s are facing threats due to the climate change as well. The impact of climate change on the performance of structures is becoming an important research issue from an engineering point of view. Climate change will affect the geographical and seasonal distribution of precipitation, wind conditions, cloudiness, air humidity and solar radiation.

Finnish multi-storey residential buildings have been built of precast concrete panels since the 1960's. In fact, half of these buildings, which for the most part are located in suburbs, were built in the fairly short period 1960-1979.These suburbs were a trial of creating an eco-city near industrial enterprises with local services and functioning public transport. In most cases the durability properties of concrete (like frost resistance, fast carbonation, low concrete cover) was poor in concrete facades and balconies made in 1960s and 70s (Lahdensivu 2012).

Recent studies shows (Lahdensivu 2010, Köliö et al. 2014) that climate change is causing due to increasing precipitation (rain and sleet) with higher wind speeds more harsh climate for porous materials like concrete, rendering and bricks. The effects of climate change will be detected as more rapid frost damage of porous materials as well as increasing corrosion damage of reinforcement in carbonated concrete.

Pictures: Jukka Lahdensivu

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Green and blue infrastructure

Green areas form an integral part of historic cities and shape their identities. At the same time they provide several sustainable functions and eco-system services - for example the mitigation of the heat island effect, storage for downpours, urban gardening, reduction of pollution, increased biodiversity and groundwater protection. The sustaining of biodiversity requires a certain minimum of space in order to succeed. Green spaces are multifunctional as they should provide for green activities and for nature as such. Proper linkage between built urban areas and green spaces is important.

Research about the micro-climates and about heat island effect, about ecosystem services in urban green areas and about urban wetland ecosystems is essential for integrating blue and green infrastructure in sustainable planning. Monitoring of the cultural environment and interdisciplinary research is needed for combining blue and green areas, climate objectives and new uses.

Recommendations

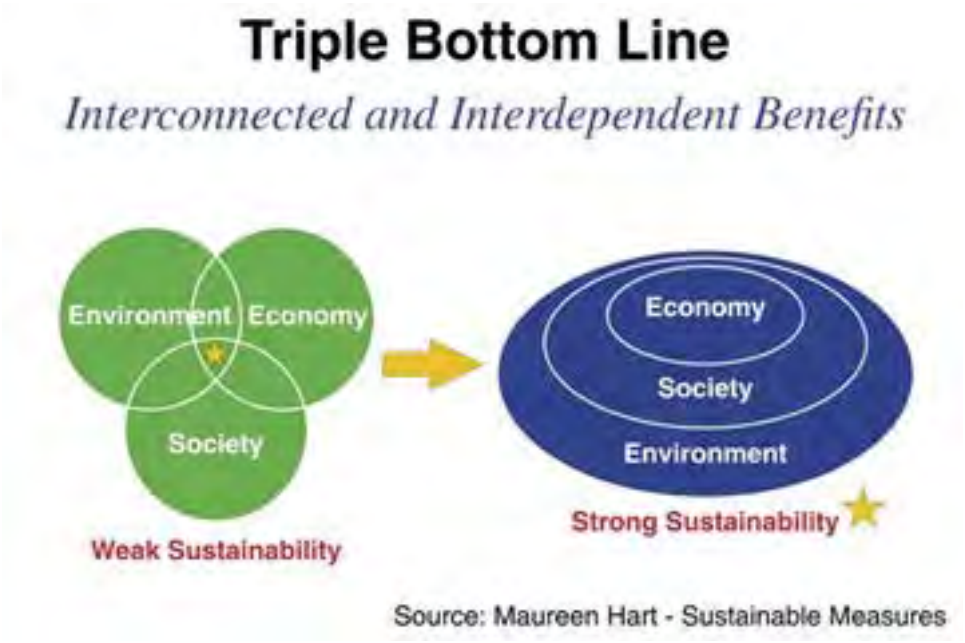
Condensation of urban fabric and preservation of urban green spaces do not contradict one another, while both of them serve mitigation and other sustainability goals. Dense town structures with integrated green areas in historical parts of cities and old towns as well as in new urban areas enable connection and engagement with nature in the city. They serve to channel and filter runoff water and mitigate the heat island effect, while they also provide room for socio-cultural-ecological functions such as urban gardening. Street planting helps to keep evaporation at bay. For the sake of biodiversity and connectivity, green wedges and networks are needed, but their functions have to be clearly defined. The role of urban green spaces in local food and energy production is likely to increase. Like urban greenery, blue infrastructure needs more attention in planning.

Figure 9. Raumanjoki stream surrounds Old Rauma. It is a valuable resource for surface water channeling, but also as an urban green infrastructure with river banks. Photo: Juhani Korpinen.

Future research, knowledge dissemination

The study of climate change is not merely a task for science or economics, as the effects of climate change do not remain within disciplinary borders. Social science and humanities are indispensable in providing information on the societal and cultural impacts of both climate change and mitigation or adaptation measures, not to speak about understanding the multifaceted connections between cultural environments and climate change. Apart from exchange of information across disciplinary borders and multiple framing, efforts should be made to promote genuine interdisciplinarity producing common conceptual frameworks, ensuring a proper research base for climate policies that are necessarily cross-sectoral.

To ensure this new platforms would be needed for discussion between cultural heritage research, economic research, environmental impact research and social research.



The concept of triple bottom line and strong sustainability. Where does the protection of cultural heritage stand in this?

A crucial point is the study of human behaviour in relation to climate change. It would be vital to study more extensively the connections of climate attitudes with cultural environments and heritage at large as well as spatial use practices that support or counteract mitigation (e.g. car-based versus car-free way of life). Participatory research and the tapping of silent knowledge are essential for such research approach.

Strong cultural heritage, which has survived through historical eras, may be compared to the environment in the notion of the "triple bottom line". This concept frames the actions of society and economy in the cultural environment, when planning the new and mixed uses.

Recommendations:

Cultural environment issues and research related to cultural environments need to be fitted into the bigger picture of climate change data. In the context of ecosystem services the natural values have achieved an economic interpretation. In a similar way a valuation model of climate change policies should be developed that takes into full account the cultural environment values. A multidisciplinary research framework needs to be established for supporting policies. There is demand for more experimental study on the relations and interaction between historic cities and climate change. New knowledge about ecosystem services needs to be incorporated in planning.

Priorities for future discussion

A Nordic perspective and framework for monitoring cultural environments and the state of cultural environments is needed. This monitoring should include cultural environment structures seen from the sustainability point of view; what is sustainable, what is dysfunctional. Cultural heritage and cultural environments are in danger of being side tracked; an evaluation model that works as a basis for climate change policies is needed to evaluate the cultural environment itself.

Recommendations and policies should have sensitivity to context. To achieve this, e.m. framework should include a toolbox. Sustainable cultural environments are multifunctional by nature; this should be kept in mind when preserving or replacing them.

Impacts of climate change to cultural environments still needs better mapping, scaling and informing of the cultural heritage sector. Disseminating this information to a wider audience requires a key message; how does climate change affect my cultural environment? What can I do to mitigate/adapt to it in my personal choices?

Closer consideration of the ”label” of climate change compared to the “label” of sustainable development is needed; sustainable development can allow society to proceed in a consumption based lifestyle with some restrictions in the long term, whereas climate change requires immediate choices and actions if it is to be avoided, and even if nothing is done.

4.3 Existing buildings as resource in climate change mitigation.

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Introduction

The following text is a result of the discussions among the experts attending our work shop. During the work shop we had interesting discussions where we shared knowledge and developed ideas and recommendations together. The main themes for the discussions were connected to how to set value on cultural heritage, climate gas emission calculation, user behavior and historic buildings representing important knowledge. We ended up proposing future actions for policy-makers and we hope that these proposals will be followed up in other contexts, among them also through further Nordic cooperation.

We are facing major challenges related to the ongoing and future climate changes. Climate change mitigation is very important in order to reduce the rate of these changes. Existing buildings, including historic buildings, represent resources because they can be used and re-used thus must be managed well to ensure sustainable development. They are already built, and climate impact by actual construction is thus already taken. In addition culturally, historically and architecturally valuable buildings represent important resources/values that are important for human identity, understanding, well-being etc.

Historic buildings and environments can be a valuable resource for sustainability and climate change mitigation; both in the limited sense, as a valuable resource, and in its wider sense, as a historical document, representing traditional knowledge and examples of how today's society may cope with resource depletion.

The goal of claiming existing buildings as an asset in climate change mitigation is to promote greater understanding of the fact/issue and to discuss and suggest implementation and policy adjustments needed to achieve synergy between policy to reduce climate change and cultural environment protection.

Main hypotheses:
Historic buildings represent resources as already constructed buildings.
Historic buildings represent knowledge that we can use as a base for sustainable development.

In this context not only listed buildings are in focus, but also architecturally, culturally and historically valuable buildings in general from before 1940.

Key issues

It is a main challenge to secure sufficient knowledge for prioritizing measures for buildings as a basis for develop policies for climate change mitigation .

Within policies for climate change mitigation there is currently a strong focus on energy use in the operational phase of buildings. Energy saving is not the only solution – energy performance must be seen in the broader context of the sustainable management of buildings. This requires balancing between the four dimensions of sustainability:

- Environmental sustainability: Resources used in the construction of the building, operational energy use, maintenance, recycling, disposal and other on-going processes that have a carbon footprint;
- Economic sustainability: Operating costs, revenues and market value of the building;
- Social sustainability: Functional values and contribution of the building or complex to the amenity of the local area;
- Cultural sustainability: Documentary and experiential values.
- To be truly sustainable in the management of buildings, all four dimensions shall be taken into account and an appropriate balance sought between them, understanding that they are complementary and mutually dependent rather than isolated quantities.

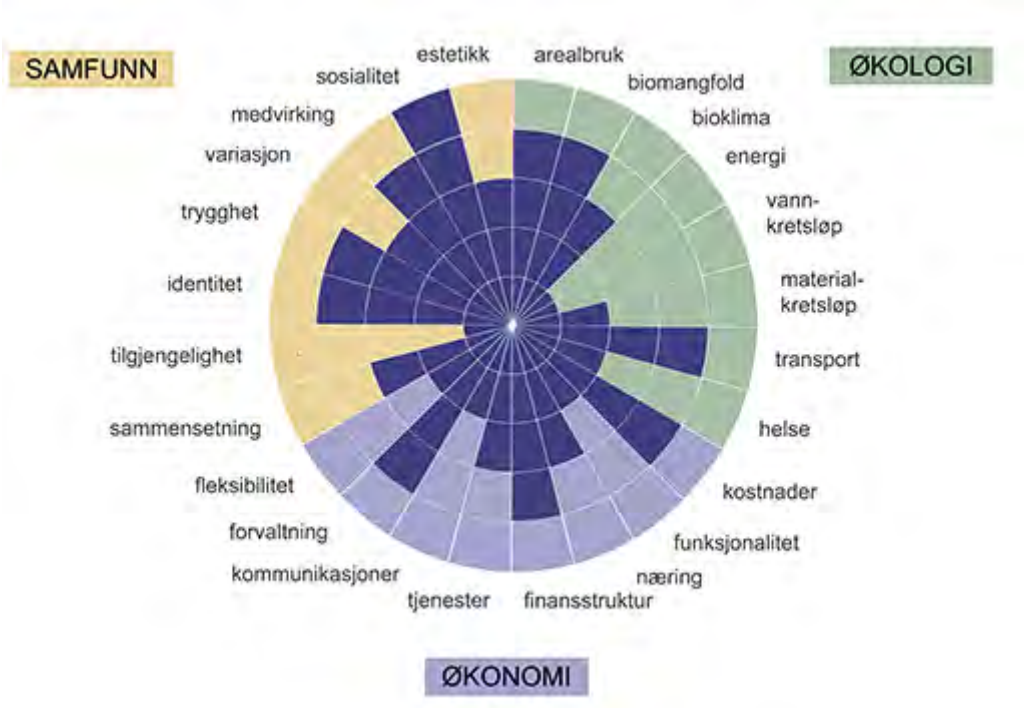

Figure 10. Sustainability value map. Chris Butters. Example of a holistic sustainability approach/ tool, which can also be used for the management of cultural heritage resources at different levels. Link to the article explaining the sustainability value map: http://www.universell-utforming.miljo.no/file_upload/idebank%20article%20chris%20butters.pdf

Old buildings and traditional ways to organize the built environment have many properties of which we can learn from and leverage on modern buildings - a source of knowledge about sustainable development that should be more used. There is some interesting evidence that principles of modern ”eco-city” planning and “eco-houses” are very similar to those used in historical towns and buildings. Complex, handmade building constructions (as in many historic buildings) are difficult to identify and to calculate with ordinary methods. Therefore analyses of how historic buildings perform do seldom give historic buildings the credit they deserve when using calculated values. In addition the climate gas emission from building new buildings (from production of materials and building parts, transportation, construction) is seldom taken into account when comparing old and new buildings. New buildings appear to be more environmental friendly then they are.

There is a lack of focus on the qualities of old buildings. They are possible to maintain and repair, they mature with grace and the building technology is based on simple solutions not demanding energy in the working phase.

Our countries ´building policies, including legislation that provides a framework for the management and development of historic buildings, are in small degree adapted to the goal of sustainable development. The concentration of advanced technical solutions, that both require great resources in production and in the operation phase, works against simple ecological building principles. There is a lack of understanding that reduction of greenhouse gas emission is the main goal, not energy saving. Acceptance of use of environmental friendly energy source as a compensation for higher energy use, can be a more environmentally friendly solution than very extensive upgrading.

The economic price label of building materials and constructions today does not include greenhouse gas emissions and pollution from cradle to grave. It is necessary to include these in the future if we shall be able to really reduce greenhouse gas emissions. Such a change would of course have major economic and social consequences. As long as we are not prepared to make such changes we must try to visualize these effects in other ways.

When it comes to energy saving there is a lack of balance between energy saving, protection of cultural heritage values and the risk of damage, and a lack of understanding of how historic buildings work and the need to look at the buildings individually. The European standard under preparation, CEN TC 346 Conservation of cultural heritage – Guidelines for improving performance of historically, architecturally and culturally valuable buildings, will hopefully help ensure a better understanding and practice.

Topics

The following is an examination and discussion on the challenges related to:

1. Greenhouse gas emission calculations adjusted for historic buildings
2. User behavior and energy use in historic buildings
3. Historic buildings representing important knowledge

It is not an aim for this report to document and advocate cultural, historical or architectural values, but it is important to emphasize that these are values which are difficult to quantify. These values are all about culture, identity, experiences etc. which are of great importance for individuals and society. Various studies have been made to highlight cultural monuments´ economic importance for commercial context, the public's willingness to pay etc.

There is a current project looking into the visualization of what nature is worth; the ecosystem service mindset. A Nordic project looking into cultural heritage and possible links to the ecosystem services mindset has just been started. For cultural heritage the most direct relevance will probably be landscape assessments. But this focus on services also from cultural heritage may increase the awareness of what values the cultural heritage gives us.

1. Greenhouse gas emission calculations adjusted for historic buildings

The amount of greenhouse gas emissions are not decreasing, so there is no doubt that rich countries have to change life style. Some minor measures have been taken. So far there have been initiatives to make both new and existing buildings more energy efficient. When we build a new energy efficient building today, it seems to be an environmentally friendly building, but when looking at the whole process "from cradle to grave" the greenhouse gas emissions are large especially when the use of environmental friendly materials is not stressed. The emissions from the materials are becoming more important, because more materials are used and emissions from the building phase are a bigger part of the total lifetime greenhouse gas emissions. The old buildings already exist, and start as "zero-emission-buildings", and even if these buildings require a larger amount of energy while in use, it will take decades before they can exceed new buildings regarding greenhouse gas emissions.

By using the excess greenhouse gas emissions as gauge it is possible to evaluate the cost of protection indirectly. Will preservation of the cultural heritage object lead to increased strain on the climate, or will preservation be better than eg. to replace it with a new house. This will enable communities to discuss if this price is worth paying for in cases where conservation causes increased climate loads. And it will also be a tool to develope measures necessary to reduce climate gas emissions parallel to conservation. Often old houses will get less good results than new houses, but some greenhouse gas calculations comparing old and new houses have documented that old houses may beat new energy efficient buildings. (see the following box)

Calculation of greenhouse gas emissions can contribute to environmental strategies and reports etc. but can also contribute to improve the existing system of for example energy certificates. The certificate is an important European tool directed towards house owners for the improvement of energy performance. In several projects (Co2olBricks, 3encult) and reports (Spara och Bevara, NIKU SIS project) the lack of adjustment for historic buildings in the calculation of energy performance has been pointed out. Since complex, handmade building constructions (as in many historic buildings) are not identified or possible to calculate with ordinary methods, the certificates does not fit for historic buildings; and therefore does not work as the information instrument it is aimed for. Since wrong measures are suggested in some countries, the certificate could be a threat to historic buildings and cultural significance.

KLIMAGASSBEREGNINGER FOR VERNEDE BOLIGBYGG VS. NYE LAVENERGIBOLIGER

En sammenligning av:
Et vernet laftet boligbygg (1812/1920), rehabilitert (2005-2010)
og
Et nytt boligbygg, lavenergihus, klasse II (2010)

Nedre Bakklandet 33, Trondheim. *Foto: Marte Boro.*

Beregninger: www.klimagassregnskap.no

Oslo, august 2011

CIVITAS
i samarbeid med
Bygganalyse AS
Siv.Ing Kjell gurigard AS

Statsbygg, one of Norway's largest public building owners and property managers has developed a web-based calculation tool for climate gas emissions for buildings and building projects. Link: http://www.riksantikvaren.no/?module=Articles;action=Article.publicShow;ID=130453

The Directorate for cultural heritage, Norway, has presented a comparison of an old notched house and a new low-energy house in order to reveal which provides the most climate gas emissions in a sixty -year perspective . The results show that the old house is slightly better than the new. In the calculations it is assumed that the old house is upgraded with insulation and new inner windows, streamlining electric specific consumption and conversion of energy supply so this is almost the same for the two houses. The new house is a low-energy house, built with standard materials and with the same shape and size as the old one. The old house is already built, the new house must be built. In the comparison, we have looked at climate gas emissions from both energy use while the house is in use and from material production. The results show that reduced emissions from refurbishment of the old house compensate for high emissions from energy use in operation. Kilde: Civitas.

2. *User behavior and energy use in historic buildings*

The energy consumption in a house is related mainly to the way humans behave, rather than to the building itself. It is the needs of people who live or work in the building that define the use of energy. This is the case for all types of buildings, but in a historic building the influence of behavior tends to be more apparent to the user. If the only source of heat is a stove, the user must first carry firewood or coal into the house and then light the fire. If high temperature is needed, more firewood must be supplied. In modern buildings, energy use is less labor intensive and therefore not so demanding for the user.

When a historic house is renovated in order to improve energy efficiency, it may not save as much energy as anticipated, because human behavior also changes. If an old heating system is replaced by central heating, it may be possible to keep a higher comfort temperature, so woolen sweaters and slippers are abandoned. A new bathroom with an abundance of hot water will increase the time it takes for a warm shower each morning. There are methods to prevent the "nice to have" becoming "need to have", such as "nudging". This is the use of a gentle, indirect push towards favorable or appropriate behavior of the individual.

One way of nudging is to make the user aware of the consequences of behavior. The energy consumption of technical installations should be monitored in order to encourage the user to limit energy use or climate gas emissions. The metering should be visualized so that the user can immediately notice the benefit of turning out the light when leaving a room or reducing the temperature by 1 °C. This may also facilitate social control in a positive way, so that saving energy becomes a trend or fashion rather than a way to save money. Methods from anthropology and psychology could be useful for developing this aspect of improving the overall performance of historic houses.

There are very few studies on the influence of human behavior on energy consumption, in particular in historic houses. There is a need to collect the existing information and combine with more research and studies in the field.

3. *Historic buildings representing important knowledge*

Old buildings have many features that we can learn from and leverage on both modern-site construction and maintenance of older buildings. Older buildings are often characterized by the fact that there was a shortage of resources when they were built. With this assumptions a building tradition with the energy and resource conservation based on passive measures were developed. This stands in contrast to the current trend towards ever more advanced technical solutions and energy-intensive processes. It is a question on ecology only by high technology or also in traditional ways. There are some experts and projects looking into this topics and there is a potential for more research.

The materials of the old buildings were usually lightly processed and transported short. The production has required little energy and caused little climate impact. Emphasis on the material properties, ie the right property and quality at the right place and function, gives good resource utilization. The materials and building components have long life, are often easy to maintain and repair and mature with grace. Reuse of materials and building parts is a tradition we should be inspired by.

Flexibility is important for sustainable development, it gives options when situation changes. Many historic buildings have such flexibility. An example is the many old res-

idential houses still used even though requirements for standard and ways of life have changed.

In order to reduce the greenhouse gas emissions it is very important that users understand how the building works and can be able to control building adapted to their needs and the user's desire to be environmentally friendly. Traditionally old buildings give good opportunity for the user to influence and understand how the building works due to low technology and simple structure etc.

An example of traditional solutions having potential for development in combination with modern technology is natural ventilation, meaning providing ventilation without the need for energy input to the operation of fans and heat exchangers and lifetime for "plant" corresponds to the building's lifetime. Further development of natural ventilation adapted to modern buildings will give us knowledge and solutions that contribute to energy efficiency.

Principles of sustainability and care for the heritage have important factors in common; combining the two can be fruitful in forming the future policies and strategies for safeguarding existing buildings and urban environments as well as development of solutions for new buildings and urban environment.

Conclusions

A Conclusions from the workshop

- Energy performance must be seen in the broader context of the sustainable management of buildings. The building policy including legislation must move towards the goal of sustainable development.
- Historic buildings must be given the credit they deserve when it comes to energy calculations, energy labelling and other analyses of how historic buildings do perform.
- The economic price label does not include greenhouse gas emissions although it is obvious that this is necessary. As long as we are not prepared to change this, we must try to visualize these effects in other ways. It is essential that users are made aware of the correlation between their actions and the impact on climate gas emissions. The user's possibility and probability to make the right decisions must be facilitated.
- The knowledge linked to traditional buildings must be activated, the similarities of modern "eco-buildings" and those used in historical buildings should be looked into as well as other qualities of old buildings which may lead to climate mitigation.

B Proposed future actions for policy-makers

The awareness on old buildings as resources for sustainability and climate change mitigation both in the limited sense, as a valuable resource, and in its wider sense, as a historic document, representing traditional knowledge and examples of how today`s society may cope with resource depletion, needs to be raised.

The group of experts within the CERCMA-project who has worked on this project proposes the following actions

- *Development of greenhouse gas emission calculation adjusted for historic buildings*

A development of a tool for greenhouse gas emission calculations adjusted for historic buildings could be an important instrument with several purposes. It can give a base for making the correct choices. Today we see that the one sided focus on energy efficiency is not the only way to reduce greenhouse gas emissions. The main aim of developing such a greenhouse gas calculation will be a tool that can help comparing climate gas emissions from existing and new buildings in a realistic and plausible way.

Greenhouse gas calculation will have building owners, associations of owners, building management and developers as a direct target group, but the understanding of the principles and logic must be explained to and understood by a wider audience and it has definitely the potential of raising public awareness to a greater extent. If we can make people aware of the problem and the advantages with "cradle-to-grave" calculations it could change opinion, which could make politicians aware of the situation, and finally put a price label directly on the amount of climate gas emissions. Ultimately directives, laws and regulations can be changed and it could be possible to reduce climate gas emissions from the building sector, today responsible for around 40% of our emissions.

Our proposal is to establish a group of experts and apply for funding a project for developing a Nordic tool for "cradle-to-grave" climate gas emissions for buildings from before 1940. It will probably be possible to use an existing tool, and further develop and adjust it to historic buildings.

- *Research on user behavior in terms of historical buildings and energy efficiency*

There is a need to understand how people act and think, and to develop methods and measures when it comes to user behavior that ensures sustainable development. Experience from many energy refurbishments shows that energy consumption is not reduced as expected. The current focus on improving the building envelope has often major weaknesses; energy and therefore climate gas emissions are not saved as planned, in fact quite the opposite. There are very few studies on the influence of human behavior on energy consumption, in particular in historic houses. The energy consumption in a house is related mainly to the way humans behave, rather than to the building itself. There is a need to collect the existing information and combine this with more research and studies in the field.

- *Research on knowledge connected to historic buildings as a base for sustainable development*

Historic buildings represent traditional knowledge that can contribute to development of environmental friendly solutions when traditional solutions are combined with modern technology. To achieve this we need to understand better how historic building functions and to develop this understanding as a basis for development of new sustainable buildings and areas.

C The Nordic way forward

We believe that it will be fruitful to collaborate within the Nordic countries on these issues.

We have many of the same environmental challenges, but we will also benefit from the exchange of experience related to climate change that could be useful in a time where the climatic conditions will change. We can achieve more by consolidating our resources, and allowing all the Nordic countries to have access to resources. In addition there are major similarities when it comes to culture, society and legislation which will be a useful basis for such cooperation.

5. Nordic cultural environments and climate change: Concluding words

Maunu Häyrynen

Like the rest of the world, Nordic societies are already facing the consequences of climate change and are bracing themselves for its full impact in the forthcoming decades. The magnitude of this will depend on the success or failure of global mitigation measures. One way or another, the effects will extend to Nordic cultural environments and will divide them according to their vulnerability to change. Coastal cultural environments are especially prone to flooding, forested and mountainous areas to extreme weather or vegetation changes, while some built environments or cultivated landscapes may escape relatively unharmed. These may in turn be particularly exposed to the effects of mitigation such as thoroughgoing energy repairs or towering wind power structures.

Climate change may bring about widely felt economic and societal changes, leading to a wholesale reassessment of cultural heritage sector in general. Nordic countries are relatively well equipped to deal with environmental and social crises, but even they may have to deal with increasing resource scarcity. Under such circumstances at least some cultural environments could be deemed as unnecessary luxury, especially if in need of costly protection and maintenance measures. On the other hand, societies tend to turn to their symbolic resources in times of crisis, striving to save them at whatever cost rather than to sacrifice them for immediate needs.

In addition to vulnerability and societal value, Nordic cultural environments may be categorised on the basis of their sustainability. Many of them are artificially maintained and thus highly energy-intensive, others are dependent on traffic or consumption. Palaces, intensively maintained historic gardens, pleasure grounds, Modernist residential areas, commercial centres, holiday resorts or entire sections of infrastructure would need to undergo energy repairs, management changes or refitting for new uses or alternatively risk falling out of grace. Wasteful user behaviour could turn even modest traditional buildings or communities unsustainable. There is no simple way to draw a line between sustainable or unsustainable cultural environments, but substantial empirical research would be needed, taking into account their full life cycle and sustainable management prerequisites.

At least some Nordic cultural environments can play a crucial part in climate change mitigation. Conservation of built heritage offers an example for contemporary building and planning, treating existing building stock as embodied energy and minimising interventions. Traditional building and planning methods may be regarded as a toolbox for low-tech construction using locally obtained, cheap and lightly processed materials. The large-scale applicability of such methods would however need more investigation, as would the user skills required for living in traditionally built environments. Without this the actual effectivity of cultural environments in mitigation is hard to estimate or prove.

A central outcome from the CERCMA expert meeting was the importance of sectorial co-operation. This was seen as a two-way process, in which the cultural heritage sector needs to fully acknowledge the climate policy goals but the protection

of cultural heritage should be mainstreamed into them at the same time. The current experience in many countries was that cultural environments were largely absent from national climate policies. On the other hand, a number of climate strategies maintain that the more resilient a society, the better its capacity to deal with climate change, and well-maintained built environments significantly contribute to resilience. In addition to that, neglecting symbolically important heritage could prove counterproductive by undermining the legitimacy of climate policies.

New kinds of evaluation models, tools and indicators would be needed to develop a strategic response to climate change within the Nordic cultural heritage sector. Limited resources might lead to contingency-type planning, which would have to be based on robust and transparent prioritising of cultural environments. Money-based valuation models were presented as a possible option for this, studying of societal value could offer another one.

On the other hand, cultural environment protection must be seen in the context of the profound change taking place in the societies of the Anthropocene. To fully fathom it, cultural environment attitudes, experiences and user behaviour would need to be studied from cultural historical, anthropological and psychological angles. It is also worth reminding that the reviewing of cultural heritage policies and evaluation systems cannot happen solely within the realm of experts but must be brought into public discussion.

A concrete short-time goal for Nordic co-operation in the cultural heritage sector is the comparison of methods, datasets and good practices that relate to cultural environments and climate change in each country and the transfer of research knowledge. The next step should consist of joint studies on energy performance in historic buildings and built environment, on the applicability of traditional building and planning methods in contemporary construction, on cultural heritage evaluation models as well as on comparative user studies in different cultural environment types. The joint development of GIS and visualisation solutions for cultural heritage and climate data would be an acute question in regard to general awareness raising and public engagement.

Specific cross-boundary climate agendas could be created for geographic areas similarly exposed to the effects of climate change and to those of mitigation and adaptation. Most Nordic coastal areas have to cope with the same kind of risk profile, forested and cultivated areas share likewise common challenges, as do Arctic and mountainous areas. A cross-tabulation of areal threats to cultural environments with their estimated economic and societal value, vulnerability and sustainability could help in determining areal foci, priorities and needs for urgent action as well as long-term planning.