



Climate change adaptation of major infrastructure projects

Country report for Sweden

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Note for the readers of the printed version: the present country report links to a large number of resources via hyperlinks, which by nature are only active in the electronic version. In order to find the identified resources, an online search will usually deliver the right result; but otherwise it is also possible to make use of Annex II of the main report where all the identified resources and their hyperlinks are presented.

Disclaimer: The identified resources are non-exhaustive and present a snapshot of the readily available and accessible material during 2017. This information was collected through finite web-based desk research, and through questionnaires and interviews aimed at the relevant national competent authorities (ESIF managing authorities, research institutes, ministry officials, etc.). Further resources might be available but not accessible due to privacy restrictions, or a lack of mandate to share related material. Following the publication of the present report, more resources will continue to reach the public domain, including through Climate-ADAPT and the identified national websites.

1. INTRODUCTION

The [EU Strategy on Adaptation to Climate Change](#) of 2013 includes actions to enhance the resilience of infrastructure and mainstream climate adaptation into the European regional and cohesion policy. The [Common Provisions Regulation](#) (CPR) of 2013 states under article 8 that climate change mitigation and adaptation, and risk prevention shall be taken into consideration for investments made with the support of the European Structural and Investment Funds (ESI Funds). The regulation integrates climate change adaptation considerations into the preparation and approval of major projects¹ or other projects funded by the ESI Funds through the requirement to conduct climate change vulnerability and risk assessments. In coordination with the ESI Funds, and complimentary to them, the LIFE fund in addition assists in the realisation of the climate change adaptation objectives. Climate change analyses (such as vulnerability and risk assessments) are also sporadically found to be undertaken for infrastructure projects that are financed outside the framework of EU funds.

This report for Sweden focuses on the adaptation to climate change of infrastructure projects supporting the requirement to undertake climate change vulnerability and risk assessments by presenting:

- **Legal, policy and institutional framework:** A schematic outline of national and regional policy and legal framework, and organisational structure to deal with adaptation;
- **Resources:** Offering the most important resources supporting the realisation of climate change vulnerability and risk assessments for infrastructure projects. The available resources for data, methodologies, tools, guidance, design standards, system framework and institutional capacity are contextualised and listed in this section.
- **Sector overview:** Identifying the approach, main strengths and weaknesses for each of these sectors: Transport, Broadband, Urban development, Energy, Water and Waste;
- **Case studies:** Current practice in adaptation and resilience of infrastructure projects.

Country Overview

The Swedish Climate Change Adaptation policy is defined at the national level by the [Ministry of the Environment and Energy](#), which is responsible for the environmental, energy and climate policy of the Government. There is no individual organisation with the primary responsibility for climate change adaptation in Sweden. In 2013 it was established that each county government must carry out surveys of how local regions are working to adapt to climate change, and that they must [develop action plans](#) for climate change adaptation and perform a follow up review. In June 2017, Sweden passed [legislation](#) stating that each county government has an obligation to pursue a climate policy based on the climate goals adopted by the Parliament (Riksdag). An [Action Plan](#) for climate change adaptation is being developed. A white paper, '[Climate Change Adaptation in the Nordic Countries](#)' (2013) by Norden defines the concept, barriers and reviews current climate adaptation policy in Europe and identifies key element for a Nordic Adaptation Strategy. An [Implementation and Evaluation of the Swedish National Adaptation Strategy](#) by [SMHI](#) has evaluated the progress of the Programme, whilst outlining the responsibilities and contribution of national authorities, municipalities, Swedish administrative boards, National Centre of Climate Adaptation and other decision makers towards development, implementation and evaluation of the [NAS](#). The

¹ major project: an operation comprising a series of works, activities or services intended in itself to accomplish an indivisible task of a precise economic or technical nature which has clearly identified goals and for which the total eligible cost exceeds EUR 50 000 000 and in the case of operations contributing to the thematic objective under point (7) of the first paragraph of Article 9 of Regulation 1303/2013 where the total eligible cost exceeds EUR 75 000 000

presentation explains in detail the EU climate change adaptation process, lists various Swedish climate adaptation initiatives and Swedish regional adaptation action plans.

All the necessary resources are available to support climate adaptation. The [Swedish Portal for Climate Change Adaptation](#) contains information about the effects of climate change, risk management and guidance for the development of an adaptation plan. This portal summarises Sweden's work with climate change adaptation, ranging from information on roles and responsibilities, best practice, case studies, tools and to function as a hub with links to the various Swedish agencies' and bodies' own databases, strategies, tools, etc. The [Swedish Meteorological and Hydrological Institute \(SMHI\)](#) provides a large amount of data in open access format on climate and the environment, both historical data and future projections. The [Swedish National Knowledge Centre for Climate Change Adaptation](#), based in SMHI, provides tools, [open data](#), and [industry-specific services](#). The Centre collects, develops and shares research, information from authorities and learning examples to facilitate sound decision making. With the help of funds that are being distributed by the Government, [SMHI](#) will develop an [Action Plan](#) for climate change adaptation. [National Geotechnical Institute](#) (SGI) has also developed a methodology for ensuring [sustainable development of coastal areas](#) where there is a risk of erosion, ravages and floods. Methodologies that support climate adaptation are available. The [Swedish Agency for Marine and Water Management](#) published a [document](#) on water and wastewater planning at municipality level, the [National Geotechnical Institute](#) (SGI) has also developed a methodology for ensuring [sustainable development of coastal areas](#), while a methodology is also available from the [Blue Spot Project](#) that provides for a comprehensive risk analysis of the road transport system with emphasis on serious physical hazards. A national study² of the [climate and vulnerability survey \(2007\)](#) was carried by the Government in 2015. This study outlined that, despite awareness of how climate change affects various sectors increasing, there is still a need for sufficient framework guidelines in relation to climate change adaptation. At a [regional](#) level, the Government in 2013 stipulated that each county administration must compile, account for and perform comparisons of what climate change adaptation actions are being taken at a local level in the municipalities. Also included on [Klimatanpassning](#) are [various publications](#) on how to perform cost-benefit analyses within various infrastructure projects. There are no specific design standards available relevant to climate change adaptation in Sweden. EU resources are in use, such as the [Guide to Cost-Benefit Analysis of Investment Projects](#), the publication on [Climate Change and Major Projects](#) and the non-paper [Guidelines for Project Managers](#).

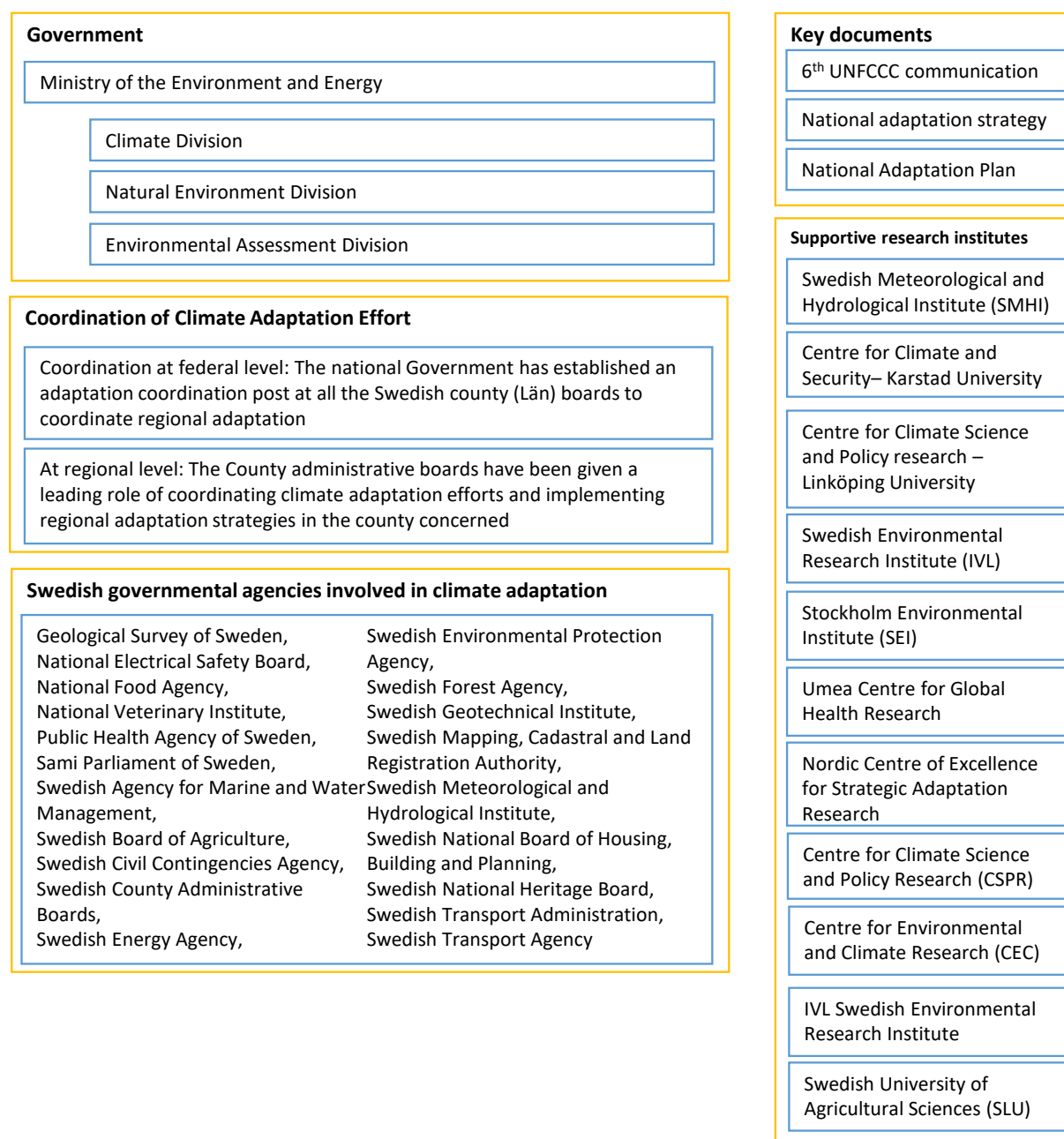
Infrastructure sectors are undertaking steps towards climate adaptation. In 2008, the government mandated the Swedish Transport Agency to perform a vulnerability survey on railway tracks which have changed, due to the worsening conditions of climate change. The [Blue Spot Project](#) study developed instructions to create a homogeneous method for the inventory and analysis of serious physical dangers for roads. A [vulnerability survey \(2008\)](#) for railway tracks is available, and Gothenburg and Norrköping have [integrated green structures \(2016\)](#) around tram tracks. In the urban development sector, various tools and guidance related to urban development can be located on [Klimatanpassning](#) such as [Show Adapt](#) and [Geokalkyl](#) – a tool where it is possible to compare costs for different alternative investments of buildings and infrastructure. [SGI](#) has developed a methodology for ensuring [sustainable development of coastal areas](#) where there is a risk of erosion, ravages and floods. Within the energy sector, a study on [adaptation to climate change among electricity distribution companies in Norway and Sweden](#), identified that companies have a higher awareness to vulnerability to climate change and have undertaken some adaptation actions. The water sector is presenting a number of initiatives to adapt to climate change. [SGI](#) provides a [tool](#) that the emergency water services can use in the event of imminent danger of race, slurry, sludge and chemical spill in sensitive land, and the report ['A Safe Drinking Water Supply' \(2016\)](#) produced a number of recommendations on adaptation actions. Following

² 'Skrivelsens huvudsakliga innehåll'

the EU Floods Directive 2007/60/EC, Sweden has performed flood risk assessments and elaborated [flood hazard and risk maps](#) and [flood risk management plans](#). Waste is to some extent covered by the [Swedish Environmental Protection Agency](#) but there are few specific guides, tools or other instruments for the waste sector that could assist in addressing climate adaptation. The [Swedish Agency for Marine and Water Management](#) published a [guidance document](#) on water and wastewater planning at municipality level.

Three case studies that demonstrate how climate change adaptation is being incorporated into infrastructure projects have been highlighted: an embankment protect against future flooding in [Kristianstad](#), a [green roofs project in Malmo](#) and the identification of [flood-sensitive sections in the road network](#).

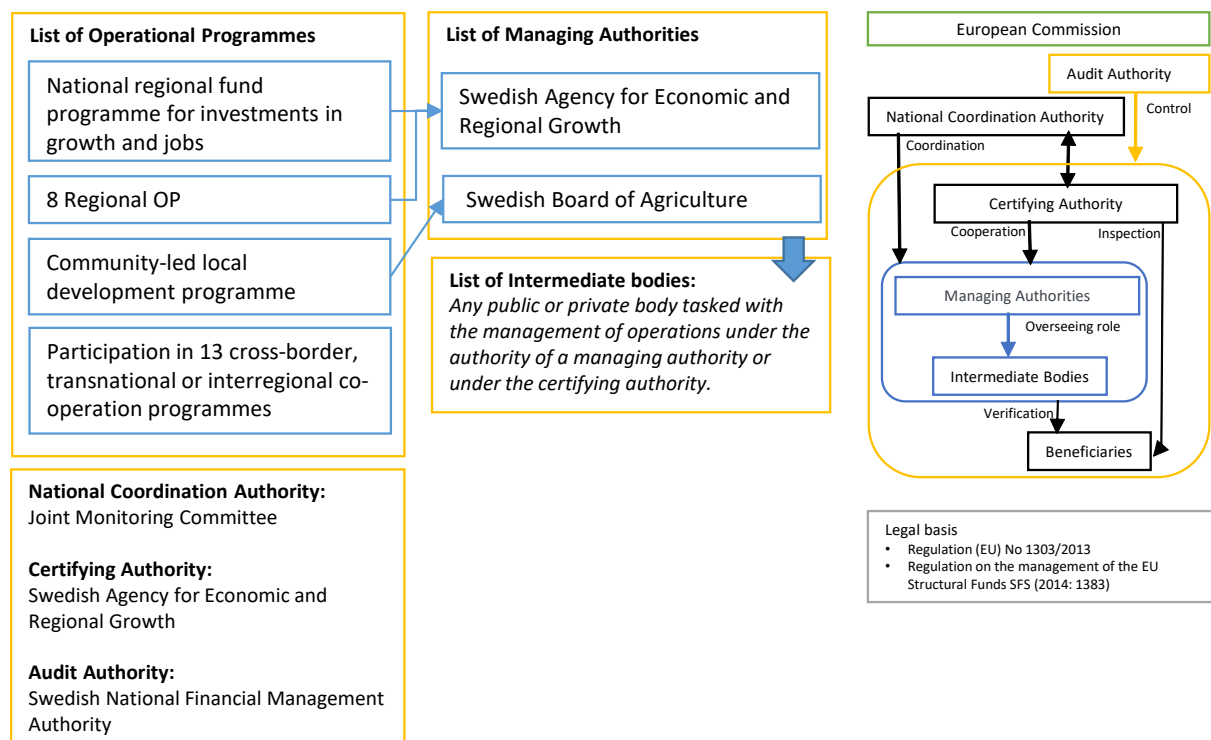
2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK



The roles and responsibilities of climate change adaptation in Sweden are divided across different levels – from local and regional to national. Various central agencies in Sweden

share the overall responsibility by being responsible for their respective sectors (see [organisational structure](#)), with no individual agency having overall responsibility for climate change adaptation. The [Ministry of the Environment and Energy](#) is responsible for the environmental, energy and climate policy of the Government. The Ministry works on issues concerning the climate, energy, biological diversity, chemicals, nature and forest conservation, marine and water environments, radiation safety and international environmental cooperation.

In 2013 it was established that each county government must carry out surveys of how local regions are working to adapt to climate change, and that they must [develop action plans](#) for climate change adaptation and perform a follow up review. This was followed by an [investigation](#) by the [SMHI](#) into vulnerabilities of climate change adaptation in Sweden. The investigation among other things pointed towards an inefficient organisational structure and unclear roles and responsibilities. Following this, a recommendation to analyse national roles and responsibilities was established. In June 2017, Sweden passed [legislation](#) stating that each county government has an obligation to pursue a climate policy based on the climate goals adopted by the Parliament (Riksdag). Each government must also clearly report on the progress of its efforts. This is intended to ensure that Sweden will have long-term climate goals beyond 2020. The legislation also provided for the creation of an independent Climate Policy Council, tasked with evaluating whether the direction of various relevant policy areas will increase or reduce the likelihood of achieving the climate goals. The reform is a central component of the country's efforts to comply with the Paris Agreement. The framework is intended to provide the long-term conditions for business and society to implement the transition needed to adapt to climate change.



The National Network for Adaptation, which is administrated by SMHI, meets several times a year and aims to facilitate horizontal coordination between national governmental bodies. One of the projects currently ongoing is to coordinate and improve the provision of spatial data that can be of use to planners working on adaptation. This means that climate change adaptation is also mainstreamed and integrated into the work of specialised government agencies.

The Swedish Environmental Protection Agency has developed an action plan with the aim of integrating the perspective of a changing climate in the agency's ongoing work on

biodiversity so that measures and tools are appropriate. Action plans with similar aims has been or are in the process of being developed by several other sectors too.

At the regional level, the County Administrative Board (CABs) have their own coordination network. This network also aims to facilitate coordination of adaptation, but at the regional level. At the municipal level, the Swedish Association of Local Authorities and Regions (SKL) also has its own adaptation network, which gathers municipalities. The aim is to support municipalities in their adaptation work, and to provide a forum for dialogue and exchange of experiences.

In Sweden, ERDF is mainly absorbed through Operational Programmes managed by the Swedish Agency for Economic and Regional Growth.

3. RESOURCES

This country report has reviewed the currently available resources in Sweden for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis³ for ESIF-funded projects, through the processes of vulnerability and risk assessments which are, broadly:

1. Vulnerability – evaluating the sensitivity and exposure of infrastructure to climate change
2. Risk – estimating the likelihood and impact of relevant climate hazards
3. Adaptation - consideration of adaptation options and integration into the project planning

The legal requirements for major projects also foresee climate change mitigation. This study however is focused on climate change adaptation and does not cover mitigation aspects.

Information on the requirements for climate change adaptation is available in the 2016 publication [Climate Change and Major Projects](#), and details on the methodology of climate resilience analysis is provided in the 2017 JASPERS publication [The Basics of Climate Change Adaptation, Vulnerability and Risk Assessment](#). Further resources are being identified in the present publication and its references. Effective vulnerability and risk assessments for the adaptation of major projects to climate change require the resources explained in the following table:

Resources	Explanation
Data Availability	The availability, accessibility and applicability of data on climate projections and impacts, on past and historic events, on geophysical parameters, on long-term scenarios, on economic, environmental and social impacts, etc.
Methodologies	The existence of quantitative or qualitative methodologies (a system of processes, a set of principles and rules) for integrating climate change adaptation in the development of infrastructure projects.
Tools	The availability of tools for planning, evaluation, impact estimation (i.e. software, maps, computer simulations, long term climate forecasts etc.) to assist with the adaptation of infrastructure to climate

³ Regulation (EU) No 1303/2013, Commission Delegated Regulation (EU) No 480/2014, Commission Implementing Regulation (EU) No 1011/2014, No 215/2014, 2015/207; and the Directives 2001/42/EC, 2011/92/EU and 2014/52/EU

	impacts
Guidance	The provision of guidance on how to use methodologies (i.e. for conducting climate change vulnerability and risk assessments) or develop the required infrastructure project documentation relating to climate adaptation.
Design Standards	The availability of published engineering design standards (i.e. by BSI, DIN, ISO) for infrastructure projects that include sections or appropriate provisions to ensure resilience to climate change impacts
System	The institutional and legal framework that the formal authorities work with to deliver their primary responsibilities for climate adaptation, infrastructure, and management of European Structural and Investment Funds
Institutional Capacity	The human and technical capacity of institutions to carry out their functions. It depends on being adequately resourced, on having the appropriate expertise, and on collaborating effectively and enforcing laws and regulations

3.1. Data Availability

Quantitative data are essential to understand the relevant risks and the requirements for any corresponding climate change adaptation in key sectors. [Klimatanpassning](#) contains information about the effects of climate change, risk management, and how an adaptation plan can be developed. This portal summarises Sweden's work with climate change adaptation, ranging from information on roles and responsibilities, best practice, case studies, tools and to function as a hub with links to the various Swedish agencies' and bodies' own databases, strategies, tools, etc.

The [Swedish Meteorological and Hydrological Institute \(SMHI\)](#) provides a large amount of data in open access format on climate and the environment, both historical data and future projections. They regularly disseminate climate change indicators and projections via their web portal, along with a list of [cases](#) from various municipalities and local projects. In 2012, they launched a heat wave warning system after the observation that prolonged spells of warm weather have seen increased mortality rates across the country. An example of this is the Geological Survey of Sweden's bedrock database. SMHI and 19 other national government agencies, including the Swedish Environmental Protection Agency, the Swedish Civil Contingencies Agency, the Swedish Geotechnical Institute and the National Board of Housing, Building and Planning and in cooperation with Sweden's municipalities and county councils jointly runs the web portal for adaptation. The portal contains information about the effects of climate change, risk management, how an adaptation plan can be developed and examples of how climate change adaptation can be integrated in daily work.

Regional climate change analysis for all 21 Swedish regions was carried out during 2015. The reports include scenarios for about 15 climate indexes with the future development in comparisons between the past and the situation today. The scenarios are also available as national geographic information layers in an open accessible database. During 2016, all regions have had the offer of an applied on-location presentation of the report for their region, together with SMHI scientists.

There are several interdisciplinary research programmes. Three examples are:

- [Mistra Urban Futures](#) is a centre for sustainable urban development. It provides an arena for the development and transfer of knowledge, where interaction with

industry, interest groups and the general public will be developed. In addition to the arena, the Centre has five regional platforms in Cape Town, Kisumu, Gothenburg, Manchester and Shanghai.

- [Mistra-SWECIA](#) is an interdisciplinary research programme on climate, impacts and adaptation. The programme brings together researchers in the fields of climate science, economics, life sciences and social sciences. Since 2008, Mistra-SWECIA has deepened our understanding of how research on climate change, its impacts and economic implications can support stakeholders. The programme was completed in 2015.
- [BECC](#), Biodiversity and ecosystem services in a changing climate, is a strategic research field where the universities of Lund and Gothenburg collaborate. The vision is to create a leading interdisciplinary research programme on the relationships between climate, ecosystem services and biodiversity

There are many research institutions with activities within the field of adaptation: The [Swedish National Knowledge Centre for Climate Change Adaptation](#), based in SMHI, provides tools, [open data](#), and [industry-specific services](#). The Centre collects, develops and shares research, information from authorities and learning examples to facilitate sound decision making. Other relevant research institutions identified include the [Centre for Climate and Security](#), the [Centre for Climate Science and Policy Research](#) (CSPR), and the [Centre for Environmental and Climate Research](#) (CEC).

The [Swedish Agency for Marine and Water Management](#) is responsible for recording climate variables monitored for EU strategies such as the [Marine Strategy Framework Directive](#) and [Water Framework Directive](#). These include [data](#) related to oceans, lakes and groundwater. The agency finances [systems](#) that hold information on the groundwater and surface water status.

[Geodata](#) specialises in environmental data analysis. The application facilitates access to geodata from different actors. The geodata portal is the entrance for search, find and view geodata from multiple government agencies and organisations. A Database of natural disasters is kept by the Civil Contingencies Agency, but does not contain information about costs. Some monitoring on economic impacts is carried out by the industry association for insurers, Swedish Assurance.

[Statistics Sweden](#) (SCB) is the leading state authority on statistics, maintaining a national database of statistics relating to the economy, society and the environment. The exact content of this database was not examined in the context of the present study.

The quality of climate data in Sweden relies on the quality of climate projections (i.e. physical processes, emission scenarios etc.). SMHI's Rossby Centre presents climate [scenarios](#) as maps, as diagrams and as downloadable data, with scenarios extending to 2100. There is also information explaining the results and the models on which they have been based. An introduction to climate scenarios is available (in Swedish) as well as guidance (in Swedish) that provides support for interpreting and using climate scenarios.

[NORD-STAR, the Nordic Centre of Excellence for Strategic Adaptation Research](#) offers state-of-the-art climate visualisation techniques and policy analysis tools to help bridge the gaps between adaptation science, practice and policy, and an explicit link between climate adaptation and mitigation. The NORD-STAR consortium consists of nine core partners from the five Nordic countries: Aalto University, Aarhus University, Chalmers University of Technology, and Institute for Research in Economics and Business Administration, Linköping University, the Norwegian University of Science and Technology, ProjectZero, the Stockholm Environment Institute, the University of Iceland, and Umeå University.

Sweden's [Seventh National Communication](#) to the United Nations Framework Convention on Climate Change (UNFCCC) also provides long-term climate change assessments across a range of sectors, with scenarios on risk and vulnerability by sector.

Updates for a wide range of national adaptation actions, can be found in the [National adaptation actions deliveries database on EIONET](#), and on the [Climate-ADAPT](#) website. There are also a number of sector-specific information portals and websites, for example the [Flood portal](#) and the map service for [landslides and erosion](#)

3.2. Methodologies

Methodologies for integrating climate change adaptation into the development of infrastructure projects rely on the basic rules of risk assessment.

The [National Geotechnical Institute](#) (SGI) has also developed a methodology for ensuring [sustainable development of coastal areas](#) where there is a risk of erosion, ravages and floods. The method can be used as a basis for physical planning and climate adaptation for new buildings as well as for existing built environment. The [methodologies](#) employed vary between regions and on a case-by-case basis. No other country-specific methodologies that are applicable across Sweden were identified within the present study.

3.3. Tools

Tools are highly valuable for facilitating climate adaptation studies and planning for infrastructure. They can be public or private, numerical or descriptive, and be provided in many mediums, such as software, text documents, maps, and so on. Some tools are generic (such as in risk assessments) whilst others are specific to a certain set of circumstances.

A selection of tools for projects in various sectors and environments in the form of guides, checklists, method descriptions, maps and other visual aid tools are available on the [Swedish Portal for Climate Change](#).

A white paper, '[Climate Change Adaptation in the Nordic Countries](#)' (2013) by Norden defines the concept, barriers and review current climate adaptation policy in Europe and identifies key element for a Nordic Adaptation Strategy. It highlights Sweden climate adaptation research, reflected by its three major initiatives including [SWECLIM](#) (that developed regional climate scenarios), [Mistra-SWECIA](#) (research programme) and [Climatools](#).

[Climatools](#) was a collaborative project (various institutions, universities, and insurance companies, and county administrations, SALAR etc.) which involved developing a range of tools to assist municipalities working towards climate change adaptation. These tools assisted authorities in calculating adaptation costs, identify resulting benefits and managing conflicts. It assisted in adapting to the consequences of climate change, conduct cost-benefit analysis and conflict management. The programme resulted in eight tools for identifying and evaluating climate change consequences and consequences of adaptation actions. The tools can be combined, but are primarily set up to be used independently. The tools cover:

- Local climate effect profile;
- Integrate climate adaptation in municipal risk and vulnerability analyses;
- Checklist for health and social care;

- Guidance for evaluation of drinking water risks associated with climate change;
- Effects of heat;
- Use social economic scenarios in the climate change adaptation; and
- Sustainability analysis.

[Hållbarhetsanalys](#) is a support tool to identify environmental, social and economic consequences from integrating climate change adaptation actions. The tool can assist the decision maker to identify impacts within the sustainability dimensions.

[Räknesnurran](#) is a tool which quantifies and adapts to the consequences of heatwaves.

A web-based interactive tool, [Show Adapt](#) aims to make it easier for homeowners to assess potential climate-related risks that may affect their homes, and provide an overview of existing guidelines for adapting to climate change and extreme weather events;

[SGI](#) has developed a tool - [Geokalkyl](#) - where it is possible to compare costs for different alternative investments of buildings and infrastructure, taking into account both geotechnical conditions, impacts of climate change and possible soil contamination. [SGI](#) also provides a [tool](#) that the emergency water services can use in the event of imminent danger of rain, slurry, sludge and chemical spill in sensitive land. The SMHI also provides a [climate scenarios tool](#), where climate scenarios are presented on maps, as diagrams and as downloadable data.

[VisAdapt](#) is a tool that guides citizens on how to prepare for weather and climate related events that may affect private houses. VisAdapt is a science-based tool developed by researchers from Linköping University (Sweden), the Norwegian University for Science and Technology (NTNU) (Norway) and Aarhus University (Denmark), together with experts from the insurance industry, in the context of the NORD-STAR project.

EIONET provides [Flood Maps](#) which are publically available, mapping areas of potential significant flood risk. EIONET also contains Flood Risk Management Plans.

For a continual update of available tools, the reader is referred to the European Climate Adaptation Platform [Climate-ADAPT](#), which has a dedicated tools section.

3.4. Guidance

Guidance is an essential requirement to ensure consistency in applying methodologies and tools.

[Klimatanpassning](#) includes [various publications](#) on how to perform cost-benefit analyses within various infrastructure projects. In addition to this, [national investigations](#) which have been undertaken in relation to climate change adaptation are available.

At a [regional](#) level, the Government in 2013 stipulated that each county administration must compile, account for and perform comparisons of what climate change adaptation actions are being taken at a local level in the municipalities. They must assess the risk related to climate change, measures to be taken in terms of climate change adaptation, and then develop action plans for the guidance of local climate change adaptation work with regular progress updates. [Klimatanpassning](#) lists the performed work related to this on the following web links, containing information and links to the county administrations' action plans for climate change adaptation.

At a sector level, the [Swedish Agency for Marine and Water Management](#) has published a [guidance document](#) on water and wastewater planning at municipality level. The

government agency is responsible for the environmental monitoring efforts of marine and freshwater bodies, and has been involved in the development of a national water policy.

A national study ('[Skrivelsens huvudsakliga innehåll](#)') of the [climate and vulnerability survey \(2007\)](#) was carried by the Government in 2015. This study outlined that, despite knowledge and awareness of how climate change affects various sectors increasing since the climate and vulnerability survey, there is still a need for sufficient framework guidelines in relation to climate change adaptation.

The [SMHI](#) also outlined in its report deficiencies and uncertainties which create barriers for climate change adaptation, including unclear roles and a lack of structural organisation. The institute underlined the need of a national strategy for climate change adaptation, with adjusted laws and framework guidelines. Further, in the government documents, it states that in order to build a more climate resilient and durable community, municipalities and other actors must ensure that preventive actions are taken in order to limit the consequences of more frequent and severe weather incidents, such as physical planning and building. The document further mentions creating green infrastructure, resilient ecosystems and using [Lantmäteriet's National Elevation Model \(2016\)](#) in order to plan construction and communities in order to avoid damages due to floods.

3.5. Design Standards

Design standards are critically important for all infrastructure projects to ensure stability and optimal functioning under the strain of natural phenomena. For civil works (including bridges, buildings, masts and towers for the mobile access networks), EN standards are available to address natural forces such as wind and snowfall, e.g. EN1991-1-4 (Eurocode 1) and EN1993 (Eurocode 3) for structures in steel. However, these standards might be outdated and not account for the impacts of climate change.

The [Swedish Standards Institute](#) (SIS) is collaborating with the [European Standardization Organizations](#) in the context of the EU Regulation No 1025/2012 on European standardisation. The European Committee for Standardisation (CEN) and Electrotechnical Standardisation (CENELEC) established the [Adaptation to Climate Change Coordination Group \(ACC-CG\)](#) to coordinate standardisation work in the field of adaptation to climate change in support of the implementation of the EU Strategy on Adaptation to Climate Change. More information is available in the section on *Available resources at the EU level* in the Final Report of the present study (European Commission, 2018).

SIS has active working groups for all of the 13 short-listed standards for climate change adaptation. Sweden has been given the mandate to review the standard on thermal performance of buildings and building components (EN ISO 15927-4) and will commence phase 2 on 17 October 2017. While this standard is in focus, the various working groups will review and comment on all standards.

Further, the SIS has formed working groups and are currently working on drafts for standards for climate change adaptation within the following areas:

- ISO/TC 207/SC 07/WG 9 High Level Framework on Adaptation;
- ISO/TC 207/SC 07/WG 10 Investments, financing and climate change;
- ISO/TC 207/SC 07/WG 11 Vulnerability assessment; and
- ISO/TC 207/SC 07/WG 12 Adaptation planning.

More information is available in the section on *Available resources at the EU level* in the Final Report of the present study (European Commission, 2018).

3.6. System

The institutional system for adapting to climate change requires a legal framework (laws and implementing regulations) and strategies and policies (with implementing action plans). The system is usually conflated with disaster management (and its various components, preparedness, reduction etc.) and more generally with resilience.

Institutional and legal framework

Regarding the legal framework, the [2015 Global Climate Legislation Study](#) describes the legislative portfolio of Sweden for addressing the expected adverse effects of climate change in Sweden.

Climate change has been implicitly included in the Swedish Environment Code (1999), requiring that an Environmental Impact Assessment be carried out before permission can be given for an environmentally hazardous activity. In 2017 a revised law for [Environmental Impact Assessments](#) (EIA) was passed which stipulates that larger infrastructure projects must include assessments for climate change adaptation. The proposed entry into force is January 1, 2018. [SMHI](#), together with the [National Agency for Public Procurement](#) has been assigned by the Government to assess which (and how) data and information that needs to be monitored and provided to municipalities in public procurement in order to take into consideration climate change adaptation within [community planning and building](#).

The [Ministry of the Environment and Energy](#) is in the process of developing a new [National Strategy for Climate Change Adaptation](#), which will be developed within the next year before Government elections in 2018.

At the regional level, Climate impacts assessments studies have been carried out for all 21 regions; most of them were performed by the Swedish Meteorological and Hydrological Institute. All 21 regions have adopted regional action plans, covering the whole territory of Sweden with nearly 800 proposed actions. The main actions proposed in the plans concern flood protection, protection of drinking water, shoreline protection, infrastructure (roads, railways), adaptation of agriculture and forestry, resilience for heat waves and health care. A number of local authorities have also developed adaptation strategies or plans for their municipality, e.g., Stockholm, Malmö, and Växjö.

At sectoral level, several national authorities have developed, or are in the process of developing, action plans for the sectors for which they are responsible. The sectors that are addressed are related to critical societal functions: Biodiversity and ecosystem services, Fresh water supply (drinking water, sewage, effluent and storm water treatment), Health, Infrastructure (transportations, telecommunication), Rural businesses (agriculture, fisheries, forestry, reindeer herding, tourism), Technical supply systems (energy supply, hydroelectric dam security, heating and cooling), Urban areas (buildings and built environment, cultural heritage).

Sweden has a well-established and functioning framework for disaster risk reduction (DRR), including work in forums for crisis preparedness. The work is coordinated by the Swedish Civil Contingencies Agency (MSB).

Responsible authorities

The roles and responsibilities of climate change adaptation in Sweden are divided across different levels – from local and regional to national. On the national level, the [Ministry of the Environment and Energy](#) is responsible for the environmental, energy and climate policy of the Government. However, no national agency currently has the overall responsibility for climate change adaptation, which is shared amongst about 30 agencies. On the regional level, the county administrative boards are responsible for climate change adaptation at a regional level since 2009. On the local level, the role of the

municipalities includes several important activities in which adaptation can and should be integrated. According to several legislations, they are also authority practitioners in charge of supervision, control and permission granting. They handle environmental protection and nature conservation as well as the examination and surveillance of the Environmental Code. The municipal emergency management and civil protection are important features for the development of risk and vulnerability analyses of adaptation strategies. The responsibility includes both sectorised operational planning and physical planning.

Various agencies (national, regional, municipalities, citizens, academics, private sector etc.) monitor climate change adaptation in Sweden within their respective operational areas and cooperate through intermediary functions such as the climate change [portal](#). The Swedish governmental agencies behind the portal have joined in a common network to facilitate the national planning and implementation of climate change adaptation measures. These are the [Geological Survey of Sweden](#), the [National Electrical Safety Board](#), the [National Food Agency](#), the [National Veterinary Institute](#), the [Public Health Agency of Sweden](#), the [Sami Parliament of Sweden](#), the [Swedish Agency for Marine and Water Management](#), the [Swedish Board of Agriculture](#), the [Swedish Civil Contingencies Agency](#), the [Swedish County Administrative Boards](#), the [Swedish Energy Agency](#), the [Swedish Environmental Protection Agency](#), the [Swedish Forest Agency](#), the [Swedish Geotechnical Institute](#), the [Swedish Mapping, Cadastral and Land Registration Authority](#), the [Swedish Meteorological and Hydrological Institute](#), the [Swedish National Board of Housing, Building and Planning](#), the [Swedish National Heritage Board](#), the [Swedish Transport Administration](#), and the [Swedish Transport Agency](#). The Swedish Meteorological and Hydrological Institute ([SMHI](#)) provides a knowledge centre for climate change adaptation on behalf of Government and functions as the supervisor of this cooperation.

Management of the ESI Funds

Sweden has set up two national Operational programmes: the National regional fund programme for investments in growth and jobs, and the Community-led local development programme. Additionally, it is participating in eight regional Operational Programmes, and in 13 cross-border, transnational or interregional co-operation programmes. The Managing Authorities for the national and regional programmes are the Swedish Agency for Economic and Regional Growth, and the Swedish Board of Agriculture. For the management of these funds, the coordination authority is comprised by the Joint Monitoring Committee; the Certifying Authority is the Swedish Agency for Economic and Regional Growth; and the Audit Authority is the Swedish National Financial Management Authority.

3.7. Institutional Capacity

The institutional challenge for climate change adaptation is that climate policy is a cross-cutting issue, and requires co-operation across a large number of institutions. To be effective in delivering climate change adaptation a minimum level of capacity is needed on leadership, technical and human resources, effective collaboration, and financial support.

Technical and human resources

An [Implementation and Evaluation of the Swedish National Adaptation Strategy](#) by [SMHI](#) has evaluated the progress of the Programme, whilst outlining the responsibilities and contribution of national authorities, municipalities, Swedish administrative boards, National Centre of Climate Adaptation and other decision makers towards development, implementation and evaluation of the [NAS](#). The presentation explains in detail the EU climate change adaptation process, lists various Swedish climate adaptation initiatives

and Swedish regional adaptation action plans. The [SMHI](#) survey facilitated practical actions, such as providing regional Governing bodies responsibility for climate change adaptation, and also the development of a National Climate Adaptation Strategy.

Persons from responsible agencies interviewed for the present study identified that while climate change adaptation is becoming an increasingly important question, it is not matched by a similar increase in human resources in several national agencies, county governments and municipalities.

Effective collaboration

Several Swedish governmental agencies have joined in a common network to facilitate the national planning and implementation of climate change adaptation measures. The main purpose of the agency network is cooperation to increase society's resilience against climate change. Each of the participating governmental agencies have responsibility for adaptation to climate change within their respective areas of expertise. By dedicating specific working groups to different climate effects the network is able to deliver common, joined-up services to the parts of society that are carrying out adaptation activities.

The Swedish Meteorological and Hydrological Institute (SMHI), has been commissioned to create a national knowledge centre for climate change adaptation, in which the [climate adaptation portal](#) operates as a tool for disseminating information. The purpose is to collect updated knowledge about vulnerability and climate change adaptation. One important aspect is to provide good examples and thereby make it easier to practice adaptation at local and regional level. Twenty governmental agencies are involved in the network and the portal. Each of the participating governmental agencies have responsibility for adaptation to climate change within their respective areas of expertise. By dedicating specific working groups to different climate effects the network is able to deliver common, joined-up services to the parts of society that are carrying out adaptation activities.

Financial resources

The [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming. Concerning major projects, by early 2018, there have been no funds allocated for major projects in Sweden for the 2016 -2020 programming period according to the datasets of the European Commission. The [data set will be updated regularly](#) to reflect changes in the programme lists and major project notifications. Further information on the financing of national climate adaptation measures from national funds, has not been found.

According to the [ESIF-viewer](#), Sweden is planning investments of 1.97 Billion EUR, with 113 Million EUR approved for Network Infrastructures in Transport and Energy (Thematic Objective 7); 45 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6); and 95 Million EUR for Information and Communication Technologies (Thematic Objective 2). The shares within these Thematic Objectives that may relate to climate adaptation are unknown.

4. SECTOR OVERVIEW

4.1. Introduction

Since 2014, the requirements for major projects to obtain ESIF funding⁴ demand that project applications integrate climate change considerations⁵, such as a vulnerability and

risk analysis and adaptation option appraisal. At EU-level, material is available to assist in fulfilling these requirements. Key websites and documents are:

- The [Climate-ADAPT](#) website containing many links to data and a [map viewer](#)
- EUROPEAN COMMISSION Directorate-General for Regional and Urban policy: The [Guide to Cost-benefit analysis of Investment projects](#) (also referred to as the 'CBA guide')
- EUROPEAN COMMISSION DIRECTORATE-GENERAL CLIMATE ACTION: [Non-paper of Guidelines for Project Managers: Making vulnerable investments climate resilient](#)
- JASPERS Guidance note: [The Basics of Climate Change Adaptation, Vulnerability and Risk Assessment](#)
- JASPERS Guidance note: [An overview of the most important sources for integrating climate change in \(major\) projects](#)

Additional relevant material can be found in the Final Report of the present study (European Commission, 2018) in the section *Available resources at the EU level* and in *Annex I*.⁶

4.2. Transport

Investments in the transport sector are very diverse, covering roads (including bridges and tunnels), inland waterways, rail, ports / airports, and public transport infrastructure. Any disruption caused in this sector can affect many other sectors (economic and societal) directly. Potential threats are sea-level rise and extreme weather events, such as extended heatwaves, flooding, heavy rainfall or storm, and landslides amongst others. Extreme weather events are a potential threat to both infrastructure and operation of the transport system.

The [Swedish Transport Agency](#), in collaboration with a number of other agencies within the transport sector, developed a proposal on a [national transportation development plan \(2011\)](#) for 2010-2021. The plan outlines investments and strategies, but climate related issues discussed mainly focus on emissions.

Road infrastructure

In 2005, the Swedish Road Administration developed instructions to create a homogeneous method for the inventory and analysis of serious physical dangers along a chosen road stretch. The instructions contain a methodology for a comprehensive risk analysis of the road transport system with emphasis on serious physical hazards. This study was referred to as the [Blue Spot Project](#).

[Kalantari et al.](#) (2014) developed a method for mapping flood hazard along roads. Instead of using advanced hydrological models, readily available parameters are used that reflect topography, soil type and land use (e.g. catchment elevation (mean), topographical wetness index, road density, soil properties, etc.). The method represents

⁴ http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm

⁵ For a compilation of the climate change requirements for major projects in 2014-2020, see: <http://www.jaspersnetwork.org/plugins/servlet/documentRepository/displayDocumentDetails?documentId=401>

⁶ European Commission (2018) Climate change adaptation of major infrastructure projects. A stock-taking of available resources to assist the development of climate resilient infrastructure. Final report.

a straightforward way to estimate flooding hazards when planning new roads or maintaining existing roads.

Railway infrastructure

In 2008, the government mandated the [Swedish Transport Agency](#) to perform a [vulnerability survey \(2008\)](#) on railway tracks which have changed bearing due to the worsening conditions of climate change, such as increasing ground frost and groundwater.

In addition, several cities are working actively to increase the number of green structures. Cities with trams, such as Gothenburg and Norrköping have [integrated green structures \(2016\)](#) around tram tracks, which improves the ability to deal with surface runoff and storm water.

Airport infrastructure

In 2008, the government mandated the [Swedish Transport Agency](#) (the "Agency") to perform a [vulnerability survey \(2008\)](#) investigating the need of advance planning to renovate airports' surface/storm water systems due to increased rainfall. Ground frost was viewed as not having a significant impact on existing infrastructure, whereas surface/storm water systems were deemed to be sufficient and able to manage slight increases of water levels. However, it was concluded that future increases will lead to capacity issues. It was estimated that half of the airports must be renovated within 20 years due to aging systems, to a cost of c. SEK 100m.

4.3. Broadband

The International Telecommunication Union has issued the recommendation L.1502 "[Adapting information and communication technology infrastructure to the effects of climate change](#)" for the purpose of identifying climate threats and their impact. L.1502 supports resilience by design in identified risky areas, and proposes changes to equipment installation standards to ensure protection from more frequent extreme weather phenomena and their impacts. The European broadband sector standardisation bodies have not prepared vulnerability assessment and risk management framework for dealing with climate change in broadband projects

The European Regional Development Fund (Regional Fund) has a total of approximately SEK 600 million, which is intended to be used to support broadband investment in the form of local networking. Telecommunications in Sweden, with overhead lines and masts, will be affected by climate change. The main effect will be a higher risk of wind-throw damage owing to reduced extent and duration of frozen ground.

For civil works (e.g. masts and towers for the mobile access networks), EN standards are available to address wind and snowfall, e.g. EN1991-1-4 (Eurocode 1) and EN1993 (Eurocode 3) for structures in steel. But these standards don't take climate change into account. CEN-CENELEC is currently working on adapting a number of EN standards to climate change. See Final Report of the present study (European Commission, 2018) for more information in the section on *Available resources at the EU level*.⁷

It is a general best practice for operators to use flood mapping information from environmental agencies to safeguard new planned data centres from flooding.

⁷ European Commission (2018) Climate change adaptation of major infrastructure projects. A stock-taking of available resources to assist the development of climate resilient infrastructure. Final report.

With regards to EU funding of Sweden's broadband infrastructure, there is comprehensive guidance provided in '[European Funding for Broadband 2014 – 2020](#)'. This report states that European Structural and Investment Funds are the largest EU public funding source that supports broadband investment. The report also states that the 2014 - 2020 total budget for broadband deployment in Sweden is approximately €235 Million.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.4. Urban Development

Investments in the urban development sector include site developments (industrial and other), urban planning, local infrastructure, building projects (such as hospitals, schools), and much more diverse projects. Cities have a unique position to analyse and respond to local impacts and vulnerabilities, such as heat island effects, which depend on the specific layout of a city, its green spaces, and numerous other factors. Cities can actively support the uptake of climate change adaptation in infrastructure projects through, for instance pilot projects, and can initiate dedicated infrastructure projects to improve their resilience to climate change.

Various tools and guidance can be located on [Klimatanpassning](#). Tools related to urban development include:

- A web-based interactive tool, [Show Adapt](#) aims to make it easier for homeowners to assess potential climate-related risks that may affect their homes, and provide an overview of existing guidelines for adapting to climate change and extreme weather events;
- The [National Geotechnical Institute](#) (SGI) has developed a tool - [Geokalkyl](#) - where it is possible to compare costs for different alternative investments of buildings and infrastructure, taking into account both geotechnical conditions, impacts of climate change and possible soil contamination; and
- [SGI](#) has also developed a methodology for ensuring [sustainable development of coastal areas](#) where there is a risk of erosion, ravages and floods. The method can be used as a basis for physical planning and climate adaptation for new buildings as well as for existing built environment.

Waterfront development, which is already often exposed to flooding, will be subject to particular risk in a changed climate. Owing to increased precipitation, floods are expected to become more frequent, especially in western and south-western Sweden. Following [Olsson & Foster](#) (2013), flooding problems caused by heavy downpours are expected to grow throughout the country. Areas not subject to flood risk at present may thus be affected in the future. In the long term, problems caused by the rising sea level may hit coastal towns in southern Sweden ([Bergström](#) 2012). A warmer and damper climate increases the risk of damp and mould in buildings.

Malmö's work on [adapting buildings](#) for climate change is well advanced. Some of the city's buildings have been given green roofs to help manage the impact of climate change.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.5. Energy

Project investments in the energy sector are related to power generation infrastructure, energy distribution networks and energy storage (e.g. through hydropower). Potential impacts of climate change on energy infrastructure may include increased damage to power generation plants or problems with energy provision and [dam safety](#), leading to black-outs or other disruptions. Disruptions in the energy sector can have large impacts on different sectors due to the increasing dependency on (electric) power provision for all kind of operational systems such as water supply (pumping installations, ...), the food system (transport, cooling), transport (electrified vehicles, dynamic traffic information), etc.

The following guidance is sourced from Sweden's [6th National Communication to the UNFCCC](#): *Energy requirements are expected to decrease due to milder winters, however excessively windy conditions and icing may, cause problems through increasing the impact on security of supply in the energy sector. In the hydropower industry, heavy rains may cause dam bursts with large-scale repercussions for consumers.*

T.H. Inderberg and L.A. Løchen (2011) studied [adaptation to climate change among electricity distribution companies in Norway and Sweden](#), where companies have a higher awareness to vulnerability to climate change and have also made adaptations. The Swedish regulatory scheme has not moved towards the direction of cost efficiency and this leaves a larger room for adaptation in the Swedish companies. The policy implications of the findings are that in order to encourage adaptation, regulatory models will have to allow for other considerations than economic efficiency, as well as include incentives for adaptation.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.6. Water

Investments in the water sector are linked to efficient water supply (including reduction of leakage), wastewater treatment and water reuse as well as the implementation of [River Basin Management Plans \(RBMP\)](#) to ensure integrated water management at the river basin scale. Important threats are linked to water quantity (droughts and floods) as well as quality (water pollution). Climate change can have an impact on both water quantity and quality. Following the EU Floods Directive 2007/60/EC, Member States are obligated to perform flood risk assessment and to elaborate [flood hazard and risk maps](#) and [flood risk management plans](#). Flood risk maps include the history of floods and climate scenarios. Member States also need to take climate change into consideration when developing RBMP. A [Guidance document on adaptation to climate change in water management](#) is available to ensure that the RBMP are climate-proofed. [Evaluations of the RBMP and FRMP](#) are also available on the EC website.

According to Sweden's [6th National Communication to the UNFCCC](#) climate change will affect the supply of drinking water, and water supply in general; disperse contaminants thus exacerbating the risk of waterborne infection and viruses spreading; cause landslides; increase the risk of saltwater intrusion into water sources; overload drainage pipes, leading to large-scale overflows of wastewater in sewage works, thereby elevating environmental and health risks.

The [Swedish Agency for Marine and Water Management](#) published a [guidance document](#) on water and wastewater planning at municipality level. The government agency is responsible for the environmental monitoring efforts of marine and freshwater bodies, and has been involved in the development of a national water policy.

[SGI](#) provides a [tool](#) that the emergency water services can use in the event of imminent danger of rain, slurry, sludge and chemical spill in sensitive land.

The published report '[A Safe Drinking Water Supply](#)' (2016) produced a number of recommendations on adaptation actions to be taken towards climate change of Sweden's drinking water supply. The recommendations focus mainly around improving communication, coordination and governance amongst Sweden's municipalities.

The city of Kristianstad is regularly in danger of flooding. Large parts were close to being flooded in 2002, and work has since been underway to build embankments and pumping stations to protect the city by preventing the water from flowing in. This [project](#) is expected to be completed by 2025. In all, 10 km of embankments are to be constructed and a further pumping station installed, making a total of 6 pumping stations.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.7. Waste

Project investments in the waste sector are related to separate collection infrastructure, re-use and recycling infrastructure, energy recovery facilities and closure of landfills. Potential impacts of climate change on waste infrastructure may include increased rates of waste decomposition, odour and dust due to increased temperatures, flooding of landfills and waste treatment facilities, and reduced water availability for wet processes in waste treatment facilities. Also the impact on transport infrastructure should be considered, as transport is a critical component of waste management (collection, transport to and from waste treatment facilities). The impact on transportation is discussed in the section on transport above.

In Sweden, waste is to some extent covered by the [Swedish Environmental Protection Agency](#), but there are no specific guides, tools or other instruments for the waste sector that could assist in addressing climate adaptation. Nevertheless, waste infrastructure needs to comply with environmental legislation, which to some degree also makes the infrastructure climate resilient.

For landfills, [Directive 1999/31/EC on the landfill of waste](#) requires that landfills are situated and designed in such a way that pollution of the soil, groundwater or surface water is prevented. This requirement is translated into national design standards for the construction of landfills that include the consideration of temperature, precipitation extremes and flooding where relevant.

Large waste treatment plants are subject to [Directive 2010/75/EU on industrial emissions \(IED\)](#), which requires as a general principle that necessary measures should be taken to prevent accidents which may have environmental consequences, and to limit those consequences. This requires that a structured management plan should be available that includes and mitigates hazards such as extreme weather conditions (e.g. flooding, very high winds). In the [BAT reference document \(BREF\) on Waste Treatment Industries](#), some information is provided on the impact of certain climatic conditions (e.g. the impact of higher temperature on biofilter performance, aerobic decomposition, etc.). Although climate change is not specifically addressed.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

5. CASE STUDIES

5.1. Case studies of climate adaptation projects

Embankments protect against future flooding in Kristianstad	
Project description	The project aims to protect Kristianstad against flooding both in the current climate and in the future. Because of its low-lying position by water, Kristianstad was in constant danger of being flooded. Large parts of the city were close to being flooded in 2002, and work has been underway since then to build embankments and pumping stations to protect the city by preventing the water from flowing in.
Photograph	N/A
Budget	The whole project cost approximately SEK 300 million, with 60% being government funded. The project reached its half-way point in 2014 and is expected to be completed in 2025.
Climate Change Vulnerability and Risks	In 2002, Hammarlundsvallen was almost breached due to a high tide, when water levels were measured at 2.15 metres above the mean. Emergency action had to be taken to protect the embankment. If the embankment had been breached, thousands of people would have been affected and several important public services put out of action, including the main hospital, the water treatment plant and the emergency station.
Climate change adaptation measures	To avoid a repetition of this near catastrophe, the municipality decided to reinforce Hammarlundsvallen and at the same time construct new embankments to protect other parts of the city from the River Helge's high tides.
Good practice	The embankments are in the form of earth and filter dikes, with an inner core of moraine which will allow a small amount of water to run through. These are reinforced with berms on the landward side that increase the strength of the dikes. This means Kristianstad should be protected against flooding both now and in the future irrespective of climate.
Further information	http://www.klimatanpassning.se/en/cases/embankments-protect-against-future-flooding-in-kristianstad-1.97877

Green roofs - Malmo	
Project description	This project involved adapting buildings for climate change across Malmo. Some of the city's buildings have been given green roofs to help manage the impact of climate change. Changes in the climate mean increased risks for towns and cities.
Photograph	n/a

Budget	The cost of establishing a green roof varies depending on conditions and what is required. The cost of a thin green roof with extensive planting is estimated at around SEK 300-600/m ² including the planting itself.
Climate Change Vulnerability and Risks	Risks facing Swedish towns include higher temperatures, regular heatwaves, higher amounts of rain and snowfall and reduced biodiversity.
Climate change adaptation measures	As climate change progresses, heatwaves are now occurring with increased frequency and are also longer lasting. This has a major impact on people's health, which is a particular issue for town and urban planning. The numerous hard surfaces in an urban environment, such as roofs, roads, car parks and paving, absorb the sun's rays instead of reflecting them back into the atmosphere.
Good practice	Green roofs can have environmental, financial and aesthetic benefits for an urban environment. Environmental benefits might include creating biodiversity and reducing the pressure on the town's surface water system, as the plants absorb water and then transpire moisture back into the atmosphere. In addition, the roof has a role as natural purifier for both water and air, producing a cooling effect.
Further information	http://www.klimatanpassning.se/en/cases/green-roofs-1.97888

Identification of flood-sensitive sections (blue spots) in the Swedish road network

Project description	This project involved identifying flood-sensitive areas in the Swedish road network. Effects of climate change have become one of the focus areas for national road authorities. However, the uncertainties inherent in predictions of future climate make it difficult to precisely quantify the changes in terms of, for example, the magnitude and frequency of rainfall.
Photograph	n/a
Budget	Not available
Climate Change Vulnerability and Risks	<p>In 2005, the Swedish Road Administration developed instructions to create a homogeneous method for the inventory and analysis of serious physical dangers along a chosen road stretch. The instructions contain a methodology for a comprehensive risk analysis of the road transport system with emphasis on serious physical hazards.</p> <p>A variety of risks are considered for different infrastructure elements, including roads, bridges and risks associated with buildings and constructions in the surrounding area. A focus is placed on landslide and collapse risk, risk for damage on roads and bridges with high water flow, risks</p>

	due to accidents with dangerous goods and risks of flooding.
Climate change adaptation measures	The Swedish Transport Administration uses several different methods. One of them compiled and analysed statistics for recorded nature-related stops (or road closures) and mapped them in a geographic information system. Another one is based on using accidents. But the best method is the Blue Spot Method , in which topography is used. The results show that the number of floods increased during these years and they indicate several clusters where the road has been flooded on several occasions.
Good practice	The model was applied to a Swedish study area with the aim of creating an assessment of TEN-T road sections vulnerable to extreme daily precipitation in southern Sweden. Based on topographic identification, the results showed a total of 1,254 blue spots near the TEN-T roads, varying in volume between 10 (minimum) and 2,800,870 m ³ (median 687 m ³).
Further information	https://www.eea.europa.eu/publications/adaptation-of-transport-to-climate

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