



# Climate change adaptation of major infrastructure projects

Country report for Finland

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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 projects<sup>1</sup> 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 Finland 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; and
- **Case studies:** Current practice in adaptation and resilience of infrastructure projects.

### *Country Overview*

Finland published a [National Strategy for Adaptation to Climate Change](#) in 2005, and set the framework for its implementation in 2014, with the [National Climate Change Adaptation Plan 2022](#). The Helsinki Metropolitan Area has, since 2012, a [Climate change adaptation strategy](#). The [Finish Climate Change Panel](#) has realised a project on [Monitoring the national energy and climate strategy - systematics and accessibility of climate policy reporting in Finland](#) (2015), where it maps out the key actors and their specific roles in climate policy reporting of Finland. A [Monitoring Group on Climate Change](#) was appointed in 2015 to coordinate the implementation of the National Climate Change Adaptation Plan. This cross-sectorial working committee, appointed by the government and led by the Ministry of Forestry and Agriculture, is monitoring and developing the implementation of the national adaptation plan. Regional and local steering is developing with over 40 municipalities participating in the climate campaign of the Association of Finnish Local and Regional Authorities.

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<sup>1</sup> 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

The main web portal for information on climate change adaptation is the [Climateguide Finland](#). The website of the [Ministry of Agriculture and Forestry](#) also presents information adaptation, it references the main framework documents and links to relevant publications. It has also developed a [database](#) of projects on climate change adaptation across different sectors. The Finnish Environment Institute (SYKE) offers comprehensive data on [flood modelling and mapping](#) that helps in efficient flood risk management. Methodologies supporting climate adaptation are available for the construction and water sectors. A [review of Finland's climate change adaptation studies](#)<sup>2</sup> contains a wealth of information on existing studies and their methodologies for estimating climate impacts. Tools regarding climate-proof planning by urban planners, construction, and landscape industries are available. [FINESSI](#) is a web tool developed at the Finnish Environment Institute which enables its user to explore the possible impacts of climate change. The Finnish Innovation Fund SITRA commissioned the development of [climate screening tool](#) with a view to enabling Finnish organisation in understanding and managing potential risks associated with climate change. The [Climate-Proof City](#) project 'ILKKA' offers tools to climate-proof planning for urban planners and construction and landscape industries based on best-practices developed in Helsinki. The [National land use guidelines of 2008](#) state that the flood hazard areas specified in official reports must be taken into consideration in land use planning and every effort must be made to prevent flood-related risks. The Finnish Association of Local and Regional Authorities issued in 2012 a [guidance](#) for the sound management of storm water in urban planning. The Finnish Meteorological Institute published a guidance for the [evaluation of energy demand](#) and [indoor physics](#) of buildings taking into account future climate change impacts. The Finnish Environment Institute has issued design standards for the lowest building levels on inland waterways and the seashore area. The [storm water guidance](#) has technical design standards on how the storm water drainage system should be sized properly. The [guide for preparing for floods in buildings](#) includes design standards required by law which state what is the lowest recommended height from sea level for constructing buildings. 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](#).

The Finnish Transport Agency provides guidance on adaptation measures for both roads and railways. The [Climate Policy Programme](#) for the Ministry of Transport and Communications' administrative sector for 2009-2020 also acknowledges that the need for resources might increase in the future and but only vaguely refers to broadband. The [ELASTINEN](#) project recognises that urban areas are more sensitive to climate risks, the biggest risk factors being storm water floods, prolonged heat and dryness. In land use planning, new construction should not be placed in flood risk areas. The Climateguide.fi repository notes the energy sector should prepare especially in production of waterpower and power distribution networks. The Energy Authority has issued a report on the reliability and development of the Finnish electricity networks. The biggest risks are increased flood or drought period. Their effects are already visible, and require adaptation measures. The Finnish Environment Institute published a report on [Water resources and Climate change – effects and adaptation](#) in 2012. The waste sector is not involved in the federal or regional authority climate change adaptation plans or initiatives organised by governmental bodies.

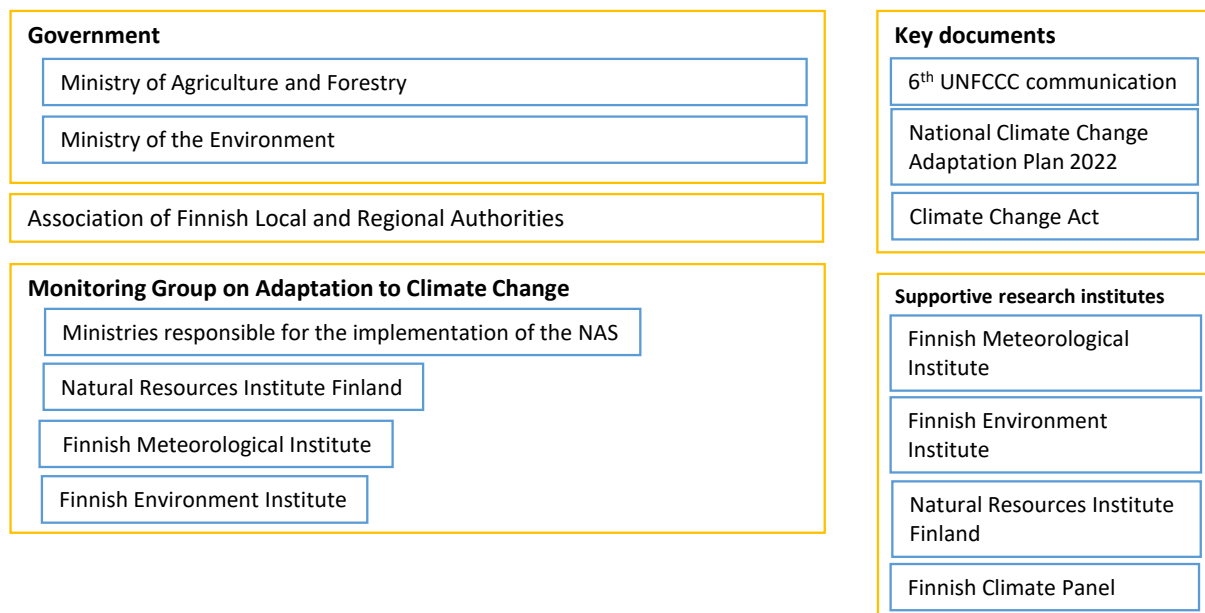
Two case studies for Finland were identified, focusing on energy infrastructure and the Elenia Säävarma Underground Cables; and on [reducing the overflow of sewage to river Vantaa](#).

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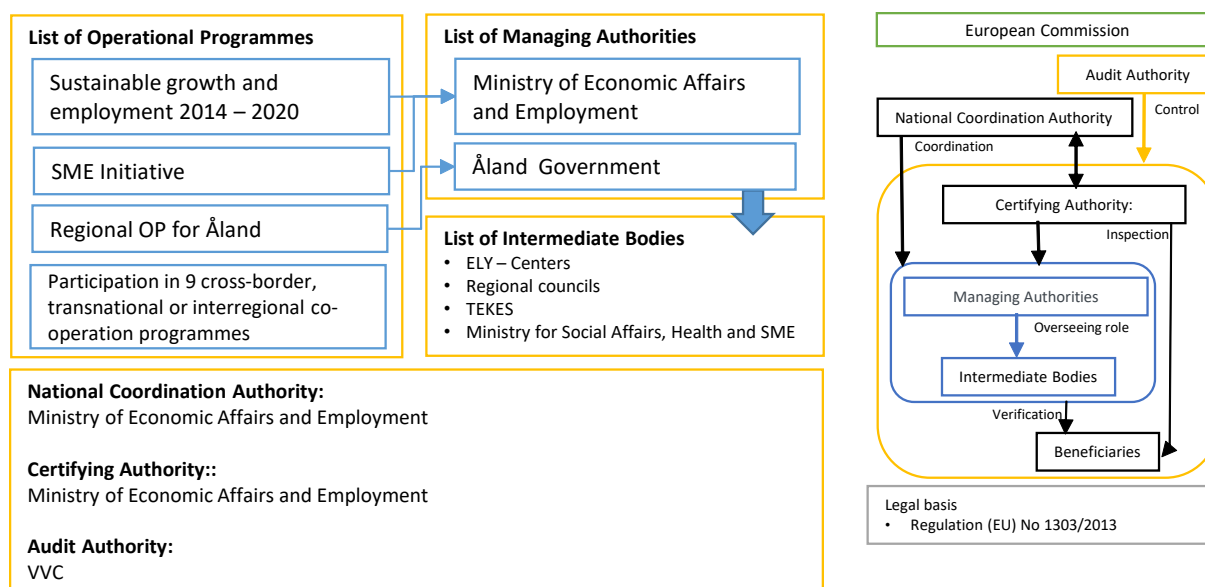
<sup>2</sup> "Arvioita Suomen muuttuvasta ilmastosta sopeutumistutkimuksia varten"

## 2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

Finland has an updated [National Climate Change Adaptation Plan 2022](#) since 2014, which is part of the planning system for climate change policy under [the Climate Change Act](#). A [cross-sectorial working committee](#), appointed by the government and led by the Ministry of Agriculture and Forestry, is monitoring and developing the implementation of the national adaptation plan. Regional and local steering is developing with over 40 municipalities participating in the climate campaign of the [Association of Finnish Local and Regional Authorities](#).



ESI Funds in Finland are absorbed through two national operational programmes managed by the Ministry of Economic Affairs and Employment, and one regional programme for the Åland archipelago.





### 3. RESOURCES

This country report has reviewed the currently available resources in Finland for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis<sup>3</sup> 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
<b>Data Availability</b>	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.
<b>Methodologies</b>	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.
<b>Tools</b>	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 impacts
<b>Guidance</b>	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.
<b>Design Standards</b>	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
<b>System</b>	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

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<sup>3</sup> 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

<b>Institutional capacity</b>	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
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### **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.

The main web portal for information on climate change adaptation is the [Climateguide Finland](#). This is an easily accessible and comprehensive source of information on climate change and its impacts and information related to adaptation measures. Sections contain [observations of mean temperatures](#), [precipitation levels](#), as well as their [future scenarios](#) according to different emission trajectories or impacts of climate change. They also provide links to relevant resources, including reports on "[Climate Change Adaptation And Mitigation In The Built Environment](#)" (June 2014), and on "[Adaptation To Climate Change: Risks, Responsibilities And Costs](#)" (December 2015).

The website of the [Ministry of Agriculture and Forestry](#) also presents information on climate change adaptation, with references to the main framework documents and links to relevant publications. It has also developed a [database](#) of projects on climate change adaptation across different sectors, which can be used as a best-practice source.

The [Finnish Meteorological Institute](#) (FMI) is the government agency responsible for gathering and reporting information about the atmosphere and providing meteorological data for commercial shipping, road maintenance, and air traffic.

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

There are a number of research institutions in Finland that make available information and data relating to climate adaptation: The Finnish Environment Institute (SYKE) offers comprehensive data on [flood modelling and mapping](#) that helps in efficient flood risk management. The Natural Resources Institute Finland (LUKE) has special expertise concerning adaptation in e.g. the agriculture and forestry sectors. The National Institute for Health and Welfare (THL) examines health related aspects of climate change. All these institutes were involved in the project [ELASTINEN](#) that provided research based information on dealing with extreme events, and the project [SIETO](#) that aims at a comprehensive vulnerability overview. The [Finnish Environment Institute \(SYKE\)](#) holds open data on water resources, natural ecosystems, and urban form. It also provides data on [flood modelling and mapping](#).

Finland's [Sixth 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 assessments by sector.

Climate change projections based on the most recent (RCP-based) GCM and RCM simulations have been analysed for Finland and are explained in [Ruosteenoja et al. \(2016\)](#)

The Academy of Finland is currently funding the project [PLUMES30](#) which aims to develop national socioeconomic scenarios for climate and its effects.

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.

### **3.2. Methodologies**

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

They are mainly available for the construction and water sectors. For the water sector, a methodology has been established to calculate the rise in rainfall level, increase in floods due to climate change and designing of flood defences.

The Finnish Environment Institute in cooperation with the Finnish Meteorological Institute, the Ministry of the Environment and the Ministry of Agriculture have developed a [methodology to estimate recommended height for construction in coastal areas](#).

Cost benefit analyses are also developed, for example on [flood protection measures from city of Salo](#). A [review of Finland's climate change adaptation studies](#) contains a wealth of information on existing studies and their methodologies for estimating climate impacts.

### **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 in risk assessments) whilst others are specific to a certain set of circumstances.

[FINESSI](#) is a web tool developed at the Finnish Environment Institute (SYKE) which enables its user to explore the possible impacts of climate change in Finland on selected impact areas and at different time periods up to the end of the 21st century. Results are gradually being transferred the tools available on ClimateGuide Finland.

[ClimateGuide Finland](#) offers several tools:

- [Intensity and frequency of short-duration rainfall in Finland](#)
- [Projected impacts](#)
- [Impacts and vulnerability identifier](#)

The consultancy TAPIO has developed a set of [indicators used a monitoring tool](#). The Finnish Innovation Fund SITRA commissioned the development of [climate screening tool](#) with a view to enabling Finnish organisation in understanding and managing potential risks associated with climate change. The [Climate-Proof City](#) project (ILKKA) offers tools to climate-proof planning for urban planners and construction and landscape industries based on best-practices developed in Helsinki.

The Finish organization VTT and the Finish Meteorological Institute have been leading and participating respectively in the project [ToPDAd](#), which developed an [interactive tool](#) aiming to help businesses and regional governments find the best strategies to adapt to climate change. ToPDAd focuses on the energy, transport and tourism sectors in particular.

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.

The [National land use guidelines of 2008](#) state that the flood hazard areas specified in official reports must be taken into consideration in land use planning and every effort must be made to prevent flood-related risks.

The 2009 [Dam Safety guide](#) (updated in 2014) develops guiding elements to build dams taking into account future climate projections with the aim of withstanding events with once in a 100 year frequency.

The Finnish Association of Local and Regional Authorities issued in 2012 a [guidance](#) for the sound management of storm water in urban planning. The Finnish Meteorological Institute published a guidance for the [evaluation of energy demand](#) and [indoor physics](#) of buildings taking into account future climate change impacts.

The Finnish Transport Agency has developed two guidance documents presenting adaptation measures in road and railway infrastructure developments including potential changes in climate, analysis on the potential effects on roads/railroads, guidance and suggested designs on how to mitigate the risks related to climate change.

- [Pre-study on the adaptation to climate change in railway management](#)
- [Pre-study on the adaptation to climate change in road management](#)

The [NAP](#) tasks the joint regional offices (ELY-keskus) of the Ministry of Employment and Economy, the Ministry of Environment, the Ministry of Transport and Communications and the Ministry of Agriculture and Forestry to develop climate resilience guidance for municipalities.

### **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 [Finnish Standards Association](#) (SFS), the national standards authority, 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).

The CEN-CENELEC [Guide 32 for addressing climate change adaptation in standards](#) has been translated into Finish.

### **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***

Finland was the first EU country to adopt a [National Strategy for Adaptation to Climate Change](#) in 2005. In 2009, the Ministry of Agriculture and Forestry published and [Evaluation of the Implementation of Finland's National Strategy for Adaptation to Climate Change](#).

The evaluation led to the adoption of an updated strategy the [National Climate Change Adaptation Plan 2022](#) of November 2014. The objectives and actions of the National Climate Change Adaptation Plan extend until the year 2022, but it aims further into the future. The mid-term evaluation of the National Adaptation Plan is foreseen for 2018.

Climate Change Adaptation is part of the planning system for climate change policy under [the Climate Change Act](#), which is in force since June 2015. Integration of climate policy is an objective throughout administration, and a number of laws have been revised or are under revision to include more strict requirements to climate change adaptation:

- The Ministry of Agriculture and Forestry of Finland passed or amended the following laws:
  - [Flood Risk Management Act](#) to reduce flood risks, prevent and mitigate the adverse consequences caused by floods and promote the preparedness against floods, and
  - [Dam Safety Act](#) to ensure safety in the construction, maintenance and operation of a dam, it includes requirements to check the adequate sizing of dams in order to safeguard against possible water level rises.
- The Ministry of Environment issued the [Land Use and Building Act](#) to ensure that construction and building activities on land and in water areas fulfill necessary preconditions for a favorable living environment by performing sustainable urban planning and development.
- The Ministry of Transport and Communications' administrative sector adopted in 2015 a [Climate Policy Programme for 2009-2020](#), in order to adapt to the climate change in the construction, maintenance and management of the transport and communications infrastructure.
- The Ministry of Transport and Communications furthermore amended the [Communications Market Act](#) to increase the risk-preparedness of telecommunication companies in the event of extraordinary weather phenomena and ensure the reliability of their operations.
- The Ministry of Trade and Industry amended the [Energy Market Act](#) with quality requirements for the electricity distribution network: distribution must be planned, built and maintained to ensure reliability requirements set by the main grid operator are met. In case of failure of the network caused by storm or snow, the act sets a prohibition on electricity distribution companies to have downtimes longer than 6 hours in urban areas and more than 36 hours in other areas.

The Helsinki Metropolitan Area has, since 2012, a [Climate change adaptation strategy](#) (Partially funded by the Life+ Financial Instrument for the Environment). The strategy aims to:

- 1) assess the impacts of climate change in the area;
- 2) prepare for the impacts of climate change and to extreme weather events; and
- 3) to reduce the vulnerabilities of the area to climate variability and change

According to the [2015 study on the Situation of local and regional government work on climate](#) "Kuntien ja maakuntien ilmastotyön tilanne", all provinces have adopted climate change adaptation plans.

The [Finish Climate Change Panel](#) has realised a project on: [Monitoring national energy and climate strategy - systematics and accessibility of climate policy reporting in Finland](#) (December 2015), where it maps out the key actors and their specific roles in climate policy reporting of Finland.

The [new Environmental Impact Assessment](#) (EIA) legislation (Directive 2014/52/EU) came into force on 16th of May 2017 and includes an assessment of climate change risks for the project.

The National Risk Assessment is undertaken in line with thematic ex-ante conditionality 5.1, according to which, national or regional risk assessments for disaster management need to be taking into account climate change adaptation

### ***Responsible authorities***

According to the 2016 national plan, the responsibility for the implementation, monitoring and reporting rests with the relevant ministries. The actions included as such that they can be considered to concern the whole administrative sector or ones that concern built environment, environmental protection, biodiversity, and water resources management and water protection. Measures concerning water resources management have been prepared in cooperation with the Ministry of Agriculture and Forestry.

The Finish central government is tasked with establishing national adaptation objectives and improving local level prerequisites for adaptation. This may involve both knowledge development and financial support or promoting the co-operation and best practices of actors, while the role of municipalities entails bringing up adaptation needs as discussion topics, and involving actors in implementing them.

A [cross-sectorial working committee](#), the Monitoring Group on Adaptation to Climate Change appointed by the government and led by the Ministry of Agriculture and Forestry, is monitoring and developing the implementation of the national adaptation plan. The Ministry of the Environment has general responsibility for the building sector through guidelines on land use planning and construction. Regional and local steering is developing with over 40 municipalities participating in the climate campaign of the [Association of Finnish Local and Regional Authorities](#). Some of them have been involved in the preparation of a regional, sub-regional or municipal climate strategy. For example, the Helsinki Metropolitan Area includes a [climate adaptation section](#).

### ***Management of the ESI Funds***

The Ministry of Economic Affairs and Employment is the Managing Authority for the two main Operational programmes: the Sustainable growth and employment 2014 – 2020 OP, and the SME Initiative OP. The Åland Government is the Managing Authority for the Regional OP for Åland. Finland is also participating in 9 cross-border, transnational or interregional co-operation programmes. The main Intermediary bodies are the ELY – Centers, the Regional councils, TEKES, and the Ministry for Social Affairs, Health and SMEs. The National Coordination Authority for the ESI Funds is the Ministry of Economic



Affairs and Employment, which also acts as the Certifying Authority, while the Audit Authority is the VVC.

### **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**

A large number of research institutes and universities have carried out research on climate change impacts, adaptation and mitigation in Finland. Several research institutions have organized their own climate-change-related programmes or research units. For example, the ISTO research programme (2006-2010) produced a comprehensive body of knowledge on the impacts of climate change and vulnerability in different sectors, thereby laying the foundation for sectoral adaptation measures. According to the results of the [ELASTINEN project](#), Finnish organizations do not systematically assess weather and climate related risks often. The [report](#) highlights actions to improve the management of weather and climate related risks and to support adaptation. These are addressed to public and private actors.

Training and capacity building is provided worldwide by the [Finnish Meteorological Institute, Expert Services and Climate Service](#) with focus on weather and climate applications covering wide variety of spatial and temporal scales.

Communication on climate change is provided by various organisations, using various channels ranging from extensive internet portals to background information sessions for the media and stakeholders. For example, the [Climateguide.fi](#) site that was designed in cooperation between the Finnish Meteorological Institute, Finnish Environment Institute and the Aalto University Land Use Planning and Urban Studies Group brings together practical, scientifically proven information on climate change. It has been opened for contributions and updating by other research organisations as well, including the Natural Resource Institute. Additionally, a number of online resources showcasing the capacity of Finland are found in [The Finnish Climate Panel](#), and [The Flood Forecasting Center](#).

#### **Effective collaboration**

The Ministry of the Environment established the [Finnish Climate Panel](#) until 2020 (according to the 2015 Climate Act). The Climate Panel is an independent, multi-disciplinary scientific body that operates in active interaction with policy making. The main task of the Climate Panel is to strengthen the interaction between research and policy making. According to the letter of nomination, the panel:

- Gives advice to the ministerial working group on bioeconomy and clean solutions in order to support decision making
- Monitors the implementation of the energy and climate strategy
- Makes assessments concerning the consistency and adequacy of the policies
- Promotes public discussion based on science and expertise
- Follows the development of climate science, technology and policy
- Makes proposals on developing and supporting research on climate policy

The Ministry of Agriculture and Forestry appointed a [Monitoring Group on Climate Change](#) to coordinate the implementation of the National Climate Change Adaptation Plan in June 2015. The monitoring group is broadly-based, with representatives from the relevant

ministries and other authorities, regional and local actors and research institutes. The term of the group is until the end of 2018. The task of the monitoring group is to:

- promote cooperation on adaptation between the government authorities and sectors of business and society,
- identify needs for research and give proposals to further develop research on adaptation,
- promote the practical use of research information,
- and steer projects in support of adaptation

Official sources are lacking, but all experts interviewed in the framework of this study confirmed that cross-sectorial cooperation is improving. Multiple research projects have received governmental funding and there are highly qualified researchers working on the subject.

Close cooperation among research institutions is a characteristic feature of Finnish research on climate change impacts, adaptation and mitigation. National research programmes, such as FICCA, ISTO and CLIMBUS, have provided funding and common goals for the research. The FICCA programme has had a key role in promoting cooperation between research institutes and universities.

### ***Financial resources***

The [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming period. By early 2018, there have been no funds allocated for major projects in Finland for the 2014 - 2020 programming period according to the datasets of the European Commission. However, the [data set will be updated regularly](#) to reflect changes in the programme lists and major project notifications.

According to the [ESIF-viewer](#), Finland is planning investments of 1.4 Billion EUR. Projects under Thematic Objective 7 for Network Infrastructures in Transport and Energy will be receiving 17 Million EUR; while an additional 28 Million EUR are approved for in Environment Protection & Resource Efficiency (Thematic Objective 6).

## **4. SECTOR OVERVIEW**

### **4.1. Introduction**

Since 2014, the requirements for major projects to obtain ESIF funding<sup>4</sup> demand that project applications integrate climate change considerations<sup>5</sup>, 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')

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<sup>4</sup> [http://ec.europa.eu/regional\\_policy/archive/projects/major\\_projects/index\\_en.cfm](http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm)

<sup>5</sup> 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>



- 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*.<sup>6</sup>

## **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 heat waves, 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.

### **Road infrastructure**

The Finnish Transport Agency provides guidance on adaptation measures for both [road](#) and [railway](#) infrastructure developments. The documents include potential changes in climate, analysis on the potential effects on roads/railroads, guidance and suggested designs on how to mitigate the risks related to climate change and suggested points of additional research.

Project developers are interested in building structures that are resilient to climate change, as is the case of the [Kruunusillat-bridge project](#), where the Finnish Meteorological Institute was consulted on the design regarding climate change adaptation.

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

### **Railway infrastructure**

See section above on Road infrastructure.

### **Airport infrastructure**

Finland has a network of 28 airports, of which 25 are maintained by Finavia (formerly the Civil Aviation Administration). Helsinki-Vantaa Airport operates about 95% of the country's international air traffic. The [Finnish Meteorological Institute](#) (FMI) has been responsible for aviation weather observations since 2012.

[Finland's Seventh National Communication under the UNFCCC](#) (2017) reports that maintenance costs at airports and the use of de-icing chemicals may increase in mid-

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<sup>6</sup> 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.

winter. Nevertheless, no specific actions or measures for making Finnish airports (more) climate resilient have been retrieved from desk research or interviews.

However, general EU guidance information is available that applies to all types of (major) infrastructure projects, including airport infrastructure. See section 4.1 for more information.

### **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 [Communications Market Act](#) refers to extreme weather conditions and states that companies should prepare adequately on extraordinary events. The [Climate Policy Programme](#) for the Ministry of Transport and Communications' administrative sector for 2009-2020 also acknowledges that the need for resources might increase in the future, also in reference to the broadband sector.

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*.<sup>7</sup>

In Finland, the [Ministry of Transport and Communications](#) is the entity governing the responsible for the development of the national broadband strategy. The [National Adaptation Strategy](#) does not address the broadband sector, but the vulnerability of the broadband network to floods can be based on the information provided by the [flood risk and hazard maps](#). It is a general best practice for operators to use flood mapping information from environmental agencies to safeguard new planned data centres from flooding.

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

For the programming period 2014-2020, the financing of broadband projects with EU funds is not foreseen in Finland, only a limited amount may be used to develop rural networks.

### **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

<sup>7</sup> 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.

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.

The [ELASTINEN](#) project recognizes that urban areas are more sensitive to climate risks, the biggest risk factors being storm water floods, prolonged heat and dryness. In land use planning, new construction should not be placed in flood risk areas. This can be deviated only if the needs are based on impact studies to demonstrate that flood risks can be controlled and that construction is sustainable. General and town planning must be prepared for growing storms, heavy rainfall and urban fire. The Association of Finnish Local and Regional Authorities (Kuntaliitto) has prepared a storm water guide as a response to increased heavy rainfall activity. The document provides guidance for project planning, legal framework, suggested design and data analysis on storm water management. The guidance is actively used comprehensive framework for efficient storm water management.

The Finish Meteorological Institute published a guidance for the [evaluation of energy demand](#) and [indoor physics](#) of buildings taking into account future climate change impacts. The Finnish Association of Local and Regional Authorities issued in 2012 a [guidance](#) for the sound management of storm water in urban planning.

The capital city of Helsinki has developed its own [Adaptation Strategy](#) (2012), the document presents adaptation measures for water management, city planning, technical works, and it also establishes a minimum building heights to be respected. Best-practices and recommendations on the basis of its implementation have been collected as part of the [Climate-Proof City \(ILKKA\)](#). The project developed climate-proof planning procedures and improved the knowledge of city officials and decision-makers. The project's site includes guidance and best practices on how to implement the adaptation, control storm waters, control urban heat island effect and build green infrastructure. There are multiple additional relevant tools and reports cited in the site.

In cooperation with the Helsinki Region Environmental Services Authority (HSY), four of the large cities (Helsinki, Lahti, Turku, and Vantaa) have launched several climate actions. Together with the Finnish Meteorological institute and the University of Turku, they have for instance developed the [planner's workbook](#) for a climate-proof city. The workbook provides a collection of tools, best practices and reports about the impacts of climate change and how to implement the adaptation activities.

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, 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, etc.), the food system (transport, cooling, ...), transport (electrified vehicles, dynamic traffic information, ...), etc.

The [ELASTINEN project](#) states that the biggest risk for energy-sector is increased storm activity, and recent storms have caused direct costs of tens of millions of euros. The

Climateguide.fi repository notes that the energy sector should prepare especially in production of waterpower and power distribution networks.

The amended [Electricity Market Act](#) foresees that electricity network must be designed so that storms or snow load does not cause more than 6 hour power outage in town areas or more than 36 hours in other areas. To comply with the legislation and increase the resilience of their distribution network, the companies [Elenia](#), [Kerava energia](#) and [Savonvoima](#) have started building electricity cables underground. The Energy Authority has issued a [report](#) on the reliability and development of the Finnish electricity networks. In that respect, they note that the renewed legislation has put pressure on the actors to increase the service reliability and to construct in underground cables.

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, and have been developed by the Finnish Environment Center (SYKE) and are publicly available. Climate change adaptation will also be addressed in the RBMP to 2021. An EU [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.

In the water sector, the biggest risks are increased flood or drought period. Their effects are already visible, and require adaptation measures. The effects on water sector are especially local because of the differences in soil and water areas. The Finnish Meteorological Institute has conducted [a study on the intensity and frequency of rainfalls](#). The results show that there is much regional difference on the rainfalls, which can be relevant when considering adequate flood preparation methods. The most relevant challenges for the water management in the future will be ageing infrastructure, vulnerability and risk management and maintaining the quality of water.

The Finnish Environment Institute published a report on [Water resources and Climate change – effects and adaptation](#) in 2012. Based on changes in watercourses and water levels from the reference period to the 1971-2000, future scenarios are elaborated for the periods 2010-39 and 2040-69.

Dam safety is the responsibility of [Centre for Economic Development, Transport and the Environment](#) (ELY Centre), which has developed [Dam safety guides](#) to provide guidelines for long-term planning, in which climate change is also taken into consideration. Dams are designed to endure floods whose occurrence of probability is 0.1 per cent, or once in 1000 years. SYKE has conducted a survey and research on the effects and adaptation needs for water management in Finland, which includes a comprehensive list of potential risks and corresponding adaptation options.

In 2014, The Finnish Meteorological Institute and Finnish Environment Research Center established the [Flood Centre](#) to promote the co-operation and improve communication in flood situations. The Flood Center aims to develop early warnings based on long range forecasts. It predicts and warns of floods and maintains constant operational information

related to foreseen and real-time flood events. The Flood Forecasting Center offers services to the regional authorities and inhabitants and operation trainers of flood areas.

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.

Currently, waste management infrastructure is mainly seen as a source of greenhouse gas emissions rather than as a sector that faces specific climate risks, following [Finland's Seventh National Communication under the UNFCCC](#) (2017). So, climate actions are related to climate change mitigation and none are related to climate adaptation. Of course, waste management infrastructure is subject to (EU) environmental legislation (e.g. Landfill Directive, IED,...) and national building provisions related to flood risks amongst others (see section 4.4 Urban development).

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 plant 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 Treatments 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 infrastructure projects which have addressed climate change adaptation**

#### **Elenia Säävarma Underground Cables**

Project description	Electricity companies in Finland have been building extensively electricity cables underground as a response to <a href="#">the renewed Electricity Market Act</a> . According to the
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	legislation, the network must be designed so that storms or snow load does not cause more than 6h breakdowns in town areas or more than 36h breakdowns in other areas.
Photograph	N/A
Budget	In 2017, the investment is planned to be over €120 M for one company.
Climate Change Vulnerability and Risks	Electricity network providers have understood that increased storm activity or increased snowloads during winter can be a major issue and cause costs and power outages. The current overhead cables are very vulnerable to storms and snow.
Climate change adaptation measures	The companies <a href="#">Elenia</a> , <a href="#">Kerava energia</a> and <a href="#">Savonvoima</a> have started building electricity cables underground to mitigate the risks. The company Elenia is planning on having 70% of its electricity network underground by 2028.
Good practice	Making the electrical network climate resilient, e.g. design and construction of underground cable network.
Further information	N/A

#### Reducing the Overflow of Sewage to River Vantaa

Project description	The Helsinki Region Environmental Services (HSY) launched a co-operation project with Vantaanjoki waters and water protection associations <a href="#">to reduce wastewater overflow to the river of Vantaa</a> that happens due to extraordinary amounts of storm water. The project aims to identify the parts of sewers, where the overflows could be prevented by increasing capacity.
Photograph	N/A
Budget	Estimated € 590 000
Climate Change Vulnerability and Risks	The project adopts a proactive approach acknowledging the increased risk of overflows in the future due to climate change. The increased rain activity and storm waters increase the possibility of overflow of sewage to rivers. The Pumping station capacity survey, indicates the bottlenecks of wastewater networks and acts as a tool for adapting to climate change
Climate change adaptation measures	Identifying the bottlenecks in the sewage system, and increasing capacity.
Good practice	Increased capacity of the sewage system in order to handle increased / changing rainfall patterns in the future.
Further information	The report is available at <a href="#">Vantaanjoen, Valuma-Alueen Jätevesiylivuodot</a>



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