Climate change adaptation of major infrastructure projects

Country report for Slovakia

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Contents

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[1] 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 Slovakia 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

The Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change is the framework document for adaptation processes in Slovakia and was approved by the Government Resolution no. 148/2014. It will need to be updated based on experience and new scientific knowledge every five to ten years. The main responsible authority for climate change adaptation is the Ministry of Environment of the Slovak Republic (MZP SR). Additional responsibilities and competences on climate adaptation lie with the Ministry of Interior, the Slovak Hydrometeorological Institute, the Water Research Institute, the Slovak Water Management Enterprise, the Ministry of Agriculture and Rural Development, the National Food and Agriculture Centre, the Hydro-meliorations, the Slovak Technical University, the Faculty of Natural Sciences at Comenius University, the Office of the Government, the Global Water Partnership Central and Eastern Europe, and other institutions. The High Level Committee for Coordination of the Climate Change Policy was established in 2012 at the state secretary level. Two special working groups

[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

were created under the Coordination Committee: one of these was designed to prepare the Strategy of Adaptation of the Slovak Republic to the Adverse Impacts of Climate Change. At the local level many initiatives have been launched recently. The capital city Bratislava acceded to Mayors Adapt initiative in October 2014. The adaptation strategy of Bratislava was adopted in September 2014. Other examples of local initiatives are Adaptation strategy of Trnava and Adaptation strategy on heat waves of Košice - Západ districts.

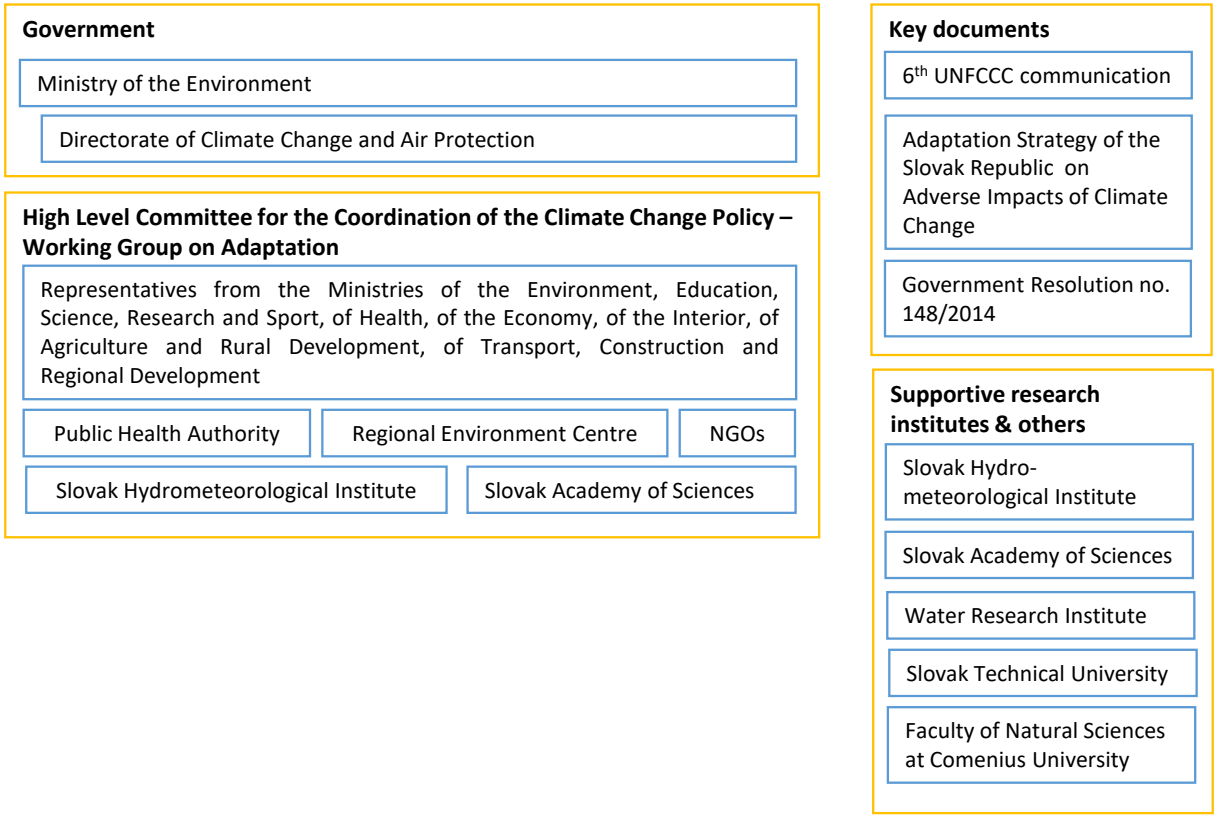
There are a number of resources available to support climate adaptation. Data to support climate adaptation planning are available through the SHMU (Slovak Hydrometeorological Institute) and its publication "Consequences of climate change and possible adaptation measures in individual sectors", which provides long-term scenarios and a lot of detail that has proven to be sufficient under present planning requirements in the Ministry of Transport and Construction. Implementation of the project POVAPSYS2 ensures greater availability of the precipitation data over the territory of the Slovak Republic in real time and provides for high quality of monitoring and forecasting meteorological and hydrological (floods) events. A national methodology has been developed, whose main objective is to help integrate the topic of climate change into the development of strategic infrastructure plans and the subsequent preparation of infrastructure projects: Assessment of Climate Change - Strengthening the Methodology and Improving the Impact Assessment of Climate Change in Infrastructure Plans / Projects in Existing Processes at the National Level. In further scientific detail, Lapin, Melo & Damborská have developed methods of climate change scenarios projection in Slovakia and present them alongside selected results. The national Climate change assessment methodology includes tools for vulnerability assessment and risk assessment, and the country is aiming to integrate these in all stages of project development. The national climate change assessment methodology includes guidance on assessing vulnerability and risk and evaluating the exposure to risky climate phenomena. The document also provides recommendations for the future development of infrastructure, and the main climate risks to take into consideration in the development of transport projects. The Ministry of Transport and Construction of the Slovak Republic periodically improves the binding technical norms that include design standards. The ministry maintains a database of transport standards for rail, road, shipping, combined transport, and for construction products used in transport. Currently, there are no design standards to safeguard the climate change resilience of infrastructure projects. 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.

Climate adaptation actions relevant for infrastructure projects are being undertaken. The Slovak climate change adaptation methodology on Improving the Impact Assessment of Climate Change in Infrastructure Plans was developed by the Ministry of Transport and Construction is applied. The Slovak Hydrometeorological Institute issued the publication on adaptation measures in individual sectors, which, in combination with other resources, has been used for projects such as the Ondava for life project, and the modernisation of the Púchov – Považská Teplá rail line, which includes climate adaptation measures. The broadband sector is not addressed in the National Adaptation Strategy, nor in the Strategic Document for Digital Growth and Next Generation Access Infrastructure (2014 - 2020) or the National strategy for broadband access. The vulnerability of the broadband network to floods can however be based on the information provided by the flood risk and hazard maps. Urban development is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors, whilst the capital city of Bratislava has developed an Adaptation Strategy for its territory; the subsequent Action Plan should be published in 2018. The energy sector is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors, while the national Climate change assessment methodology includes a section on the adaptation of the sector and details on how to estimate potential adaptation options. The water sector is addressed with flood risk and hazard maps, and River Basin Management Plans (RBMP). The National Adaptation Strategy presents the different impacts climate change will have on the hydrologic circle of the country, and the

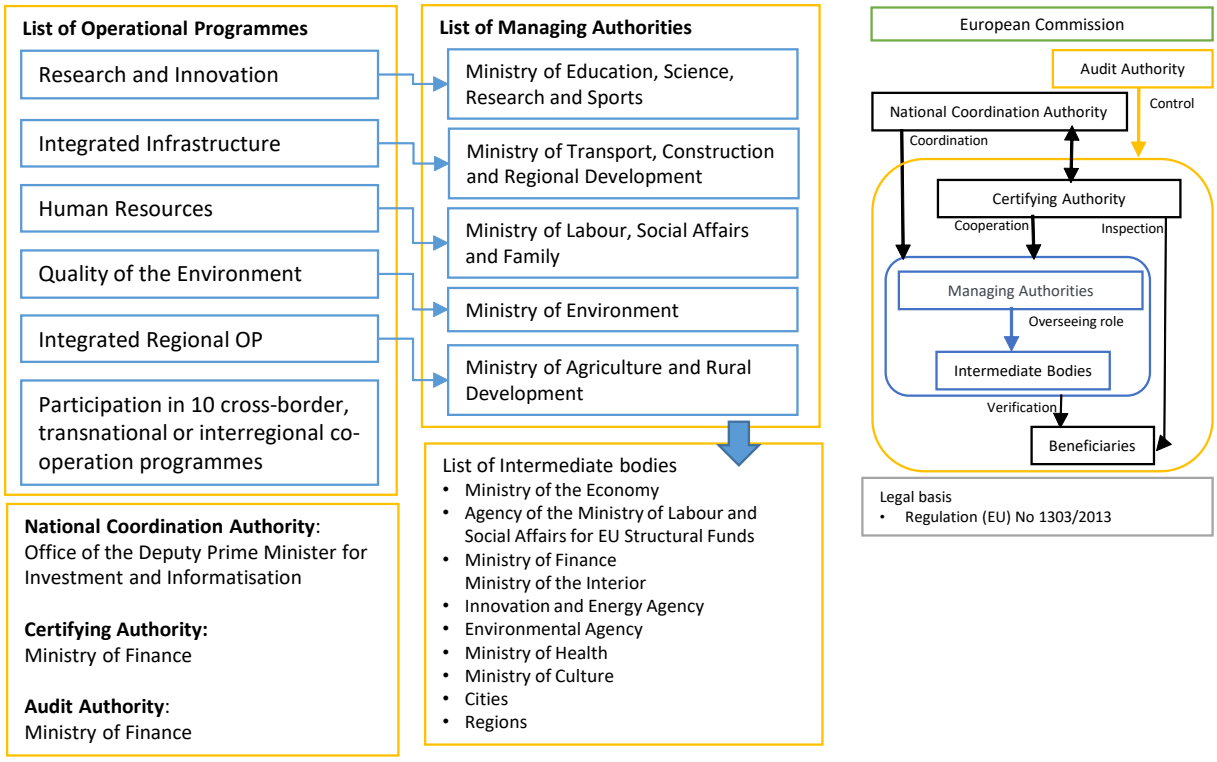
EEA Grants climate adaptation programme contributes to improve the resilience and preparedness for both floods and droughts, as well as to increase both the expert capacity and public awareness and understanding of flood protection. The waste sector is not involved in the national or regional authority climate change adaptation plans or initiatives organised by governmental bodies, but is subject to the transposed EU Directive 1999/31/EC on the landfill of waste which requires that landfills are situated and designed in such a way that pollution of the soil, groundwater or surface water is prevented.

Case studies identified in Romania include the reconstruction of ecosystem functioning at the upper site the Ondava river catchment area, the modernization of the Púchov – Považská Teplá railway line, and the addressing of climate risks in the Žilina – Košice railway corridor.

2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK



The main responsible authority who has primary responsibilities for climate change adaptation is the Ministry of Environment. The High Level Committee for Coordination of the Climate Change Policy (the Coordination Committee) is comprised of two working groups, of which the working group on adaptation was designed to prepare the Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change (hereinafter referred to as the "NAS"). It was established to develop the national adaptation strategy, and continues with the adaptation agenda. The Working Group members include representatives from other ministries, and institutions, such as the Public Health Authority, the Regional Environmental Center, the Slovak Hydrometeorological Institute (SHMU), and the Slovak Academy of Science and other professional institutions, research and non-governmental organizations. The institution responsible for the NAS preparation was the MZP SR.



In the Slovak Republic, Cohesion Funds for infrastructure investment is mainly absorbed through the Integrated Infrastructure Operational Programme, managed by the Ministry of Transport and Construction. Adaptation measures are primarily financed through their integration into sectoral politics. Currently adaptation measures in Slovakia are financed and co-financed from the Operational Programme Quality of the Environment 2014 – 2020 and Village Restoration Programme. The ESI Funds are enabling the development of major projects in the 2014 – 2020 programming period for Slovakia. Concerning major projects, by early 2018, there have been 730 Million EUR approved for Network Infrastructures in Transport and Energy; and 66 Million EUR in Environment Protection & Resource Efficiency.

3. RESOURCES

This country report has reviewed the currently available resources in Slovakia for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis[2] 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.

[2] 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

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 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.

The Slovak Hydrometeorological Institute (SHMI) is the organization providing hydrological and meteorological services at the national and international level. The SHMI's activities include the following: monitoring of quantitative and qualitative parameters of the air and water in Slovak territory; collecting, verifying, interpreting and archiving data and information on the condition and regime of air and water; describing developments in the atmosphere and hydrosphere; and issuing forecasts, warnings and other information regarding the atmosphere and hydrosphere. All the aforementioned data, information and other research are made available to the public.

The main source of climate adaptation data is in SHMI's publication "Consequences of climate change and possible adaptation measures in individual sectors" (2011), which

provides long-term scenarios of climate change. This data has proven to be of sufficient detail under present planning requirements in the Ministry of Transport and Construction. This publication analyses in detail the issues of climate change and its consequences on the natural environment, human health and selected sectors of the national economy of the Slovak Republic. There is a wide range of sectorial strategies and action plans addressing adaptation issues. The document also includes a proposal for appropriate adaptation measures including economic analyses of potential impacts on GDP and employment. Climate projections are available from the Climate Change and Adaptation Report of the SHMU project for eight selected sectors from 2011.

The framework for complex environmental monitoring in Slovakia has been determined by the resolutions of the Slovak Government No. 623/1990 Coll., No. 449/1992 Coll. and No. 620/1993 Coll. Monitoring subsystems are fundamental units of the National Monitoring System and several of these are operated by the SHMI. The existing network of automatic weather stations measure quantitative and qualitative variables e.g. soil moisture, global radiation, precipitation occurrence and visibility. The output of all data is digital form as images, maps, tables and reports formatted according to WMO standards (alphanumeric codes, binary codes BUFR and GRIB). The SHMI provides data gathered through the monitoring subsystems for decision-making, management, research and development as well as for general public information.

Slovakia'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 assessments by sector.

The Statistical Office of the Republic of Slovenia 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.

Institutions in Slovenia that make available information and research relating to climate adaptation, including the National Institute of Chemistry (KI) and the Urban Planning Institute of the Republic of Slovenia (UPIRS).

Implementation of the project POVAPSYS2 ensures greater availability of the precipitation data over the territory of the Slovak Republic in real time and provides for high quality of monitoring and forecasting meteorological and hydrological (floods) events.

A short chapter on adaptation actions in key sectors is available in the report "Information on the progress made in implementing adaptation measures in the Slovak Republic".

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. A national methodology has been developed, whose main objective is to help integrate the current topic of climate change into the development of strategic infrastructure plans and the subsequent preparation of infrastructure projects: Assessment of Climate Change - Strengthening the Methodology and Improving the Impact Assessment of Climate Change in Infrastructure Plans / Projects in Existing Processes at the National Level. Within this report, there is an assessment of the vulnerability the following sectors: water management, biodiversity, health, agriculture, forest management, transport, energy, tourism. The risk of the negative climate change impact on the sectors was estimated in selected geomorphologic

units. The impacts on GDP (Gross domestic product) and on the employment in mentioned sectors were also analysed using the modelling tools (CGE) and the elaborated approach with given level of aggregation determined by the first use and availability of data.

Within the Integrated Infrastructure OP 2014-2020, there is a valid methodology for carrying out a cost benefit analysis (CBA) for transport investment projects. The cost of adaptation measures are included in the overall investment and O&M cost. The measures are incorporated during the project design stage and all the measures are in line with Slovak technical standards.

Lapin, Melo & Damborská have developed methods of climate change scenarios projection in Slovakia and present them alongside selected results.

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.

The national Climate change assessment methodology includes tools for vulnerability assessment and risk assessment, and the country is aiming to upgrade these to be applicable in all stages of project development. These tools include

- Estimation of climate development in Slovakia
- Identification of climatic risks for the development of transport infrastructure
- Identification and selection of options for climate change adaptation

The Floods Directive requires Member states to prepare Flood Hazard Maps and Flood Risk Maps. Slovakia has realised such maps, which are updated every 6 years and uploaded to the flood hazard and risk maps deliveries database on EIONET.

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. To realize vulnerability assessments (based on exposure and sensitivity) and climate change risk assessments (based on likelihood and impact) in Slovakia, the guidance of the European Commission is used:

- Guidance of DG CLIMA - Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient
- Guidance of DG ENV – Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment

The national climate change assessment methodology includes guidance on assessing vulnerability and risk and evaluating the exposure to risky climate phenomena. The

document also provides recommendations for future development infrastructure, and the main climate risk to take into consideration in the development of transport projects

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 Slovak Office of Standards Metrology and Testing (UNMS-SR), the national standards authority, is collaborating with the European Standardisation Organisations 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).

According to the UNMS-SR, there are currently no additional and specific national standards for adaptation to climate change.

The Ministry of Transport and Construction of the Slovak Republic periodically improves the binding technical norms that include design standards. The Ministry maintains a database of transport standards for rail, road, shipping, combined transport, and for construction products used in transport. Currently, there are no national design standards that explicitly safeguard the climate change resilience of infrastructure projects.

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

The Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change is the framework document for adaptation processes in Slovakia and was approved by the Government Resolution no. 148/2014. The strategy priorities include:

- disseminating information and knowledge on adaptation issues at all levels of governance as well as the general public;
- strengthening the institutional framework for adaptation processes in the Slovak Republic;
- developing and developing comprehensive risk assessment methodologies for climate change from national to local level;
- developing and applying methodologies for the economic assessment of adaptation measures (macroeconomic impacts) and developing and implementing an instrument for the selection of investment priorities based on an assessment of the inter-sectorial aspects of adaptation measures.

The Government resolution No 148/2014 also foresees the provision of information on the implementation of adaptation measures and the strategy update regarding new scientific knowledge on climate change.

The Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change will need to be updated based on experience and new scientific knowledge every five to ten years – also to reflect the conclusions of the Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC). The update of the National adaptation should be approved by the government by the end of 2018.

The 2011 publication "Consequences of climate change and possible adaptation measures in individual sectors" by the SHMU (Slovak Hydrometeorological Institute) is the first comprehensive document that tries to connect the scenarios and possible consequences of climate change to the widest range of sectors and sectors with proposals for appropriate proactive adaptation measures.

The Ministry of Environment approved, in October 2017, the Slovak National Action Plan to Combat Drought. The action plan consists of three parts: monitoring and warning systems for drought, science and research (for identifying vulnerabilities) and adaptation measures combating drought in areas of water management, agriculture, forestry and urban areas.

On Disaster risk management Slovakia has adopted a National strategy on security related risks in Slovak republic. Slovakia has also transposed the revised Environmental Impact Assessment Directive. Act 142/2017 is in force since 15th June 2017 and it considers climate change adaptation.

Responsible authorities

The main responsible authority who has primary responsibilities for climate change adaptation is the Ministry of Environment of the Slovak Republic (MZP SR), which maintains a webpage where information on adaptation is available. The institutional structures that deal with the impacts of climate change, including prevention, preparedness and response to natural disasters are within the Ministry of Interior, while flood protection is covered by the Ministry of Environment.

Additional responsibilities and competences on climate adaptation lie with the Slovak Hydrometeorological Institute, the Water Research Institute, the Slovak Water Management Enterprise, the Ministry of Agriculture and Rural Development, the National Food and Agriculture Centre, the Hydro-meliorations, the Slovak Technical University, the Faculty of Natural Sciences at Comenius University, the Office of the Government, the Global Water Partnership Central and Eastern Europe, and other institutions.

For the coordination of activities (information transfer, adaptation measures monitoring etc.), there is a National Contact Point at the Ministry of Environment, a Working Group for Adaptation, and a High Level Committee for the Coordination of Climate Change Policy (HLC). More information on their roles is provided at the following sub-section on Institutional Capacity.

Management of the ESI Funds

Under the EU Regulation 525/2013 the preparation of the NAS is ex-ante conditionality of the Operational Programme Quality of the Environment, in order to ensure that the proposed adaptation measures are properly mainstreamed into the relevant Operational Programs. The relevant Operational Programmes that incorporate the thematic objective 5 on climate change and risk prevention is the OP Quality of Environment, whose Managing Authority is the Ministry of Environment; and the OP Integrated Infrastructure, whose Managing Authority is the Ministry of Transport and Construction. Additional OPs, but with a lesser or absent role in Major Projects are the Rural Development Programme, and the Integrated Regional Operational Programme.

Under the Quality of Environment OP the ESIF 2014 – 2020 provides support for increasing the resilience to the impacts of climate change by reducing the risks related to floods (to receive over € 419 million Union support), for improved water management in agriculture, restoration of ecosystems and prevention of forest fires (€ 315 million Union support) and for promotion of risk management in the area of climate change (€ 261 million Union support). Under the OP Integrated Infrastructure.

Project developers applying for EU funding need to demonstrate they consider for climate adaptation. Projects are prepared by beneficiaries and the evaluated and selected by the Managing Authorities. The EU-level JASPERS network provides support for beneficiaries and Managing Authorities in area of climate change adaptation.

At the local level many initiatives have been launched recently. The capital city Bratislava acceded to Mayors Adapt initiative in October 2014. The adaptation strategy of Bratislava was adopted in September 2014. Examples of local initiatives are Adaptation strategy of Trnava and Adaptation strategy on heat waves of Košice - Západ districts, while cities and towns with adaptation strategies and activities include Zvolen, Kežmarok, and Čierny Balog.

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

On the research level, Slovak institutions are participating in several international research projects. For example the Comenius University participates in the CC-TAME Project (Terrestrial Adaptation & Mitigation in Europe), and the SHMU participates in the project Joint Disaster Management Risk Assessment and Preparedness in the Danube macro-region (SEE Risk) which is focused on risk assessment and with purpose to foster awareness and effectiveness of the measures in emergency situations caused by climate change. Other R&D agencies, universities, the Slovak Academy of Sciences, and research institutes linked to the ministries have included the adaptation in their research tasks

Effective collaboration

Coordination of activities (information transfer, adaptation measures monitoring etc.) is organised as follows:

- the National Contact Point (the Ministry of Environment) provides communication with international organizations and coordinates national activities in cooperation with the Working Group for adaptation;
- the Working Group for Adaptation provides the adaptation activities in the area of its competence, cooperates with professional institutions and other relevant organizations, is responsible for preparation of the documents for the Coordination Committee for Climate Change Policy and for decision-making;
- the High Level Committee for the Coordination of Climate Change Policy (HLC) defines the main tasks and gives overall lines for further policy-making processes on adaptation

Financial resources

Adaptation measures are primarily financed through their integration into sectoral politics. Currently adaptation measures in Slovakia are financed and co-financed from the Operational Programme Quality of the Environment 2014 – 2020 and Village Restoration Programme. The ESI Funds are enabling the development of major projects in the 2014 – 2020 programming period for Slovakia. Concerning major projects, by early 2018, there have been 730 Million EUR approved for Network Infrastructures in Transport and Energy; and 66 Million EUR in Environment Protection & Resource Efficiency. The data set will be updated regularly to reflect changes in the programme lists and major project notifications.

The programmes and mechanisms targeted by the Slovak Authorities for financing adaptation measures are the European Economic Area Financial Mechanism (EEA) and the Norwegian financial mechanism, the LIFE+ Program and the Horizon 2020.

4. SECTOR OVERVIEW

4.1. Introduction

Since 2014, the requirements for major projects to obtain ESIF funding[3] demand that project applications integrate climate change considerations[4], 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*.[5]

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 extreme weather events, such as extended heat ~~waves, flooding, heavy rain~~fall or storm, and landslides amongst others. They are a

[3] http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm

[4] 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

[5] 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.

potential threat to both infrastructure and operation of the transport system. The transport sector is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors.

Road infrastructure

The National Adaptation Strategy presents the vulnerability of the sector (road, airways, rail, and waterways). It promotes design optimization and effective monitoring as adaptation measures. Effective monitoring of climate data may be done on the basis of the information provided by the Slovak Hydrometeorological Institute.

The Integrated Infrastructure Operational Program is planning 20 transport projects for the 2014-2020 programming period. Specifically, there are:

- Six projects under Priority Axis 1 - Railway Infrastructure (TEN-T CORE) and Restoration of Mobile Resources
- Eight projects under Priority Axis 2 - Road Infrastructure (TEN-T)
- Two projects under Priority Axis 3 - Public passenger transport
- One project under Priority Axis 5 - Rail Infrastructure (Excluding TEN-T CORE)
- Two projects under Priority Axis 6 - Road Infrastructure (Excluding TEN-T CORE)
- One project under Priority Axis 7 - Information Society

There is a valid methodology for carrying out a cost benefit analysis (CBA) for transport investment projects within the OP; the cost of adaptation measures are included in the overall investment and O&M cost. The measures, in line with the Slovak technical standards, are incorporated during the project design stage.

The Ministry of Transport and Construction maintains a database of transport standards used in transport. Currently however, there are no design standards to safeguard the climate change resilience of infrastructure projects.

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

Railway infrastructure

The Slovak climate change adaptation methodology on Improving the Impact Assessment of Climate Change in Infrastructure Plans developed by the Ministry of Transport and Construction is applied. For instance the feasibility study for the railway Corridor IV (state border CZ/SR – Kúty – Bratislava – Nové Zámky - Štúrovo/Komárno – state border SR/HU) and the feasibility Corridor V (Žilina – Košice – Čierna nad Tisou state border) took account of climate change impacts based on this methodology.

See also the section on road infrastructure for additional relevant documents.

Airport infrastructure

Slovakia's Seventh National Communication under the UNFCCC (2017) reports that aviation will be more susceptible to extreme weather events, namely that Bratislava Airport and Košice Airport will be negatively influenced by dangerous climatic phenomena in winter (e.g. black ice, snow cover). However, no specific strategy on making airports climate resilient was retrieved from desk study or interviews. But more general materials are available which apply to all types of 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 Ministry of Transport and Construction is the managing authority for the Operational Programme Integrated Infrastructure OPII (PA1 till PA 8). The intermediate body for PA7 (information society) is Deputy Prime Minister's Office for Investments and Information of the Slovak Republic (UPVII). The Ministry bears the primary responsibility for the national broadband strategy and the policies. UPVII as intermediate body is the entity governing the attribution of EU funds for broadband projects. There are no projects in the Broadband sector specifically addressing the climate change adaptation.

The National Adaptation Strategy does not address the sector. The specific documents for the Broadband sector is the Strategic Document for Digital Growth and Next Generation Access Infrastructure (2014 - 2020) and the National strategy for broadband access, both not specifically addressing the issues of climate change adaptation.

The vulnerability of the broadband network to floods can however 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 centers from flooding.

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.*[6]

For the programming period 2014-2020, the Integrated Infrastructure OP is planned to contribute with 89.25 million € to the development of broadband projects. Funded projects have not specifically addressed the issues of climate change adaptation.

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

[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.

to climate change. Urban development is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors.

The National Adaptation Strategy presents the different impacts climate change will have on the sector (overheating of buildings, higher demands on water consumption, lower traffic safety and increased congestion flow, disruption in supplies of energy, damage of equipment). It promotes the improvement of city structure to increase air circulation, the development of water retreatment facilities, the adaptation of technology and materials to climate change. The importance of green and blue infrastructure in urban areas is highlighted in the strategy. Effective monitoring of climate data may be done on the basis of the information provided by the Slovak Hydrometeorological Institute.

The Quality of the Environment OP for 2014-2020 provides funding for the development of environmental infrastructure, flood protection, increased resilience, and energy efficiency of building, improved wastewater treatment.

The capital city of Bratislava has developed an Adaptation Strategy for its territory and an Action Plan. Bratislava and the Faculty of Natural Sciences of Comenius University are part of a Horizon2020 project under the call Security DRS 9: Science and Innovation for adaptation to climate change, aiming to the standardization of the vulnerability assessment to climate change in urban areas.

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). With regards to energy consumption, while not part of the 'energy infrastructure projects' as such, there is a link to changes in energy efficiency regulations in buildings and, for instance, building requirements regarding cooling/ shading, etc.. 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, etc.), transport (electrified vehicles, dynamic traffic information, ...), etc.

The energy sector is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors.

The national Climate change assessment methodology includes a section on the adaptation of the energy sector to climate change and details on how to estimate potential adaptation options. The National Adaptation Strategy presents the different impacts climate change will have on the energy sector: mainly the increase vulnerability of production infrastructure to adverse weather and an increased energy demand in the summer. It promotes the adoption of safety measures to improve infrastructure resilience. Effective monitoring of climate data may be done on the basis of the information provided by the Slovak Hydrometeorological Institute.

Major projects are not supported under the Priority Axis (PA) 4 Energy efficient low-carbon economy in all sectors of the Operational Programme Quality of Environment. Out of the supported projects under this PA, none deals with adaptation to climate change.

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), waste-water 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. The water sector is covered in the 2011 document Consequences of climate change and possible adaptation measures in individual sectors.

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 past floods and climate scenarios. The flood risk and hazard maps for Slovakia are publicly available and there are separate map layers for hazard maps and for risk maps. 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. Relevant is also the Strategy for the implementation of the Water Framework Directive.

The National Adaptation Strategy presents the different impacts climate change will have on the hydrologic circle of the country: resources will be scarcer in the south and the east due to increased occurrence of drought and increased occurrence of floods over the country. The Strategy promotes the optimization of land use to avoid water run-off and the adoption of measures to ensure the sustainability of the water resources while limiting pollution.

Slovakia is regularly affected by overflowing rivers as well as long drought periods. The EEA Grants climate adaptation programme contributes to improve the resilience and preparedness for the consequences from both floods and droughts locally as well as to increase both the flood expert capacity and public awareness and understanding of flood protection. It awarded two projects in the frame of the call Adaptation to Climate Change - Floods and Drought Prevention (ACC02 SK02) in two Slovak cities – Bratislava and Zvolen. Both projects are aiming on adaptation to climate change in urban areas, especially focusing on sustainable rainwater management.

Two international projects supported by Interreg – DriDanube and FramWat – deal with drought and efficiency of natural water retention measures. DriDanube's Drought User Service is one of the most recent drought monitoring tools based on remote sensing data, as a complementary method to the already existing observation-based monitoring.

Effective monitoring of climate data may be done on the basis of the information provided by the Slovak Hydrometeorological Institute.

Under the OP Quality of the Environment, a project has been approved to develop 22.41 km of public water distribution network in the Žilina region to extend the distribution network in an effort to improve the quality of the water and the interconnections between the systems. 123.46 km of public sewage will also be developed. This project is schedule to receive 49 € millions of ERDF.

Under the Integrated Regional OP, addressing the issue of increasing the availability of water sources for drinking water supply is based on the Water plan of the Slovak Republic, which includes plans for management of the river basin of the Danube and Vistula basin. Measures under this OP are expected to contribute to adaptation to unfavourable climate changes, which is contained comprehensively at national level in the Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change.

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, odor 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.

The National Adaptation Strategy does not address the sector. Effective monitoring of climate data may be done on the basis of the information provided by the Slovak Hydrometeorological Institute.

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 climate adaptation projects

Ondava for life - Reconstruction of ecosystem functioning of the landscape within the upper site the Ondava river catchment area	
Project description	The objective of the project is to improve the capacity of the landscape to adapt to climate change impacts
Photograph	
Budget	€ 1,681,738
Climate Change Vulnerability and Risks	The upper part of the Ondava water basin is, due to inappropriate land use and ecosystem functioning loss, a source of flash floods from heavy rainfall that the current landscape pattern is not able to mitigate or eliminate by natural and balanced ecosystem functions.
Climate change	The project is expected to achieve the restoration of important habitats and ecosystems that were damaged or

adaptation measures	destroyed by human activities (in forest, wetlands, meadows and other natural or semi-natural landscapes), reconstruction of river banks, hydromorphology and hydrological regime, to build up of several measures for soil erosion prevention, water retention and flood prevention.
Good practice	The project designed 12 different climate adaptation measures, secured the approval of landowners and land users for the realization of these measures and established a non-profit organization (Ondava pre život) to ensure the sustainability of the results of the project and the continuation of activities towards further climate change adaptation in the region.
Further information	http://www.ondavaprezivot.sk/SK/projekt/

5.2. Case studies of infrastructure projects which have addressed climate change adaptation

Modernization Púchov – Považská Teplá	
Project description	Modernization of the railway line for the track speed up to 160 km/h. Project consist of 15,9 km long railway line with two tunnels (1,1 km and 1,8km), three major bridges over the Váh river and water reservoir Nosice, one railway station and two railway stops.
Photograph	
Budget	400 608 560 EUR
Climate Change Vulnerability and Risks	High temperatures, strong wind, snow phenomena, frost phenomena, draught and fires, heavy rains, storms, floods, landslides
Climate change adaptation measures	- catenary system is designed for wind speed of 33 m/s and for frost area "L" – light frost area, - secured buffer-zone of 60 meters from the axis of the railway, resp. 15 -50 m in case of road infrastructure, - all building structures are designed for extraordinary wind load, - provision of forecasted and warning service of SHMÚ (Slovak Hydrometeorological Institute), - provision of substitute bus transport in case of temporary railway traffic interruption, - important switches are equipped by electronic system of heating-up controlled by computer, - on switches are installed detectors of weather conditions, - increased maintenance and control of risk-bearing

	sections, - provision of substitute bus transport in case of temporary rail traffic lockouts, - retaining walls are designed according to Eurocode 1 including their drainage, - dewatering of railway permanent way and subgrade, tunnels, bridge objects and roads is ensured, - proposed vertical and horizontal alignment of the track is designed for Q100 flow of Váh river, - culverts are designed for Q100 of main watercourses, for sufficient dewatering of tributary area, - in-depth-based bridge pillars
Good practice	Already in the planning and design phase of this modernization project, climate change has been taken into consideration. A wide set of vulnerabilities and risks have been accounted for, such as constructions that can cope with high wind speeds and frost, measures to anticipate on heavy rain and flood risk, a monitoring and warning system, etc.
Further information	/

Climate risks in the Žilina – Košice railway corridor	
Project description	Climate adaptation study in the context of the modernisation of the railway corridor Žilina – Košice – Čierna nad Tisou (Slovakia/Ukraine border)
Photograph	
Budget	N/A
Climate Change Vulnerability and Risks	The identification of the climate sensitivities of the project, and the use of expert judgment, offered the following key risks: Flooding – riverine and flash floods, Landslides (in conjunction with flooding), Avalanches, Icing /freezing rain, extreme winds
Climate change adaptation measures	The assessment provided Inputs for MCA and alternatives selection, and a more detailed assessment for five selected alternatives. The measures considered were: Locational and height options Suggestions for more detailed planning Technological options, i.e. repairable bridges, traction poles, … Management options, uses of modern but sensitive

	equipment, and the deployment of diesel machines during ice spells.
Good practice	The climate change assessment was performed very early in the process (before alternatives selection and design works). Available scenarios (climate change and flooding) were used. Lessons learned were reported (e.g. lack of some data, improvement of internal and external consultations for better insights).
Further information	Case study presentation at the JASPERS Network

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