



Climate change adaptation of major infrastructure projects

Country report for Spain

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Contents

1.	INTRODUCTION	6
2.	LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK	8
3.	RESOURCES	9
	3.1. <i>Data Availability</i>	10
	3.2. <i>Methodologies</i>	11
	3.3. <i>Tools</i>	12
	3.4. <i>Guidance</i>	13
	3.5. <i>Design Standards</i>	13
	3.6. <i>System</i>	14
	3.7. <i>Institutional Capacity</i>	16
4.	SECTOR OVERVIEW	18
	4.1. <i>Introduction</i>	18
	4.2. <i>Transport</i>	18
	4.3. <i>Broadband</i>	19
	4.4. <i>Urban Development</i>	20
	4.5. <i>Energy</i>	21
	4.6. <i>Water</i>	22
	4.7. <i>Waste</i>	23
5.	CASE STUDIES	24
	5.1. <i>Case studies of infrastructure projects which have addressed climate change adaptation</i>	24
	5.2. <i>Case studies of infrastructure projects which have addressed climate change adaptation</i>	25

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

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

1. INTRODUCTION

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

This report for Spain 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 [National Climate Change Adaptation Plan](#) was approved in 2006 and created a framework to enhance Spain's ability to adapt to climate change. The plan is based on a [Preliminary Evaluation Report of Climate Change Effects in Spain](#), published in 2005. The plan's objectives are carried out through the implementation of Work Programmes. The 3rd Work Programme of the PNACC was adopted in 2013.

The Spanish Climate Change Office (OECC), is the administrative body for climate change while the Spanish Ministry of Agriculture and Fishery, Food and Environment is the leading practitioner on integrating climate change adaptation into project development.

At a regional level, the Autonomous Communities have developed and are maintaining strategic frameworks, plans and programmes regarding climate change adaptation. On a local level, the [Spanish Network of Cities for the Climate \(RECC\)](#) brings cities and villages together, which are committed to sustainable development and climate protection

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

Spain has adequate resources for climate adaptation. The web portal for information on climate change adaptation, [AdapteCCa](#), compiles this data and makes it easily accessible by means of a cartographic viewer. Climate change data from the [IPCC website](#) is combined with regional data from the Spanish State Meteorological Agency ([AEMET](#)), while sea level and air and water temperature data is made available by the State's ports ([Puertos del Estado](#)), and occasionally data from the [IEO](#) (Spanish Institute of Oceanography). The first Impact Assessment, provided in 2005, is the [Preliminary Evaluation Report of Climate Change Effects in Spain](#). Guidance in Spain primarily given by the OECC, based on the [National Climate Change Adaptation Plan](#). The website on [Environmental Impact Assessment](#) is recommended as guidance by the OECC for considering Climate Change Adaptation. The document on [Climate Change Adaptation Integration into Business Strategy](#) provides guidance for companies to incorporate risks of, and vulnerability to, climate change in their business strategies. The pilot project [Iniciativa ADAPTA](#) is exploring adaptation options and tools to incorporate risk and vulnerability considerations. 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](#). A number of tools (or more precisely, cartographic viewers) are available to be used during the design phase of major projects, namely the [National cartographic viewer of flood-prone areas \(SNCZI\)](#), [Cartographic viewer C3E on Climate Change at Spanish Coast Areas](#), the [Cartographic viewer for the "Principado de Asturias" region](#), and the [viewer AdapteCCa for climatic scenarios](#). The OECC found that the viewers are not frequently used, because they have a high level of detail, and consequently the data output encompasses a lot of information. Additionally, the [AQUATOOL](#) offers a decision support system for water resources planning and management. The Spanish Association for Standardization ([UNE](#)) is collaborating with the [European Standardisation Organisations](#) in the [Adaptation to Climate Change Coordination Group \(ACC-CG\)](#) to coordinate standardisation work in the field of climate adaptation.

The main infrastructure projects are making efforts towards climate adaptation. A working group on the need of climate change adaptation for the Spanish backbone of the transport infrastructure was formed, which consists of the [State Secretary for Infrastructure, Transport and Housing](#), the [State Secretary of Environment](#), [Adif](#), [Renfe](#), [Puertos del Estado](#), [AENA](#), [Ineco](#), [CEDEX](#), OECC, [AEMET](#) and the [European Environment Agency](#). The Spanish urban development sector has access to various online sources of data and information; The [AdapteCCa](#) information exchange and consultation platform provides general information; whilst on a local level, the [Spanish Network of Cities for the Climate \(RECC\)](#) is a platform for technical support for the local administrations. Within the infrastructure sector, most guidance on climate change vulnerability and risk assessment is provided by the national and regional authorities provide guidance for the transport and energy sectors and for ports and coastal areas. The OECC, the Technological Investigation Institute Comillas (Madrid), the UNE and the Ihoibe identify no specific design standards that specifically incorporate climate change adaptation. An [analysis of the climate change impact on the Spanish energy sector](#) was published in 2015 by the Pontifical University Comillas (Madrid), which provides an explanation on how risk and vulnerability assessment on the energy sector have been performed. The water sector is mainly concerned with the issue of drought and floods. Following the EU Floods Directive 2007/60/EC, Spain has performed flood risk assessments and elaborated [flood hazard and risk maps](#) and [flood risk management plans](#). A [nation-wide cartographic viewer displaying flood-prone regions at coastal and inland areas](#) is available for fluvial and marine flooding risk. The broadband and waste sectors are not involved in the national or regional authority climate change adaptation plans or initiatives organised by governmental bodies.

Three detailed case studies that demonstrate how climate change adaptation is being incorporated into infrastructure projects have been highlighted, covering the examples of [ENDESA](#), [GRUPO FERROVIAL](#) and [Renfe](#) for integrating climate change adaptation into its business strategy.

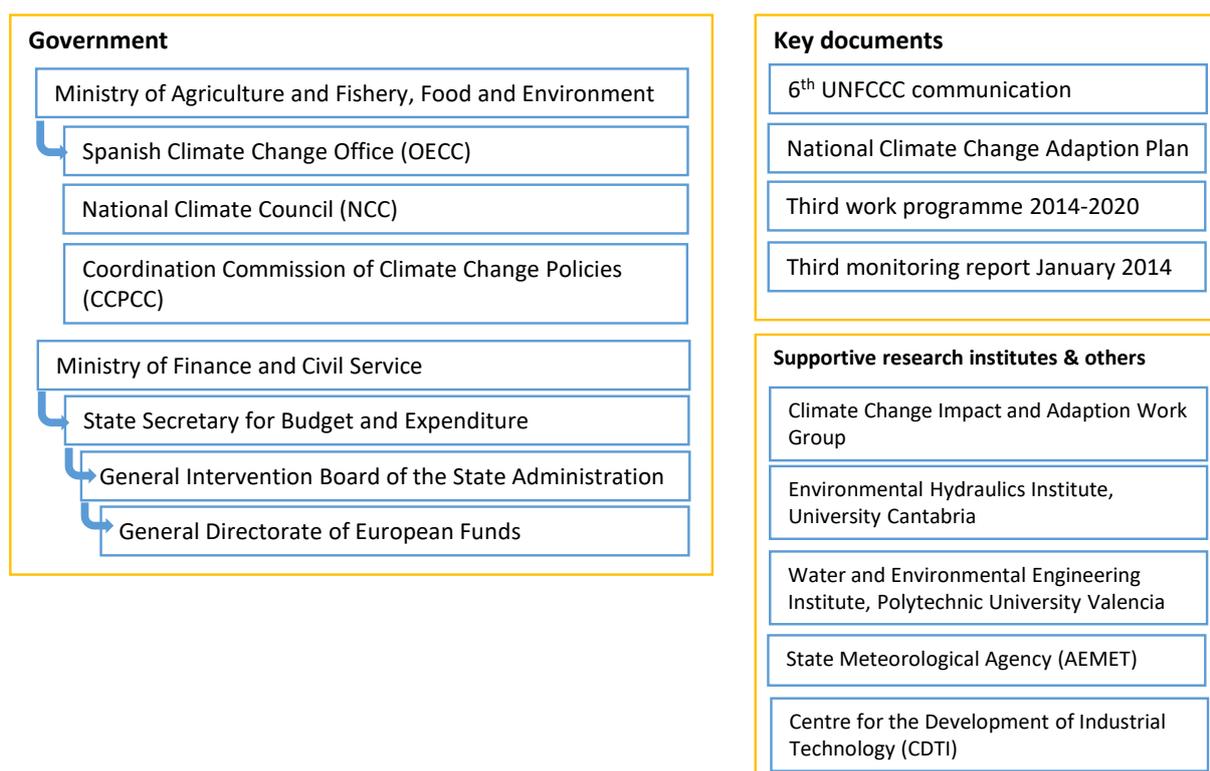
2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

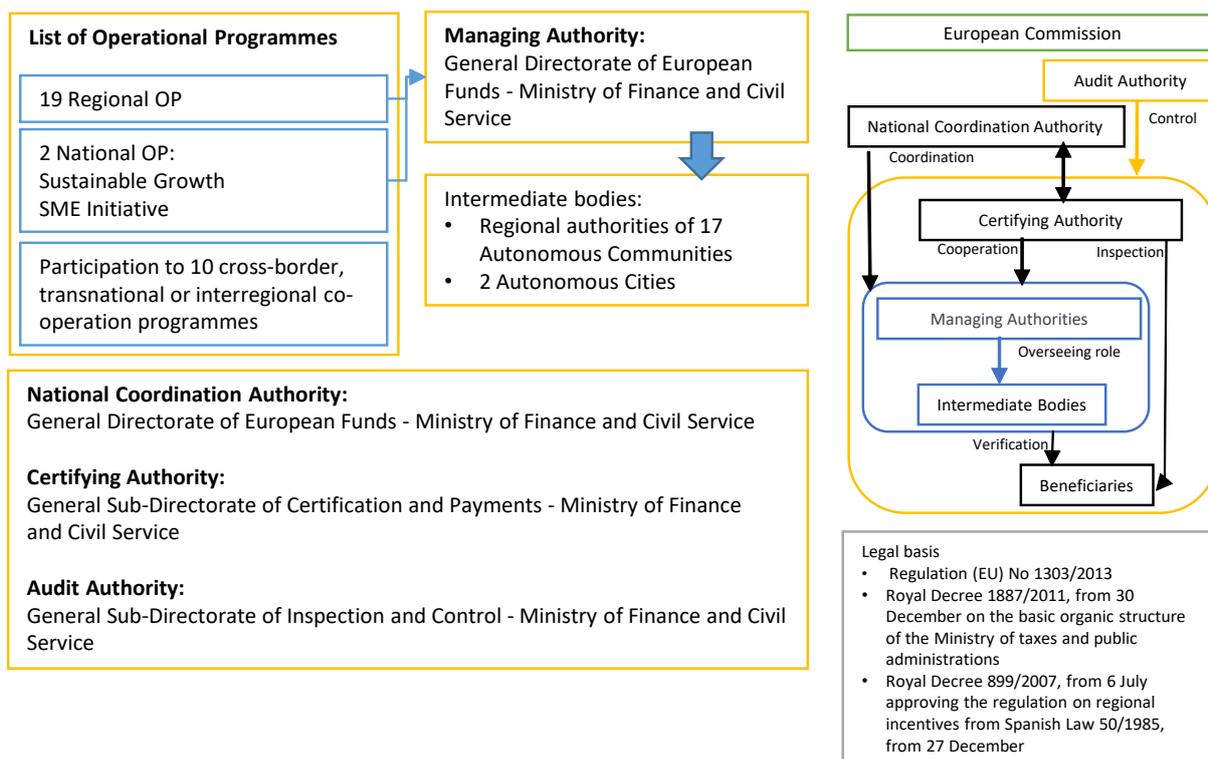
In Spain, the Spanish Climate Change Office (OECC by its Spanish acronym), a General Directorate of the Ministry of Agriculture and Fisheries, Food and Environment, is in charge of adaptation policy-making. The OECC coordinates the participation of the different administrations and stakeholders.

Following the adoption of the [National Climate Change Adaptation Plan](#) (PNACC) in 2006, a Coordination Commission of Climate Change Policies (CCPCC) was formed to coordinate between the General State Administration, the Autonomous Communities and at the local level. This Commission approved the PNACC and, by means of Work Programmes, establishes action lines for certain time frames. The [Third Work Programme](#) covering the period 2014-2020; was adopted in 2013. The OECC proposes the Work programmes to the CCPCC, which, together with the National Climate Council (NCC) is responsible for giving advice during the development of proposals for infrastructure construction and renovation projects and the recommendation of adaption strategies during planning, construction and operation phases of these projects.

The OECC is the leading practitioner on integrating climate change adaption in project developments. The Autonomous Communities (Spain is divided into 19 regions, which are, to a limited or wider extent, politically and administratively autonomous) have developed and are maintaining strategic frameworks, plans and programmes regarding climate change adaption. The Spanish information exchange and consultation platform for climate change adaption, [AdapteCCA](#) (accessible online), compiles complete information on frameworks and actions at the level of the autonomous communities. On a local level, the [Spanish Network of Cities for the Climate \(RECC\)](#) brings cities and villages together, that are committed to sustainable development and climate protection. The objective is to provide technical support for the local Spanish governments (municipality, city and village level), as well as a forum for knowledge and experience exchange.

The national authority has the overall coordination related to EU funding, with the 19 regional authorities acting as intermediary bodies.





3. RESOURCES

This country report has reviewed the currently available resources in Spain for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis² 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:

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

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.

Spain uses the [IPCC website](#) (Data Distribution Centre of Intergovernmental Panel on Climate Change) as one of the main sources for climate change data.

The Spanish State Meteorological Agency [AEMET](#) provides mainly temperature and precipitation data. The [National Aerospace Technical Institute](#) provides atmospheric climate data. Sea level and air and water temperature data made available by the State's ports ([Puertos del Estado](#)), and occasionally data from the [IEO](#) (Spanish Institute of Oceanography) related to sea-level. For example, data from the IPCC and from the AEMET were used by the University of Cantabria for the development of a cartographic viewer on climate change impacts on Spanish coastal areas ([C3E](#)).

Spanish Basin authorities have created [Special Plans on Droughts](#) (PES), which provide analyses on historical droughts. Further to this, [hydrological indicators](#) were developed to predict drought situations and assess their frequency.

The web portal for information on climate change adaptation [AdapteCCa](#) compiles this data and makes it easily accessible by means of a cartographic viewer, which shows potential future temperature and precipitation scenarios.

[Regional climate scenarios](#) have been developed under the coordination of the AEMET.

The [Third Work Programme](#) implementing the Plan Nacional de Adaptación al Cambio Climático (PNACC) presents information regarding the vulnerability of several sectors, including *inter alia* Forestry, Agriculture, Energy, Transport and Urban Development. The OECC regularly published detailed [sectoral vulnerability assessments](#).

Spain's past impact and vulnerability assessments are summarised in the study, "[A Preliminary Assessment of the Impacts in Spain due to the Effects of Climate Change](#)" (2005), which was promoted by OECC, and included the participation of more than 400 experts.

Spain'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 by sector.

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

Research institutes active in the area of climate adaptation include the [Basque Centre for Climate Change](#), and the [Centre for the Development of Industrial Technology](#) (CDTI).

Updates for a wide range of national adaptation actions, can be found in the National adaptation actions deliveries database on [AdapteCCa](#), the [EIONET database](#), 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.

Spain is making use of the [MEDIATION Toolbox](#) is a structured database of methods and tools that are available to support the assessment of climate change impacts and vulnerability, and adaptation decision-making. [MEDIATION](#) incorporates a toolbox of methods and models for use in climate change impacts, adaptation and vulnerability studies, which integrates closely with the integrated methodology. In this way the project aims to create both a means of guiding a user through an adaptation assessment, and provide exemplary tools or recommend methods to be used, based on individual requirements. Methodologies included within the database include:

- Multi-criteria analysis: Several metrics by which the alternatives can be characterized in terms of their costs and benefits;
- A framework for development practitioners and institutions working on climate change vulnerability and adaptation in mountainous environments; and
- A vast selection of impact studies, divided by sector and geographical focus, highlighting the methods employed.

The OECC is leading the pilot project [Iniciativa ADAPTA](#), with the aim of exploring adaptation options and tools to incorporate risk and vulnerability considerations into

different business strategies. A phase of the project saw the application of several methods to assess economic costs and benefits of different adaptation measures in two main energy and infrastructure companies. No recommended methodologies have been established yet in the PNACC.

3.3. Tools

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

A number of tools in form of cartographic viewers are available to be used during the design phase of major projects:

[National cartographic viewer of flood-prone areas \(SNCZI\)](#), provided by the Spanish Ministry of Agriculture and Fishery, Food and Environment, allows the user to consult the probability of a flooding event at any location in Spain (fluvial and marine origin of the flooding risk with respect to different time intervals).

[Cartographic viewer C3E on Climate Change at Spanish Coast Areas](#), developed by the Spanish Ministry of Agriculture and Fishery, Food and Environment, The Spanish Ministry of Science and Innovation and the University of Cantabria. This is an online tool detailing flooding and erosion risk assessments and the impact on infrastructures on the Spanish coast. It focuses on impact and adaption for large coastal cities and the tourism sector. The tool is innovative in being a very effective instrument for qualitative and quantitative exposition, vulnerability and consequences consultation for potential current and future climate change impacts at the Spanish coastal areas.

[Cartographic viewer for the "Principado de Asturias" region](#), developed by the Spanish Ministry of Agriculture and Fishery, Food and Environment and the University of Cantabria. The C3E is a first version based on the 4th report of the IPCC. The idea is to develop one viewer for coastal areas of each Autonomous Community with a better resolution (as planned in the 5th report of the IPCC). This procedure is on its way, and the viewer for Asturias is the pilot. For the other coastal regions, it will take a couple more years to be developed.

The [viewer AdapteCCa for climatic scenarios](#) (projections), developed by the Spanish Ministry for Agriculture and Fishery and Food for and Environment, Biodiversity Foundation, Spanish State Meteorological Agency and the OECC: Considers mainly temperature and rainfall data. The OECC identified the need of incorporating additional indicators (such as heat waves) depending on each sector's requirements. This is foreseen for next year.

Furthermore, the [Water and Environmental Engineering Institute \(IIAMA\)](#) of the Polytechnic University of Valencia, developed a decision support system for water resources planning and management, named [AQUATOOL](#). According to the IIAMA, this program has been used in the majority of Spanish River basins during the development of their hydrologic plans, as well as in river basins in Ibero-America, Western Asia and North Africa. Applications and developments for the [AQUATOOL](#) system is currently being developed, such as the SIMGAMS tool, which will allow the management of available water resources on basin scale, considering priorities regulated by law.

The OECC is leading the pilot project [Iniciativa ADAPTA](#), with the aim of exploring adaptation options and tools to incorporate risk and vulnerability considerations into different business strategies.

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 website on [Environmental Impact Assessment](#) in Spain was created in 2016 by the [Spanish Association on Environmental Impact Assessment](#) and is recommended as guidance by the OECC for considering Climate Change Adaptation during Environmental Impact Assessments. An expansion of the website with case studies is being planned, and the results of this phase will be incorporated into the next Monitoring and Assessment report of the National Climate Change Adaptation Plan.

The [AdapteCCa](#) platform offers guidance documents in the database such as the, [Integration of Climate Change Adaption into Business Strategy project](#), providing methodological guidance for the analysis and prioritization of climate change adaption measures.

The Spanish Ministry for Agriculture and Fishery and Food published on its websites Spanish summary reports of the Assessment Reports from the IPCC. The most recent [summary report of the Fifth Assessment Report \(2014\) of the IPCC work group II](#) (this work group focuses on climate change impact, adaptation and vulnerability) gives a simplified version of the Fifth Assessment Report for public use presents relevant data for climate change impacts and vulnerability assessments as well as adaption strategies. The report can be used as a guidance during climate change adaption assessments.

In 2009, the [Spanish Federation of Municipalities and Provinces](#), in collaboration with Spanish Network of Cities for the Climate (RECC) and the Spanish Ministry of Agriculture and Fishery, Food and Environment, issued a report on [Climate Change Vulnerability on a Local Level](#). The report presents regional climate change scenarios, resulting from regional climate models carried out by AEMET and vulnerability analyses for PNACC defined vulnerable sectors (agriculture, biodiversity and nature protection areas, water resources, forestry, tourism, energy, coastal areas, human health). The outcomes of the analyses are presented in a sheet with sectoral vulnerability analysis results and proposals for adaptation measures for each sector and each municipality of the network (RECC).

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 Spanish Association for Standardization ([UNE](#)) 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).

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 Spanish Climate Change Office (OECC), as the administrative body of the Environmental Ministry, prepared the reference framework in Spain for climate change adaptation; the [National Plan for Adaptation to Climate Change](#) (PNACC), presented in 2006. The PNACC constitutes the reference framework for the coordination of the public administrations to address the impacts of climate change over key sectors and resources. It is based on a [Preliminary Evaluation Report of Climate Change Effects in Spain](#) (2005). The implementation of the in the plan's objectives are being carried through Work Programmes. The [Third Work Programme](#) covering the period 2014-2020 was adopted in 2013. Implementation of the Spanish National Climate Change Adaptation Plan is monitored across sectors through the PNACC monitoring reports which are carried out periodically by the OECC (Spanish Climate Change Office), in coordination with the GTIA (Working Group on Impacts and Adaptation with regional administrations), and adopted by the CCPC and the CNC. The third [progress report](#) was published in 2014 and supports the review of the Work Programme.

The [Spanish law on Environmental Assessments](#), articulates that climate change must be taken into account during both Environmental Impact Assessments and Strategic Environmental Assessments, but adaptation measures only have to be incorporated in the Strategic Environmental Assessment, but not necessarily in the Environmental Impact Assessments. A revision is currently in [preparation](#) (draft law) to integrate the revised EIA Directive 2014/52.

Disaster risk reduction is a field recently considered in adaptation to climate change planning in Spain. The 3rd Work Programme of the PNACC considers this issue as a crosscutting matter to be included in all sectors and territories. According to the official [website of the Ministry of Agriculture and Fishery, Food and Environment on Flooding Risk Management Plans](#), flooding risk management plans for almost all Spanish River basins have been approved in 2016, except for the Canary Islands and the internal basins of Catalonia, which are planned to be approved in 2018. According to the official [website of the Ministry of Agriculture and Fishery, Food and Environment on Monitoring of Flooding Risk Management Plans](#), annual monitoring reports evaluating the achievement of the goals of the Flooding Risk Management Plans are being issued by each river basin.

Responsible authorities

The OECC is in charge of developing, implementing and monitoring the PNACC. Nevertheless, the OECC performs its tasks together with other Units from the Ministry such as Water, Coastal and Marine Areas, Environmental Assessment, Biodiversity, Forest, Agriculture and Rural Development, AEMET and OAPN, and other Ministries (Health, Transport...). In brief, the following institutions have various roles and responsibilities with regard to climate change adaptation on a national level:

- Ministry of Agriculture and Fishery, Food and Environment
- Spanish Climate Change Office (OECC)
- Coordination Commission of Climate Change Policies (CCPCC)
- National Climate Council (NCC).

The responsibility for coordination of the National Climate Change Adaption Plan and its work programmes, is with the OECC within the Ministry of Agriculture, Food and Environment, including responsibilities for promotion of data generation, tools and relevant information for the development of each impact evaluation, facilitation of participatory processes and establishment of links between different working groups.

The Coordination Commission of Climate Change Policies (CCPCC) coordinates between the General State Administration, the Autonomous Communities and the local level. The commission was formed in 2004 and approves Work Programmes. The Impacts and Adaptation Working Group (GTIA) is its technical working group involving the central and regional governments, where coordination and integration of adaptation strategies and activities are pursued, and the activities to implement the PNACC are decided.

The development of action lines to be implemented during the impact, vulnerability and adaption assessments for sectors and systems are highlighted through the Work programmes. The PNACC is assessed by means of reviews of the Work Programs, which result in quadrennial Monitoring and Assessment Reports of the PNACC issued by the OECC. Consequently, the OECC is considered the institutional body with strongest capacity with regards to climate change adaption.

At the regional Level, the Autonomous Communities have developed and are maintaining strategic frameworks, plans and programmes regarding climate change adaption, which are implemented via initiatives and actions. The information exchange and consultation platform regarding climate change adaption in Spain, [AdapteCCA](#), compiles complete information on frameworks and actions at the level of autonomous communities, including a [complete list of regional Adaptation strategies and plans](#).

On a local level, the [Spanish Network of Cities for the Climate \(RECC\)](#) brings cities and villages together, which are committed to sustainable development and climate protection. The objective is to provide a tool for technical support for the local Spanish administrations, as well as a forum for knowledge and experience exchange. Furthermore, some municipalities have worked their own vulnerability analysis in their territories (like [Madrid city council](#)) and other cities are making use of the European initiative '[Mayors Adapt](#)' (Mayor covenant on climate change adaption), committing their cities to develop local adaption strategies or to integrate Climate Change Adaptation into existing plans. Regional differences between the Autonomous Communities are evident, such as variances in terms of financial support, implementation /guidance/encouragement and follow-up by the authorities regarding climate change adaptation. Therefore the OECC is planning the following:

- It is planned to extend to all Autonomous Communities a coastal cartographic viewer on climate data, like the one for Asturias. This way, there would be high-resolution information in the coastal domain for the application of risk evaluation and decision making. This will take a couple of years before it is implemented;
- Financial support will be given to de Autonomous Communities from the central administration;
- Specific areas or activities will be subject to climate change adaptation regulations. For example, private ports (such as smaller "sports" ports) will have to incorporate their own adaptation plan; and
- These processes are coordinated by the OECC.

The Autonomous Community Canary Islands, for instance, being a small archipelago in the Atlantic Ocean off the coast of Africa, is exposed to a significant risk and vulnerability to meteorological phenomena, affecting the principal economic activity of the islands, tourism. The Canarian government developed and approved in 2009 the [Canarian Strategy to address Climate Change \(ECLCC\)](#). The [Canarian Agency on Sustainable Development and Climate Change \(ACDCC\)](#) was then created. The key objectives of the ECLCC is the elaboration of a climate change mitigation plan and a climate change adaptation plan. The development of the ECLCC was stopped in 2011 and the ACDCC was disbanded between 2011 and 2015, due to restructuration within the Canarian government. Nevertheless, according to the above-mentioned study on [Climate Change Adaption Processes on Islands: The Case of the Canary Islands](#), during recent years some initiatives have been implemented, which are indirectly related to climate change adaptation; 78 of 88 municipalities of the Autonomous Community are participating the United Nations Campaign '[Making Cities Resilient](#)', and various municipalities are forming part of the [Covenant of Mayors for Climate & Energy](#).

Management of the ESI Funds

Spain has set up 2 main national Operational Programmes for 1) Sustainable growth, and 2) the SME initiative. These are further linked with 19 regional Operational Programmes, while the country is also participating in 10 cross-border, transnational or interregional co-operation Operational Programmes. The Managing Authority for these 31 Operational Programmes is the General Directorate of European Funds at the Ministry of Finance and Civil Service. The intermediary bodies are the regional authorities of 17 autonomous communities, and two autonomous cities. Regarding the control system for the ESI Funds, the National Coordination Authority, the Certifying Authority, and the Audit Authority are located in separate departments in the Ministry of Finance and Civil Service. The legal basis for the functioning of the Spanish management of ESIF is the Royal Decree 1887/2011, on the basic organic structure of the Ministry of taxes and public administrations; and the Royal Decree 899/2007, approving the regulation on regional incentives from Spanish Law 50/1985.

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

The institutional capacity (human, technical, equipment) relevant to climate change adaptation is currently developing further, based on the Work Programmes and regional strategic frameworks, plans and programmes at the level of the Autonomous Communities. Budgetary resources are available through the European ESI Funds, and Government or Autonomous Community Treasury.

The following strategies, plans and instruments have specific references to the research needs of the PNACC:

- Spanish Strategy for Science, Technology and Innovation (2013-2020)
- State Plan for Scientific and Technical Research and Innovation (2013-2016). The OECC is currently delivering its input into the new Plan 2017-2020 for mainstreaming climate change needs into research priorities at a national level.
- National Parks (OAPN): grants support for research on global change in these protected areas

- Biodiversity Foundation: provides co-financing grants for the development of projects related to climate change adaptation issues.

Effective collaboration

There are three coordinating Bodies involved in the [National Plan for Adaptation to Climate Change](#) (PNACC):

1. The National Climate Council (CNC), linked to the Ministry of Environment, involves different Departments of the National Administration, the Autonomous Communities, the Spanish Federation of Municipalities and Provinces, representatives from research institutions, social actors and nongovernmental organizations
2. The Coordination Commission of Climate Change Policies (CCPCC) is a coordination and collaboration body between the National and Regional Administrations for all matters related to climate change. Local entities are also represented in this Commission.
3. The Environmental Sector Conference is a political high-level cooperation body with a multilateral composition that brings together members of the Ministry of the Environment, on the State General Administration, and members of the Environmental Council, representing the Administrations of the Autonomous Communities.

The Spanish Climate Change Office (OECC) and the National Centre for Environmental Education lead the project "[Answers to Climate Change from Communication and Education](#)": in the framework of the PNACC, a programme of 'sectoral seminars' is organised, where researchers, policymakers from the central and the regional administrations and the civil society present and examine research results, the outcomes of sectoral vulnerability assessments, policy experiences, and discuss on their use and further priorities for informing policies.

LIFE-SHARA brings together partners from Spain and Portugal, and its expected results include improving the Spanish adaptation platform AdapteCCa (in terms of contents and functionalities), involving key stakeholders to work together and mainstream adaptation into their planning and managing activities, expanding the level of awareness and building capacities for adaptation to climate change. LIFE SHARA lays the grounds for a long term transnational cooperation mechanism between the Adaptation Units of Portugal and Spain that will catalyse joint actions and projects and will conduct to the organization of the first Iberian Conference on Adaptation to Climate Change.

Financial resources

The present study examined how the [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming period for Spain. Concerning major projects, by early 2018, there have been no funds allocated for major projects in Spain 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](#), Spain is planning investments of 27 Billion EUR. Projects under the Thematic Objective 5 on promoting climate change adaptation, risk prevention and management will be receiving 237 Million EUR, with an additional 2,236 Million EUR approved for Network Infrastructures in Transport and Energy (Thematic Objective 7); 2,065 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6); and 1,872 Million EUR for Information and Communication Technologies (Thematic Objective 2). The shares within these Thematic Objectives that may relate to climate adaptation are unknown.

4. SECTOR OVERVIEW

4.1. Introduction

Since 2014, the requirements for major projects to obtain ESIF funding³ demand that project applications integrate climate change considerations⁴, 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 sea-level rise and extreme weather events, such as extended heatwaves, flooding, heavy rainfall or storm, and landslides amongst others. Extreme weather events are a potential threat to both infrastructure and operation of the transport system.

Road infrastructure

A working group on the need of climate change adaption for the Spanish backbone of the transport infrastructure was formed, which consists of the [State Secretary for Infrastructure, Transport and Housing](#), the [State Secretary of Environment](#), [Adif](#), [Renfe](#), [Puertos del Estado](#), [AENA](#), [Ineco](#), [CEDEX](#), [OECC](#), [AEMET](#) and the [European Environment Agency](#).

The group issued a [report](#) in 2013 presenting a study on potential climate change impacts on transport infrastructures in Spain. Furthermore, the report provides methodologies on

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.

vulnerability assessment and provides proposals for potential adaptation measures for the Spanish transport infrastructures.

Data is available on the [AdapteCCA](#) information exchange and consultation platform.

Tools are provided in the form of several viewers; the [national cartographic viewer of flood-prone areas \(SNCZI\)](#), the [C3E cartographic viewer for coastal areas](#), the [cartographic viewer for the "Principado de Asturias region"](#) and [AdapteCCa for climatic scenarios viewer](#) (projections on temperature and precipitation).

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

Railway infrastructure

Guidance is available for the backbone of the transport infrastructure. A pilot study, included in the [Integration of Climate Change Adaption into Business Strategy](#) project (2014), resulted in a detailed analysis of the vulnerability to climate change for the company's railway activity. It connects the cities Alicante, Valencia, Castellón, Tarragona and Barcelona. The second phase of this project was completed in 2016 and resulted in a proposal outlining adaptation measures. These results could serve as a guiding document for other similar projects, however, the results of the second phase from 2016 have not been published.

A report titled [Adaptation of Transport to Climate Change in Europe - Challenges and Options across Transport Modes and Stakeholders](#) was issued by the European Environmental Agency in 2014. According to this report, there is a disaster risk management plan being prepared under the responsibility of the Civil Protection Services.

The same [report](#), and the [report on Need for Climate Change Adaption of the Spanish Backbone Transport Infrastructure \(2013\)](#), both mention that since 2011, the Spanish rail service operator Renfe started using a software application called *Borrasca*, which provides advance information on changes in weather conditions over the upcoming hours which could affect the movement of its trains, in order to allow Renfe to establish preventive measures.

See also section above on road infrastructure, and section 4.1 for more general documents that can help in taking climate considerations into account.

Airport infrastructure

No specific strategy on making Spanish 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.

From the research conducted, limited resources were identified relating to formal authorities and institutions for broadband in Spain. No specific guides, tools or other instruments have been identified for the Spanish broadband sector that could assist in addressing climate adaptation. Nevertheless, broadband is a relevant sector: following the '[European Funding for Broadband 2014 – 2020](#)' report, Spain included for about 464 Million Euro broadband investments into their 2014-2020 programmes.

As for all sectors, various non-sector specific sources of data and information can be consulted:

- The [AdapteCCa](#) information exchange and consultation platform;
- Cartographic viewers for coastal and areas on flooding risk, temperature, erosion, sea level rise etc. These viewers can be applied to any infrastructure projects.

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

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

4.4. Urban Development

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

The Spanish urban development sector has access to various on-line sources of data and information. The [AdapteCCa](#) information exchange and consultation platform provides general information, as well as miscellaneous guidance and methodological documents, and a cartographic viewer on temperature and precipitation data. Other useful (previously mentioned) cartographic viewers for coastal areas are available for flooding and erosion risk assessment and the impact on infrastructures at the Spanish coasts, and a nation-wide cartographic viewer is provided to consult for flooding-prone areas on the coasts and inland areas (fluvial and marine flooding risk). They are focused on impact and adaption in big coastal cities and the tourism sector. According to the OECC, little guidance around how to use established methodologies and tools is available, and technical knowledge is needed to properly understand and apply them.

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.

On a local level, the [Spanish Network of Cities for the Climate \(RECC\)](#) is a platform for technical support for the local administrations. In 2009, the [Spanish Federation of Municipalities and Provinces](#), in collaboration with RECC and the Spanish Ministry of Agriculture and Fishery, Food and Environment, issued a [report on Climate Change Vulnerability on a Local Level \(2009\)](#). The report presents regional climate change scenarios, resulting from regional climate models carried out by [AEMET](#) and additionally vulnerability analyses for the in the PNACC determined vulnerable sectors (agriculture, biodiversity and nature protection areas, water resources, forestry, tourism, energy, coastal areas, human health). The outcomes of the analyses are presented in a sheet with sectoral vulnerability analysis results and proposals for adaptation measures for each sector, and each municipality of the network (RECC).

Furthermore, Spanish cities can make use of the European initiative '[Mayors Adapt](#)' (Mayor Covenant on climate change adaption), which is referenced on the [AdapteCCa website](#).

The [Water and Environmental Engineering Institute \(IIAMA\)](#) of the Polytechnic University of Valencia is currently working together with the [Research Group on Construction Technology](#) of the University Cantabria, on a project named [SUPRIS](#). The project is financed by the [Spanish Ministry of Economy, Industry and Finance](#) and [European Regional Development Fund \(ERDF\)](#) to promote climate change adaption of cities by transformation of urban spaces by preparing their surfaces including pavements and roofs of the buildings to handle extreme rainfall and temperature events. The project is currently still at an early stage.

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

The Spanish energy sector is provided with various on-line sources of data and information. The [AdapteCCa](#) information exchange and consultation platform provides general information, as well as miscellaneous guidance and methodological documents, as well as a [cartographic viewer](#) on temperature and precipitation data. Other useful cartographic viewers for coastal areas are available, covering flooding and erosion risk assessment and the impact on infrastructures at the Spanish coasts, as well as a nation-wide cartographic viewer presenting flood-prone areas at coastal and inland areas (fluvial and marine flooding risk). These viewers could be applied for energy infrastructure projects in the coastal and inland areas, since they provide comprehensive flooding and erosion impact information for all areas along the Spanish coast line.

Guidance for impact and vulnerability assessment is available in the private sector; an [analysis of the climate change impact on the Spanish energy sector](#) was published in 2015 by the Pontifical University Comillas (Madrid), which provides an explanation on how risk and vulnerability assessment for climate change impacts on the Spanish energy

sector have been performed, and presents the results of this assessment. Therefore, it could serve private energy companies as a source of information and a rough guide. The Pontifical University Comillas worked together with the water department of the Spanish Environmental Ministry. According to the Technological Investigation Institute of the University Comillas, no other Climate Change Adaptation guidance related work has been carried out so far for the Spanish energy sector.

A pilot study, included in the [Integration of Climate Change Adaption into Business Strategy](#) project from 2016, resulted in a proposal for climate change adaptation measures for hydroelectric plants at the water reservoirs of Cala (Sevilla) and El Tranco (Jaén), as well as the run-of-the-river station of Mengíbar (Jaén), which could serve as a guiding document for other similar projects.

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

4.6. Water

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

Water supply / availability is a sensitive topic in Spain as occasionally the country suffers water scarcity. Aquifers are often over-exploited especially in southern regions, resulting in reduction of groundwater quality and availability. Alternatives to exploitation of groundwater projects have been launched in the past considering sea water desalination or water transfer from rivers, which are abundant in water, to other (more arid) regions.

As for all sectors, the various on-line sources of data and information can be consulted. The [AdapteCCa](#) information exchange and consultation platform provides general information, as well as miscellaneous guidance and methodological documentation, and a cartographic viewer on temperature and precipitation data. Other useful cartographic viewers for coastal areas are available for flooding and erosion risk assessment and the impact on infrastructures at the Spanish coasts, as well as a [nation-wide cartographic viewer displaying flood-prone regions at coastal and inland areas](#) (fluvial and marine flooding risk). These viewers can be applied for water infrastructure projects in the coastal and inland areas.

Further, a pilot study, included in the [Integration of Climate Change Adaption into Business Strategy project](#) (2014), resulting in a proposal of climate change adaptation measures for a desalination plant (Canal de Alicante, Andalusia), could serve as a guiding document for other similar projects.

A national project, IMPADAPT (Global Change Impact and Adaption of Water Resource Systems) is being developed by the [Water and Environmental Engineering Institute \(IIAMA\)](#) of the Polytechnic University of Valencia and the [Spanish Mining and Geology](#)

[Institute \(IGME\)](#). It aims to develop methodologies and tools to study the recent and future impact of the global change in water resource systems, and to design adaptation strategies with an integrated approach (including hydrological, economic, urban hydraulic, agronomic, statistical, ecological and many more parameters), to be of use for hydrological planning. The study is financed by the [European Regional Development Fund \(ERDF\)](#) and the [Spanish Ministry of Economy, Industry and Finance](#).

Further, the IIAMA, developed a decision support system for water resources planning and management, named [AQUATOOL](#). This program has been used in the majority of Spanish River basins during the development of their hydrologic plans, as well as in river basins in Ibero-America, Western Asia and North Africa. Applications and developments of the [AQUATOOL](#) system are currently in process, such as the SIMGAMS tool, which will allow to manage available water resources on basin scale, considering the priorities regulated by law.

Another water management strategy to adapt to global change at river basin scale was developed by the IIAMA, together with the [French Geological Survey \(BRGM\)](#) and the [European Centre for Research and Advanced Training in Scientific Computing \(CERFACS\)](#). The corresponding scientific article is called [Integrating top-down and bottom-up approaches to design global change adaptation at the river basin scale \(2015\)](#). The article contributes new methodological elements for the development of an integrated framework for decision-making under climate change uncertainty, advocating an interdisciplinary approach. The method considers an integrated approach to support the selection of adaptation measures at the river basin level; by comprehensively integrating the goals of economic efficiency, social acceptability, environmental sustainability and adaptation robustness. A case study was developed in the Orb river basin in France, and another is being developed for the Júcar River in Spain. Currently, the methodology developed during this study is being implemented in the national IMPADAPT project.

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

4.7. Waste

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

In Spain, no specific examples, guides, tools or other instruments have been identified for the waste sector that could assist in addressing climate adaptation. Nevertheless, waste treatment plants and landfills need to comply with environmental legislation, which can make them more climate resilient.

[Directive 1999/31/EC on the landfill of waste](#) requires that landfills are situated and designed in such a way that safeguard against pollution of the soil, groundwater or surface water. 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

Integration of Climate Change Adaption into Business Strategy – Pilot case ENDESA	
Project description	Endesa is a private, energy supply company providing electricity and gas. The pilot case includes a detailed analysis of the vulnerability to climate change for the company’s activity at the hydroelectric plants in the water reservoirs of Cala (Sevilla) and El Tranco (Jaén), as well as the run-of-the-river station of Mengíbar (Jaén). This was carried out in a first phase and presented in a report in 2014. In a second phase of the pilot, adaption measures for the three reservoirs in Andalusia were identified. The outcomes of this second phase were published in 2016.
Photograph	N/A
Budget	N/A
Climate Change Vulnerability and Risks	Major risks were identified related to increasing temperature, which would lead to mayor evapotranspiration of vegetation of basins and a major need of water and irrigation supply. Less precipitation in basins resulting in less hydroelectric production and increase of water selling costs are some of the other risks revealed by the study. Risks related to extreme weather events are considered to be of minor importance.
Climate change adaptation measures	Proposed adaption measures: <ul style="list-style-type: none"> • Water demand management: By influencing the demand, optimization of the management of the hydroelectric installations shall be achieved. • Meteorological and climatological predictions and water reservoir management • Handling of suspended solids to minimize the accumulation of sediments in the water reservoirs to resolve technical problems of the installations (clogging) • Adaption of emergency plans to new climate conditions.

Good practice	Except for implementation, all steps of climate change adaption assessment have been carried out and are described: The pilot can serve as a methodological guide for other transport infrastructure projects. The pilot can also serve as a methodological guide for other, similar projects.
Further information	Website of the Spanish Ministry for Agriculture and Fishery and Food and Environment

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

Integration of Climate Change Adaption into Business Strategy – Pilot case GRUPO FERROVIAL	
Project description	Grupo Ferrovial is a multinational infrastructure company with the following four divisions: Highways, Airports, Construction and Services. Detailed analysis for the vulnerability to climate change of the desalination plant Canal de Alicante was carried out as a first phase, and presented in a report in 2014. In a second phase of the pilot, adaption measures for the plant were identified. The outcomes of this second phase were published in 2016.
Photograph	N/A
Budget	N/A
Climate Change Vulnerability and Risks	<p>Increased temperatures and less precipitation, sea level rise, (regional climate projections) were identified as major risks.</p> <p>Impact analysis concluded that deviations in sea water quality due to increased sea water temperature, such as increased salinity could be a major impact for the plant, because more chemical products will be applied to assure water quality, implying an increased energy consumption. Changes in the design of high-pressure pumps and membranes were deemed necessary.</p> <p>Furthermore, an increased demand due to drier periods was predicted, as well as damages at the water caption infrastructure and water transport could be a result of extreme weather events.</p>
Climate change adaptation measures	<p>Proposed adaption measures:</p> <ul style="list-style-type: none"> • Admixture of sodium hydroxide to minimize the effects of increased water temperature in order to be in compliance with applicable legislation in terms of quality of supplied water • Membrane replacement to assure process efficiency • Sodium hypochlorite clash to minimize bacteria growth due to increased water temperature and protect installations
Good practice	Except for implementation, all steps of climate change adaption assessment have been carried out and are described: The pilot can serve as a methodological guide for other transport infrastructure projects. The pilot can serve as a methodological guide for other,

	similar projects.
Further information	Website of the Spanish Ministry for Agriculture and Fishery and Food and Environment

Integration of Climate Change Adaption into Business Strategy – Pilot case Renfe

Project description	<p>Renfe is a public company operating the Spanish national railway network. Prepared by Spanish Ministry for Agriculture, Food and Environment, Spanish Biodiversity Foundation (Fundación de Biodiversidad) and the Spanish Climate Change Office (OECC) in 2014 in Madrid.</p> <p>Detailed analysis of the vulnerability to climate change of the company's activity at the railway which connects the cities Alicante, Valencia, Castellón, Tarragona and Barcelona. According to the OECC, a second phase of this project was completed in the beginning of 2016, proposing adaptation measures, but the result has not been published.</p>
Photograph	N/A
Budget	N/A
Climate Change Vulnerability and Risks	Extreme weather events and temperature increase were identified as main risks.
Climate change adaptation measures	No adaptation measures were identified during the first stage of the pilot, which is the only one published so far. However, a second stage of the study is reported by the OECC to include an in-depth risk, opportunity and vulnerability analysis, and design and implementation strategy.
Good practice	The outcomes of the second stage of the study (in-depth risk, opportunity and vulnerability analysis, and design and implementation strategy) will include most important steps of climate change adaption assessment and can serve as a methodological guide for other transport infrastructure projects.
Further information	Website of the AdapteCCa platform: http://www.adaptecca.es/sites/default/files/documentos/renfe.pdf

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