



# Climate change adaptation of major infrastructure projects

Country report for France

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

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

## 1. INTRODUCTION

The [EU Strategy on Adaptation to Climate Change](#) of 2013 includes actions to enhance the resilience of infrastructure and mainstream climate adaptation into the European regional and cohesion policy. The [Common Provisions Regulation](#) (CPR) of 2013 states under article 8 that climate change mitigation and adaptation, and risk prevention shall be taken into consideration for investments made with the support of the European Structural and Investment Funds (ESI Funds). The regulation integrates climate change adaptation considerations into the preparation and approval of major projects<sup>1</sup> or other projects funded by the ESI Funds through the requirement to conduct climate change vulnerability and risk assessments. In coordination with the ESI Funds, and complimentary to them, the LIFE fund in addition assists in the realisation of the climate change adaptation objectives. Climate change analyses (such as vulnerability and risk assessments) are also sporadically found to be undertaken for infrastructure projects that are financed outside the framework of EU funds.

This report for France 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 Adaptation Strategy](#) was adopted in 2006 and complemented in 2011 by the adoption of the [National Adaption Plan](#). The process for the revision of the National Adaptation Plan (NAP) has started in June 2016 and is expected to conclude in 2018. Adaptation is under the responsibility of the Ministry of the Environment since 2001, when climate change was identified in the Environmental Code as a national priority. To address climate adaptation at the national level, the National Observatory on the Effects of Climate Change (ONERC) was set up in 2001 by the Ministry of the Environment, as part of the General Directorate on Energy and Climate and tasked with the collection and dissemination of information on the risks posed by climate change. It primarily works with the Intergovernmental Expert Group on the Evolution of Climate (GIEC), a research group under the aegis of the International Panel on Climate Change (IPCC). At the regional level, each region has to submit a [Regional Scheme for Climate, Air and Energy](#)

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

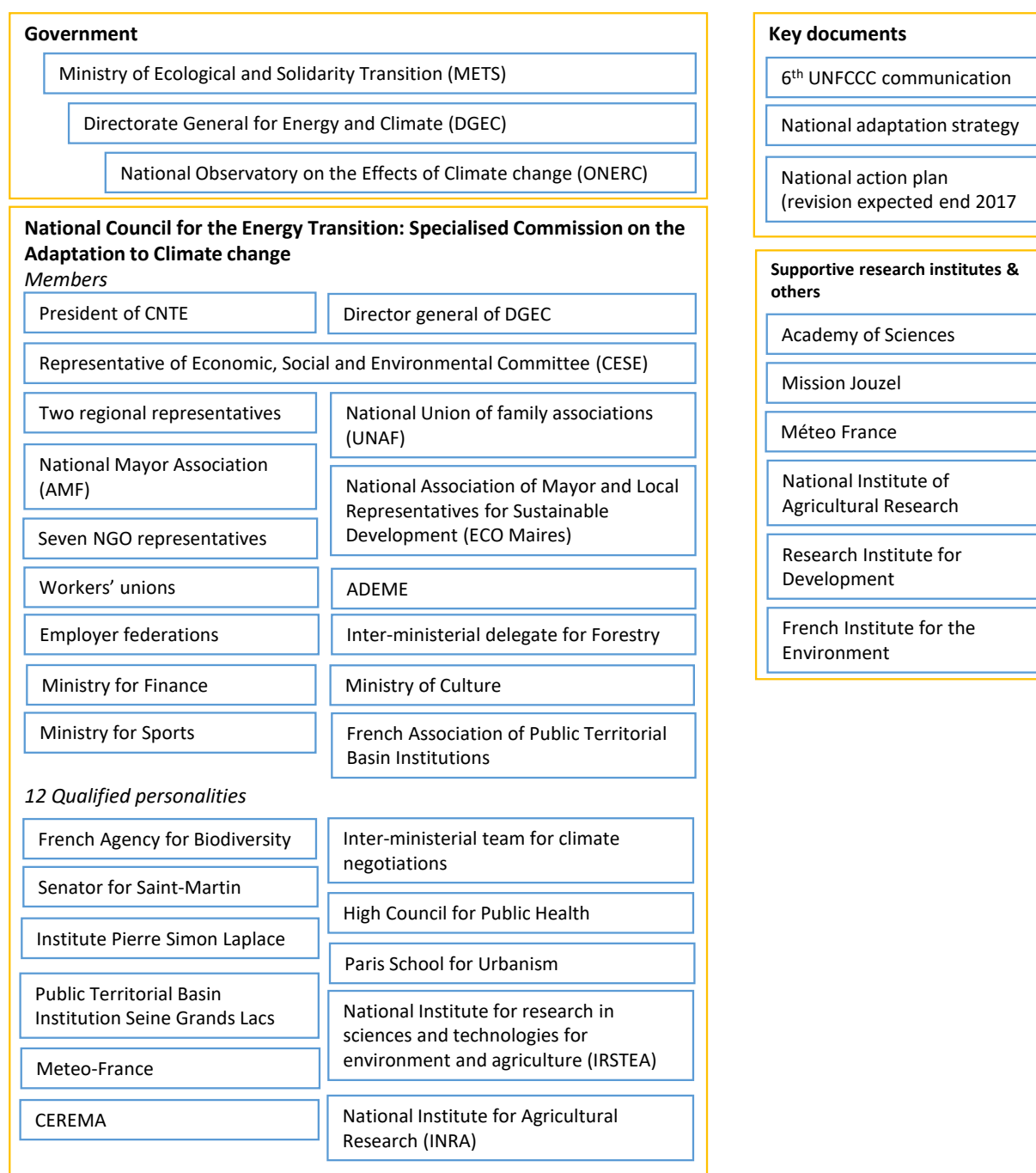
since 2007. These must include a vulnerability assessment of the territory and a section dedicated to adaptation to climate change.

Important websites for climate adaptation information and data are provided by the [Ministry of the Environment](#), [WIKLIMAT](#), and by the [National Meteorological Service, Météo France](#), which is accessible online. Regional data can be found in the Regional Schemes for Climate, Air and Energy (SRCAE). France has set up as a resource centre providing [methodological and operational support for the implementation of a Climate-Territorial Energy Plan](#). From the outcome of the review and recommendation process that will serve as a basis for the 2018 National Adaptation Plan, [the new NAP will provide a clear methodology](#) to support the identification of infrastructure projects critically at risk from climate change. The National Meteorological Service [Météo-France](#) has developed several tools to assess the potential impacts of climate change, including [DRIAS](#), [ARPEGE CLIMAT](#) and [ClimatHD](#). To assess the overall risk for a territory in France, the Ministry of the Environment developed an [interactive map](#) of all the geological risks, the [GEORISQUE](#) tool. The ADEME has compiled a [list of potential vulnerability indicators](#) in a report in an effort to provide public authorities in charge of undertaking vulnerability assessment with a toolbox. As an action of the 2011 National Adaptation Plan, a specific tool is [being developed](#) by the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) to support decision-making in the transport sector. As part of the 2010 report on the [Economy of the adaptation to Climate Change](#) the Ministry of the Environment published guidance on the assessment of costs and benefits of adaptation in 2010 which can be applied to territories or infrastructure. A [guidance for territories to perform climate change vulnerability analysis](#) was also published in 2011 by the MOE to assist local authorities in assessing their vulnerability to climate change. As part of the 2010 report on the [Economy of the adaptation to Climate Change](#), the MOE published guidance on the assessment of costs and benefits of adaptation in 2010, which can be applied to territories or infrastructure. As an action of the 2011 National Adaptation Plan, a specific guide is being developed to provide assistance in estimating costs and benefits of adaptation measures in the transport sector: the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning has published a first [methodological framework](#). The French Standardisation Association (AFNOR) has yet to address the issue of climate change adaptation. EU resources are in use, such as the [Guide to Cost-Benefit Analysis of Investment Projects](#), the publication on [Climate Change and Major Projects](#) and the non-paper [Guidelines for Project Managers](#).

The transport sector was specifically targeted by the 2011 National Adaptation Plan with four different actions carried out by the General Directorate for Infrastructure, Transport and Sea ([DGITM](#)) and the Centre for Studies and Expertise on Risks, the Environment, Mobility and Planning (CEREMA). The broadband sector has so far taken little steps towards adaptation, but from the outcome of the review and [recommendation process](#) that will serve as a basis for the 2018 National Adaptation Plan, [adaptation of broadband will be addressed](#). Urban development was specifically addressed in the 2011 National Adaptation Plan with four measures to improve how adaptation is taken into account in urban planning. [ROSAU](#) is a tool specifically developed to increase urban resilience. In the energy sector, the French TSO (RTE) publishes a yearly report on projected consumption and production patterns which is used for the evolution of planning procedures to ensure that maintenance processes are planned according to the new patterns influenced by temperature evolutions. Overall, the existing infrastructure is considered to be able to sustain projected temperatures, though localised adjustment may be necessary. For the water sector, in 2016 the CEREMA published a new [national vulnerability assessment](#) on the risk of flooding. It is noted that following an engagement during the COP21, the six regional water regulators Agences de l'Eau [committed](#) to integrate adaptation measures in their planning schemes for the period 2016-2021. The waste sector is not dealt with in the national or regional authority climate change adaptation plans or initiatives organised by governmental bodies.

Case studies identified in France cover a Water management initiative in a new district in Rouen (more information from: [Luciline - Rives de Seine](#)) and the [Bellegarde Railway Station](#).

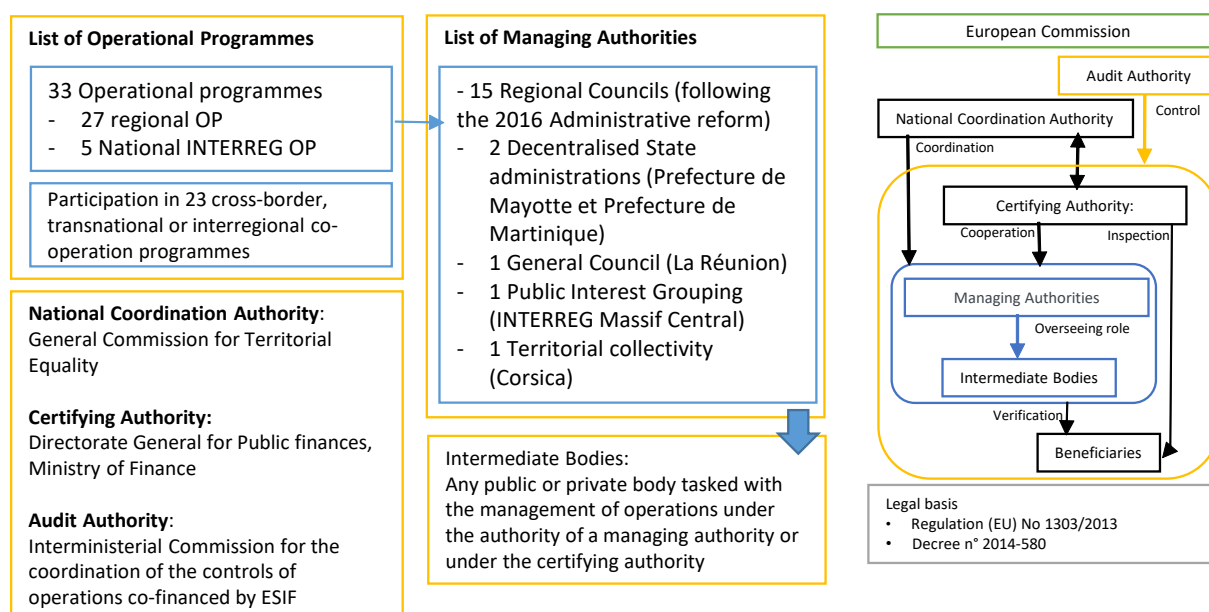
## 2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK



In France, the national climate adaptation framework is headed by the Ministry Of Ecological And Social Transition. The General Directorate for Energy and Climate, and within it the National Observatory on the Effects of Climate Change (ONERC) is in charge of adaptation policy-making. A number of key documents have been published, namely the national Adaptation Strategy and the National Action plan, while the latter in process of being updated in 2018. A National Observatory on the Effects of Climate Change has been established, it has inter-ministerial competences and is participated by all relevant ministries and government bodies, including civil society organisations, municipalities, overseas territories etc. Supportive institutions provide scientific input to the work of the observatory, and develop tools and guidelines that are useful for the development of



infrastructure. The General Directorate on Energy and Climate designs and enforces policies on climate change mitigation and adaptation. Within the General Directorate, the National Observatory on the Effects of Global Warming is in charge of adaptation policy-making. For the financing of major projects, ERDF is mainly absorbed through regional Operational Programmes managed by Regional Councils.



### 3. RESOURCES

This country report has reviewed the currently available resources in France for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis<sup>2</sup> for ESIF-funded projects, through the processes of vulnerability and risk assessments which are, broadly:

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

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

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

<sup>2</sup> Regulation (EU) No 1303/2013, Commission Delegated Regulation (EU) No 480/2014, Commission Implementing Regulation (EU) No 1011/2014, No 215/2014, 2015/207; and the Directives 2001/42/EC, 2011/92/EU and 2014/52/EU

<b>Resources</b>	<b>Explanation</b>
<b>Data Availability</b>	The availability, accessibility and applicability of data on climate projections and impacts, on geophysical parameters, on long-term scenarios, on economic, environmental and social impacts, etc.
<b>Methodologies</b>	The existence of quantitative or qualitative methodologies (a system of processes, a set of principles and rules) for integrating climate change adaptation in the development of infrastructure projects.
<b>Tools</b>	The availability of tools for planning, evaluation, impact estimation (i.e. software, maps, computer simulations, long term climate forecasts etc.) to assist with the adaptation of infrastructure to climate impacts
<b>Guidance</b>	The provision of guidance on how to use methodologies (i.e. for conducting climate change vulnerability and risk assessments) or develop the required infrastructure project documentation relating to climate adaptation.
<b>Design Standards</b>	The availability of published engineering design standards (i.e. by BSI, DIN, ISO) for infrastructure projects that include sections or appropriate provisions to ensure resilience to climate change impacts
<b>System</b>	The institutional and legal framework that the formal authorities work with to deliver their primary responsibilities for climate adaptation, infrastructure, and management of European Structural and Investment Funds
<b>Institutional capacity</b>	The human and technical capacity of institutions to carry out their functions. It depends on being adequately resourced, on having the appropriate expertise, and on collaborating effectively and enforcing laws and regulations

### **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. A number of resources are available for project developers to base vulnerability assessments on, especially in terms of data.

Improved access to information related to climate change adaptation was one of the main measures of the 2011 National Adaptation Plan. Climate information is available and easily accessible as the Ministry of the Environment (MOE) has a specific [webpage dedicated to climate change adaptation](#). It summarises the institutional framework and links to a number of relevant reports, studies and databases, including the main [climate change indicators](#). Observations of the French climate are available on the Météo France (French national weather service) [website](#) which provides yearly and seasonal assessments, public climatologic data and extreme events early warning including storm surges.

[WIKLIMAT](#), a specific platform to share knowledge between the different actors involved with climate change adaptation, was set up in July 2013 by the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) within the framework of the National Adaptation Plan. It enables stakeholders to contribute by promoting their initiatives and achievements. The majority of climate information is

provided by the [National Meteorological Service, Météo-France](#), which is accessible online (temperature levels, precipitation levels, weather forecasts etc.).

The National Institute of Statistics and Economic Studies ([INSEE](#)) is responsible for coordinating France's official statistical service and disseminates information on the French economy and society, although the exact content of these databases was not examined in the context of the present study.

Research institutes active in the area of climate adaptation include the Institute Pierre Simon Laplace ([IPSL](#)), the European Centre for Research and Teaching in Environmental Geosciences ([CEREGE](#)), the Laboratory of Climatology, Risk, and Environment ([LCRE](#)), and the Laboratory of Dynamic Meteorology ([LMD](#)). IPSL contributes to climate studies on a global scale. They study the atmosphere, the oceans, the ice, the continental surfaces, marine biogeochemistry, radiative balance of the Earth, the water and carbon cycle (IPSL, 2017).

A comprehensive overview of how climate change will affect the French territories in the future decades is found in the [five reports from the Mission Jouzel](#) on [the French climate in the 21st century](#). A 2009 [report](#) by the National Observatory on the Effects of Climate Change (ONERC) offers an quantification of [costs and impacts of climate change in France](#), with specific sections on the energy sector and the transport sector.

Regional climate data can be found in the Regional Schemes for Climate, Air and Energy (SRCAE) adopted by each region. They each include a vulnerability analysis of their territory. Regional Observatories on the Effects of Climate Change (ORECC) are also reliable data repositories. Several projects were set up to gather data at a more detailed level while Regional Observatories on the Effects of Climate change were installed to collect regionalised data sets. [AcclimaTerra](#) is a project in New Aquitaine Region to support local actors in drafting their adaptation strategy. [Hyccare](#) contains specific information on climate change and its impacts on water resources in Burgundy. [GREC](#) is a project identifying climate information specific to Provence-Alpes Côte d'Azur. [EXTREMOSCOPE](#) is a database that references extreme events. The ONERC published in 2013 a report describing [the effects of climate change in the French Overseas territories](#) by sector.

The ADEME supports local authorities in the implementation of adaptation actions to climate change with [collections of experiences](#):

- [Vulnerability diagnosis of a territory to climate change](#)
- [Collection of ex-ante evaluation experience of territorial actions](#)
- [Develop and implement an adaptation strategy or action plan in a territory](#)
- [Monitor and evaluate climate change adaptation in the territories](#)
- [Indicators of vulnerability of a territory to climate change](#)

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. To support project managers and administrative authorities in charge of conducting vulnerability analyses for the purpose of the Regional Schemes for Climate, Air and Energy (SRCAE), the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) published in 2014 a [methodological note](#) (not publicly available) to support them in this exercise by listing data sources and providing guidance for its completion.

To support the achievement of adaptation measures on the basis of the SRCAE in the Territorial Climate-Energy Plan (PCAET), the MOE and the Agency for the Environment and the Management of the Energy (ADEME) have set up a resource centre providing [methodological and operational support for the implementation of a Climate-Territorial Energy Plan](#).

The National Observatory on the Effects of Climate Change (ONERC) published in 2010 a note on [taking account of rising sea level when estimating the impact of climate change and potential adaptation measures](#). The MOE published in 2015 a methodology for [calculating the costs of resilience in network infrastructure](#) to take into account future climate parameters.

From the outcome of the review and recommendation process that will serve as a basis for the National Adaptation Plan, the new PNACC will include a provision aiming to provide a methodological framework to support the identification of infrastructure projects critically at risk from climate change. The review also noted the need for further work to identify costs and benefits of adaptation measures in different sectors.

### **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 Meteorological Service Météo France has developed several tools to assess the potential impacts of climate change. [DRIAS](#) is an aggregate of climate datasets compiling the most recent scenarios from different French research centres. This tool serves as a repository of best-practice for climate projection, a precise interactive way to visualise projections. It also offers an export function. Météo France also makes available a comprehensive numerical model to develop climate projections, [ARPEGE CLIMAT](#). A third tool available on the website of Météo-France is [ClimatHD](#), an interactive map presenting the past and future climates in France.

To assess the overall risk for a territory in France, the MTES has developed an [interactive map](#) of all the geological risks, the [GEORISQUE](#) tool. While it is not specifically assessing the risk posed by climate change, flood level projections are taken into account.

The ADEME has compiled a [list of potential vulnerability indicators](#) in a report in an effort to provide public authorities in charge of undertaking vulnerability assessment with a toolbox. The ADEME supports local authorities in the implementation of adaptation actions to climate change with [thematic tools](#) such as the [Guide on "Reducing the urban heat island"](#) and the [Green book of research project "Climator"](#). It offers [regionalized toolboxes](#): for [Franche-Comté](#), for [Languedoc-Roussillon](#), for [Burgundy](#) and [Poitou-Charentes](#). In this context, ADEME also provides a specific excel file to support the preparation of vulnerability assessment as part of its tool [IMPACT'CLIMAT](#).

As an action of the 2011 National Adaptation Plan, a specific tool is [being developed](#) by the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) to support decision-making in the transport sector by providing an operating framework to assess the vulnerability of the infrastructure and inferring a "vulnerability rating" (see section Transport).

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. As part of the 2010 report on the [Economy of the adaptation to Climate Change](#) the Ministry of the Environment published guidance (p.34-38) on the assessment of costs and benefits of adaptation in 2010 which can be applied to territories or infrastructure. A [guidance for territories to perform climate change vulnerability analysis](#) was also published in 2011 by the MOE to assist local authorities in assessing their vulnerability to climate change. As an action of the 2011 National Adaptation Plan, a specific guide is being developed to provide assistance in estimating costs and benefits of adaptation measures in the transport sector: the Centre for Study and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) has published a first [methodological framework](#) and is now gathering feedback on its implementation in an effort to improve it.

The ADEME supports local authorities in the implementation of adaptation actions to climate change with [methodological guides](#), namely the [Impact'Climat](#), a diagnostic approach to the impact of climate change on the territory, and [Objectif'Climat: Monitoring and evaluation method for climate change adaptation policies](#)

A [list of measures to address climate change in urban development](#), including adaptation measures, has been published in 2015 by the Ministry of Housing and Territorial Equality (MHTE) (see the Section on Urban Planning). To support project developers in integrating greater risks posed by water in their cost-benefit analysis, the CEREMA published a [study](#) providing [the costs of measures protecting against water damages](#). In 2016 the French Initiative for Coral Reefs (IFRECOR) developed a set of specific guidelines to assess the [costs and benefits of adaptation for coastal infrastructure in inter-tropical environment](#). This document is of particular relevance for the French Overseas Territories as it provides a framework for cost-benefit analysis.

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

For the transport sector, the 2011 PNACC set out an action to review and adapt technical standards for the construction, maintenance and operation of transport networks infrastructure in mainland France and its overseas territories. CEREMA published in 2015

a report on the [revision of standards in the Transport sector](#), and the identified standards are currently being reviewed (for more information please refer to the section on Transport). However, for some technical transport infrastructure benchmarks it is currently impossible to say whether they should be adapted and how, because current climate data and projections for the future climate are not always compatible with the form of the data provided in the reference guides and allowing the experts to decide.

### **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***

In 2006 the ONERC published the [National Adaptation Strategy \(2006\)](#) which was formally adopted by the Prime Minister. It was complemented in 2011 by the adoption of the [National Adaption Plan \(2011\)](#) which set out 280 specific measures divided in 20 action sectors. The [2011 National Adaptation Plan](#) (PNACC) clearly indicated actions to be undertaken in several sectors to develop relevant methodologies, while others were not addressed, either because they were not included in the plan or because they were not identified as priority sectors.

The 2011 PNACC is currently under review. Many different economic stakeholders were involved in the process which was structured around six working groups and delivered 33 recommendations. Between June 2016 and May 2017, the six working groups for a new National Adaptation Plan for Climate Change (PNACC) completed their work within the following 6 components: [Governance](#), [Prevention and Resilience](#), [Adaptation and preservation of environments](#), [Knowledge and information](#), [Economic sectors](#), [International Action](#). Based on these, a [new plan](#) is expected to be published before the end of 2018.

At the regional level, each region has to submit a SRCAE's (Regional Scheme on Climate, Air and Energy) since 2007. These must include a vulnerability assessment of the territory and a section dedicated to adaptation to climate change. All the 26 (one per region) SRCAE's have been approved, covering 100% of the French population. At a more local level, the SRCAE are translated into local (Cities or Inter-municipality associations) plans (PCET: Climate Plan on Energy and Territory) or Urban plans (PLU Local Urbanization Plans). The number of foreseen plans is over 400.

The River Basin Management Plans are (Schémas directeurs d'aménagement et de gestion des eaux - SDAGE) (2016-2021) are under development and aim to include climate adaptation actions and measures.

The [National Research Strategy](#) also includes a reference to Climate Change Adaptation.

Regions and local authorities (departments, municipalities, etc.) must set up with a [Territorial Climate Air Energy Plan](#) PCAET where they specifically address the issue of climate change (mitigation and adaptation) and have become mandatory since 2010 for local authorities with more than 50,000 inhabitants. Climate change is incrementally included on a sector-by-sector basis in most town planning documents, where it is possible to add the "local planning continuity" documents (SCoTs) and the local authority and joint local authority town planning documents (PLUs). The law specifically asks these local planning documents to aim for climate change mitigation and adaptation (town planning code).



The Directive 2014/52 on environmental impact assessment (EIA) has been transposed in France. The national legislation requirements are expressed in terms of the need to assess the impact of projects, (and, in the case of the Strategic Environmental Assessment directive) plans and programmes on the climate. A guide to climate change vulnerability assessment in the national EIA framework is under consideration.

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

### ***Responsible authorities***

In France, the Ministry of the Environment / General directorate for energy and climate, and within it the National Observatory on the Effects of Climate Change (ONERC) is in charge of adaptation policy-making. The ONERC was set up in 2001 by Law 2001 – 153 under the authority of the Ministry of the Environment and tasked with the collection and dissemination of information on the risks posed by climate change.

Measures in the 2011 National Adaptation Plan have been mostly implemented by the different services of the Ministry of the Environment, but they also involved other ministries or bodies of government. The PNACC process has been undertaken by the central government for national issues. Regional planning is led by the Regional assemblies and local state representatives. Local adaptation planning is led by the local councils. The PNACC and regional planning are not formally coordinated.

The prevention, preparedness and response to natural disasters is dealt with by the [Directorate-General for Risk Prevention](#) (DGPR), under the responsibility of the Ministry of the Environment.

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

France has 33 Operational programmes: 27 regional OPs and 5 National INTERREG OPs. It is also participating in 23 cross-border, transnational or interregional co-operation programmes. The Managing Authorities for the ESI Funds are 15 Regional Councils (following the 2016 Administrative reform), two Decentralised State administrations (Prefecture de Mayotte et Prefecture de Martinique), one General Council (La Réunion), one Public Interest Grouping (INTERREG Massif Central) and Territorial collectivity (Corsica). National Coordination Authority is the General Commission for Territorial Equality, the Certifying Authority is the Directorate General for Public finances at the Ministry of Finance, and the Audit Authority is the Interministerial Commission for the coordination of the controls of operations co-financed by ESIF.

### ***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.

A publicly available [medium-term evaluation report](#) (Dec 2013) indicates whether the implementation of the PNACC actions and measures had started, with a [short description of the actions and measures undertaken](#), including at sectorial level where relevant. The assessment report noted that although it was the first plan, its overall progress was very satisfactory since 80% of the actions and about 75 % of the measures initiated would be completed by the end of 2016.

### ***Technical and human resources***

The Ministry of Environment maintains a dedicated [webpage on adaptation](#). That offers details on the legal framework, the process of developing the new climate adaptation plan, basic climate data, methodologies and other useful bibliographical references.

Adaptation is under the responsibility of the Ministry of the Environment since 2001 when climate change was identified in the Environmental Code as a national priority. The ONERC ([Observatoire national sur les Effets du Réchauffement Climatique](#)) was set up the same year by the Law 2001 – 153. Under the authority of the Ministry its mission is to collect and share information, studies and research projects linked with the risks posed by climate change. It primarily works with the Intergovernmental Expert Group on the Evolution of Climate (GIEC), a research group under the aegis of the International Panel on Climate Change (IPCC). [ONERC is organised](#) as one [director](#), one [president](#) and a [Steering Board](#) consisting of 26 members.

### ***French Outermost Regions***

The French Outermost Regions (ORs) are the Caribbean islands of Guadeloupe, Martinique and Saint-Martin, the Reunion and Mayotte in the Indian Ocean over the coast of Africa, and French Guiana in South America. These territories have similar characteristics and face some common challenges (as recognised in Article 349 TFEU).

In France, coastal protection in outermost regions is, currently, a sub-national and private sector issue with capital measures only being exceptionally open to co-financing by the Government or the EU. As such, the French ORs do not receive much support at the national level for the implementation and financing of coastal defence measures. Detailed information can be found from the Policy Research Corporation ([The economics of climate change adaptation in EU coastal areas](#)) and for the IUCN webpage on [EU Outermost Regions and Overseas Countries and Territories Programme](#).

### ***Effective collaboration***

A clear division of responsibilities is identified in the PNACC even though there is not a specific horizontal governance structure for adaptation. Sectorial departments are in charge of implementing measures in their area of competence while ONERC ensures overall implementation monitoring. Every action committed in the PNACC identifies the leading actors and partners to be considered for implementing each action. The PNACC contains a set of identified transversal actions, where many sectorial Ministries are involved.

The involvement of stakeholders in the development of adaptation policy has been significant in France, in particular in the preparation of the new PNACC. Consultations were made with the metropolitan and overseas regional administrations. The private sector and interest groups were also actively involved. Scientists participated in the process, and the general public was electronically consulted on policy drafts.

### ***Financial resources***

The [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming period. Concerning major projects, by early 2018, there have been 4 Million EUR approved for Network Infrastructures in Transport and Energy; 8.2 Million EUR for Low-Carbon Economy; 8.1 Million EUR in Environment Protection & Resource Efficiency; and 7 Million EUR for Information and Communication technologies. These reported figures are unrepresentative for the size of France, but the [dataset will be updated regularly](#) to reflect changes in the programme lists and major project notifications.



According to the [ESIF-viewer](#), France is planning investments of 15.5 Billion EUR. Projects under the Thematic Objective 5 on promoting climate change adaptation, risk prevention and management will be receiving 88 Million EUR, with an additional 289 Million EUR approved for Network Infrastructures in Transport and Energy (Thematic Objective 7); 632 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6); and 869 Million EUR for Information and Communication Technologies (Thematic Objective 2).

The PNACC 2011-2015 had an allocation of 168 M€ for specific expenditures to be dedicated to implement the actions that are in the PNACC. Cross-cutting/coordinated adaptation action is included in that budget, and coordination actions, climate services, websites, capacity building and other actions are effectively implemented.

## **4. SECTOR OVERVIEW**

### **4.1. Introduction**

Since 2014, the requirements for major projects to obtain ESIF funding<sup>3</sup> demand that project applications integrate climate change considerations<sup>4</sup>, such as a vulnerability and risk analysis and adaptation option appraisal. At EU-level, material is available to assist in fulfilling these requirements. Key websites and documents are:

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

Additional relevant material can be found in the Final Report of the present study (European Commission, 2018) in the section *Available resources at the EU level* and in *Annex I*.<sup>5</sup>

### **4.2. Transport**

Investments in the transport sector are very diverse, covering roads (including bridges and tunnels), inland waterways, rail, ports / airports, and public transport infrastructure. Any disruption caused in this sector can affect many other sectors (economic and societal) directly. Potential threats are sea-level rise and extreme weather events, such

<sup>3</sup> [http://ec.europa.eu/regional\\_policy/archive/projects/major\\_projects/index\\_en.cfm](http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm)

<sup>4</sup> For a compilation of the climate change requirements for major projects in 2014-2020, see: <http://www.jaspersnetwork.org/plugins/servlet/documentRepository/displayDocumentDetails?documentId=401>

<sup>5</sup> European Commission (2018) Climate change adaptation of major infrastructure projects. A stock-taking of available resources to assist the development of climate resilient infrastructure. Final report.

as extended heat waves, flooding, heavy rainfall or storm, and landslides amongst others. Extreme weather events are a potential threat to both infrastructure and operation of the transport system.

### **Road infrastructure**

The transport sector was specifically targeted by the 2011 National Adaption Plan with four different actions carried out by the General Directorate for Infrastructure, Transport and Sea ([DGITM](#)) and the Centre for Studies and Expertise on Risks, the Environment, Mobility and Planning ([CEREMA](#) 2015 Reports: the PNACC [Action 1](#), [Action 3](#)). France has reviewed design codes and infrastructure standards in the transport sector that are related to climate change variables. The country is developing methodology on assessing vulnerability of French airports to climate change. A guide looking at transport networks in general is under development. A network of infrastructure managers has been set up with regular meetings and exchange of experience.

The first [action](#) was to review and adapt technical standards for the construction, maintenance and operation of transport networks infrastructures and equipment) in continental France and overseas territories.

On more than 1000 technical references examined, the French experts have identified 241 relevant references for the climatic criteria defined in the Jouzel scenarios. Of these, 160 standards would not require any revision at this stage, 23 standards were identified as needing priority updating, and 58 standards, i.e. 24% of the standards in question, could be revised according.

The second action foreseen by the National Action Plan is to analyse the existing literature to infer the potential impacts of climate change on mobility and to analyse the local adaptation strategies to identify specific adaptation measures. A report will be published in 2018.

The third [action](#) provided for the set-up of a methodological framework for the performance of risk analysis:

- Definition and analysis of climate hazard
- Breakdown of the infrastructure into smaller study units (between systems, components, etc.) to assess the physical vulnerability factor of each unit, the average of which providing a "vulnerability rating".
- Cross-referencing the issue of the network with its characteristics to assess its functional criticality
- Definition of a level of risk for each system and component

The fourth action consists of assessing the vulnerability of land, sea and air transportation networks in mainland France and overseas territories to provide for the definition of appropriate and phased response strategies to local and global climate change issues. This action has been only recently started by the CEREMA.

From the interviews many found the approach taken for transport networks interesting and with a high replicability potential. From the outcome of the review and [recommendation process](#) that will serve as a basis for the National Adaption Plan, it is inferred that this orientation will be pursued.

In synergy with the FOR Programme, FEHRL's French member IFSTTAR has launched the ["5th Generation of Roads" programme](#), which aims to design full scale demonstrators integrating the numerous innovations already available within research centres, and demonstrating the synergies among them. Specifically, there is work being undertaken on areas that are relevant to the resilient road, such as trials on heating and cooling pavements including porous asphalt and energy generation from the pavement using photovoltaic technologies.

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

### ***Railway infrastructure***

The French rail company SCNF adopted in 2012 an overall approach to climate change adaptation, rather than performing specific studies for each component and systems: under the project [Climat D’Rail \(Towards an adaptation plan for railway infrastructure\)](#) internal and external experts were gathered. Three actions were defined as outcome:

- Develop a regionalised vulnerability map for the next three decades
- Update the construction and maintenance standards of the infrastructure (this in on-going as part of the action 1 mentioned above)
- Reflect on a long-term management of the climate crisis

In the latest (2014) [technical note](#) from the Directorate General for Infrastructure, Transport and the Sea providing guidance and the economic evaluation of transport project, the issue of adaptation is listed as one of the objectives to be taken into account.

See also section above on road infrastructure for relevant (background) documents.

### ***Airport infrastructure***

Regarding the airport infrastructure, a methodology has been developed to assess their vulnerability to climate change. Developed by the General Directorate for Civil Aviation (DGAC) in 2013, the [Airport vulnerability to climate change \(Vulclim\)](#) maps the different risks that different infrastructure structural elements are exposed to in order to infer a vulnerability level and identify the necessary work to be conducted. This methodology is identified by IFRECOR as an important element for the adaptation of airport infrastructure in the French overseas territories as most airports there are located near the coast and at very low altitude.

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

## **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 broadband sector is not addressed in the 2011 National Action Plan. The broadband network is often developed along the railroad tracks but the synergies between the two sectors were not considered. From the outcome of the review and [recommendation process](#) that will serve as a basis for the National Adaption Plan, [adaption of the sector will be addressed in the new plan](#).

Project developers make use of the tools mentioned in the Tools section to identify the future climate their project will be subject, but it not incorporated in the risk assessment.

To perform their risk / vulnerability assessment they make use of software to compute load calculations for the telecommunications cables:

- Orange (incumbent network provider in France) proprietary software: CAPFT
- [CAMELIA COMAC](#): Mechanical calculation software for overhead distribution lines

For civil works (e.g. masts and towers for the mobile access networks), EN standards are available to address wind and snowfall, e.g. EN1991-1-4 (Eurocode 1) and EN1993 (Eurocode 3) for structures in steel. But these standards don't take climate change into account. CEN-CENELEC is currently working on adapting a number of EN standards to climate change. See Final Report of the present study (European Commission, 2018) for more information in the section on *Available resources at the EU level*.<sup>6</sup>

The vulnerability of the broadband network to floods is based on the information provided in the regional Master Schemes for Planning and Water Management ([SDAGE](#)). It is a general best practice for operators to use flood mapping information from environmental agencies to safeguard new planned data centres from flooding.

Several broadband infrastructure deployment projects have been approved for ERDF funding for the 2014-2020 programming period (for example, so far, Broadband deployment in [Alpes-Maritime](#), in [Provence-Alpes-Côte d'Azur](#), in [Aisne](#), in [Auvergne](#)). However, the average ERDF funding is, lower than the limit for major projects and as such, project developers were not mandated to perform climate vulnerability and risk assessments. No standards specifically adapted to the climate change are included in the [2016 Guide for Broadband development](#).

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.

Urban development was specifically addressed in the 2011 National Action Plan with four measures to improve how adaptation is taken into account in urban planning. These measures were not specifically designed for infrastructure.

[ROSAU](#) is a tool specifically developed to increase urban resilience: it identifies and evaluates the interdependencies of the different urban services to assess the potential domino effects and support in the design of adequate solutions.

The Centre for Studies and Expertise on Risks, the Environment, Mobility and Planning (CEREMA) produced a report listing measures to better integrate climate change in urban planning, including adaptation measures. This was the outcome of a working group set up in 2015 by the Ministry of Housing as part of the project "Club PLUi" which gathered interested local authorities and experts to support the integration of climate change issues in the Local Urban Plan (PLU). Through interviews and workshops, three

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

deliverables were produced: two dissemination materials and a [reference document listing all possible measures](#) to integrate climate change in urban planning, transport infrastructure, buildings and the energy sector at the local level.

The Scientific and Technical Centre for Building (CSTB) published in 2015 an overall assessment of the [climate hazards in the build environment](#). On the specific issue of the urban heat island effect, the ADEME published [guidance on heat island effect](#) in 2012 to support public authorities in dealing with this phenomenon.

The CSTB holds a [repository of standards](#), the [Batipedia](#), applicable to the sector (DUT). These standards were updated last in 2009. They are accessible to infrastructure promoters only. The CSTB advises on updates of [urban building standards](#) based CEN CENELEC Guide 32 "Guide for addressing climate change adaptation in standards".

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, ...), transport (electrified vehicles, dynamic traffic information, ...), etc.

The energy sector was specifically addressed in the [2011 National Action Plan](#) with five measures to take into account the projected evolution of temperatures. The first measure, for example addresses the issue of adaptation for energy infrastructure. Infrastructure developers may find accessible and comprehensive climate projection data, including maps and graphs using the [ARPEGE CLIMAT](#) and [DRIAS](#) tools (see Section Tool). Adaptation measures to be taken in this sector mainly regard the evolution of planning procedures and technical criteria to better prepare not only new infrastructure but also existing infrastructure.

The [French TSO \(RTE\) publishes yearly reports](#) on projected consumption and production patterns which is used for the evolution of planning procedures to ensure that maintenance processes are planned according to the new patterns influenced by temperature evolutions. Overall, the existing infrastructure is considered to be able to sustain projected temperatures, though localised adjustment may be necessary. For this, more detailed information is necessary but seems to be lacking.

Work on operational measures to adapt nuclear installations specific was conducted in 2012 by the Nuclear Safety Authority (ASN) along with EDF on maintaining the functioning of the power plants and of their cooling system.

Adaptation to higher flood risk has started to be taken into account by the existing hydropower production infrastructure (see Section Case Study 1).

Following the summer of heat waves in 2003 and 2006, Electricité de France (EDF) launched a new "referential" already ([Referentiel Grands Chauds](#)) to ensure their nuclear plants would comply with regulations governing river temperatures and be more resilient to new climate parameters. This triggered investments to improve the cooling equipment

and the introduction of new monitoring measures.<sup>7</sup> EDF elaborated a [comprehensive adaptation strategy](#).

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.

Hydrographic basins, partly considering adaptation in the planning and water management master plans (SDAGE): all of the Water Development and Management Master Plans for 2016-2021 contain a section on ways in which to take climate change into consideration, including assessing the impacts on both aquatic environments and water resources, assessing potential impacts on areas identified as under pressure, producing an adaptation strategy and incorporating these priorities into the master plan's strategies, provisions and work program

The water sector was addressed in the 2011 National Action Plan from a resource point of view, but not from the infrastructure perspective. Explore 2070, a project led by the Ministry of the Environment in 2010-2012 had the objective of [elaborating adaption strategy](#) for water resources and delivered two reports: one on underground resources, and the other on surface resources. Cost analyses were run as part of the project but these have not been [published](#) in detail. A report on [projected water resources in 2030](#) was published in 2012 by the Centre d'Analyse Stratégique, a decision-making and expertise institution under the authority of the French Prime Minister. On the local level, the [Hyccare](#) project contains specific information on climate change and its impacts on water resources in Burgundy.

It is noted that following an engagement during the COP21, the six regional water regulators Agences de l'Eau [committed](#) to integrate adaptation measures in their planning schemes for the period 2016-2021.

To accommodate the risk posed by higher floods, an EU SEQUANA exercise to simulate a 1/100 flood event was run in the region Île-de-France in 2016. Following this exercise (and the actual flood that happened a few months later) several adaptation measures were implemented in a number of localities in the region to increase the resilience of the water supply infrastructure, including the contractual allocation of specific funds for the safety of infrastructure and the implementation of Smart water system to better monitor real-time water levels.

In 2016 the CEREMA published a new [national vulnerability assessment](#) on the risk of flooding. The Water Development and Management Master Plans 2016-2021 ([SDAGE](#)),

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<sup>7</sup> SFEN [Adapter les centrales nucléaires au changement climatique](#)



are useful planning documents which also integrate adaptation measures in climate change at basin level.

France has been actively involved with its neighbour countries Germany and Luxembourg to develop transnational cooperation to harmonise flood management in the Moselle and Saar basins as part of the project [FLOW MS](#).

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.

The waste sector is not addressed in the 2011 National Action Plan, and no information has been identified for the adaptation of the sector, other than that the sector mainly focuses on mitigation measures.

Under the current programming period for example, one project has been approved for ERDF funding (19€ million) in Martinique (Complexe Petit Gallion) and as such, the project developer was not bound to perform climate vulnerability and risk assessments.

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**

Water management in a new district in Rouen

Project description	Development of an eco-district in Rouen.
Photograph	N/A
Budget	60€ million
Climate Change Vulnerability and Risks	<p>Risk of flooding</p> <ul style="list-style-type: none"> <li>• Changing precipitation patterns</li> <li>• Rising level of the Seine estuary</li> </ul> <p>Urban heat island effect</p> <ul style="list-style-type: none"> <li>• Higher average summer temperatures</li> <li>• Increase in the number of heat wave days</li> </ul> <p>Source: <a href="#">Adaptation des bâtiments aux changements climatiques – Le changement climatique et ses effets en Haute-Normandie</a></p>
Climate change adaptation measures	<p>Integrating higher risk of flooding from changing rainfall:</p> <ul style="list-style-type: none"> <li>• Creation of a retention basin</li> <li>• Integration of the risk posed by flooding by the Seine due to increase in heavy rain episodes by the development of a flood chamber and the elevation of ground levels</li> </ul> <p>Reduction of the urban heat island effect</p> <ul style="list-style-type: none"> <li>• Unearthing existing water streams</li> <li>• Development of green roof</li> </ul> <p>Collection of rainwater</p>
Good practice	Makes use of existing resources to offer adaptation solutions.
Further information	Normandie, Development Durable: <a href="#">Luciline - Rives de Seine</a>

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

Bellegarde Railway Station	
Project description	Construction of a railway station integrating the observed and expected wider thermal amplitudes.
Photograph	N/A
Budget	12€ million
Climate Change Vulnerability and Risks	Higher average temperatures in summer and projected increase in number of heat wave days raised the issue of higher thermal amplitude with very cold winters.



	The change of annual thermal amplitude raised the issue of how to include it in the design of the building, in order to provide thermal comfort both in summer and in winter.
Climate change adaptation measures	The design of the station includes an innovative system which uses solar energy to heat air in winter and favours natural ventilation in summer and is complemented by heat pumps, solar panels and earth pipes which in winter ventilates the hot air and in summer cools the inside air while ensuring evacuation of hot air outside.
Good practice	Adaption to both colder and warmer temperature directly into the design.
Further information	<a href="#">AREP – Bellegarde TGV</a>



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