



# Climate change adaptation of major infrastructure projects

Country report for Greece

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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 Greece 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](#) (NAS) was adopted in 2016 with a 10-year implementation horizon. Significant responsibilities have been assigned to the 13 Regions which need to develop climate adaptation action plans. The Regional Adaptation Action Plans are the key tool for ensuring the sustainability of infrastructure against climate change and their content has been specified in [Ministerial Decision 11258/2017](#), which set out the [content requirements for Regional Adaptation Plans](#). The Ministry of Energy & Environment (MEEN) is the national competent authority for national adaptation policy. A National Climate Change Adaptation Committee has been established, it is chaired by the Minister of Environment and Energy, and includes representatives of all competent ministries, the regional and local government, the National Meteorological Service, the academic and research community, NGOs and the national enterprises federation. It is the central advisory body of the State for the coordination, monitoring and evaluation of climate change adaptation policies.

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

The [Ministry of Environment and Energy](#) coordinates the task of data collection on climate change impacts, and collaborates for data processing with institutes such as the National Technical University of Athens, the National Meteorological Service and the Greek Statistical Authority. There are useful data on climate adaptation to be accessed via decentralised sources, such as the Hellenic Institute of Transport and the University of the Aegean through the [ERA BEACH project](#). Sea level data are available from the Permanent Service for Mean Sea Level ([PSMSL](#)) and wave regime data are sourced from the Environmental Monitoring System of the Hellenic Centre for Marine Research. Satellite data are provided by the Greek private company TERRA SPATIUM. For major infrastructure projects implemented in Greece, climate vulnerability and risk assessments are carried out based on the methodology suggested by the guide [Climate Change and Major Projects, EC 2016](#). Other Operational Programmes with Major Projects (excluding phased projects) are expected to be identically addressed. The [Institute of Environmental Research and Sustainable Development](#) of the National Observatory of Athens undertakes climate impact assessments and climate vulnerability assessments. The [Risk and vulnerability assessment](#) presented in the [National Adaptation Strategy](#) used an activity/output based method for allocating regional and sectorial damages, following estimates of the [2011 Bank of Greece study](#). The National Adaptation Strategy provides references for tools that are available in the sectors of biodiversity, water, and health (EMEKA 2015). The [CYPADAPT Multi-Criteria Analysis tool](#) ([direct download link](#)) has been designed to allow for the prioritisation of measures for adapting to climate change impacts. Due to the exceptionally long coastline, and its relation to the tourism industry, a number of tools have been developed in Greece with applicability to coastal areas. The [THALIS - CCSEAWAVS tool](#) is estimating the effects of climate change on sea level and wave climate of the Greek seas, coastal vulnerability, and safety of coastal and marine structures. 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 recent study on climate adaptation by [Dianeosis \(2017\) "Climate Change Impacts on Development"](#) examined the inclusion of climate adaptation requirements in standards specified by law and applicable to either infrastructure or infrastructure-related environmental studies.

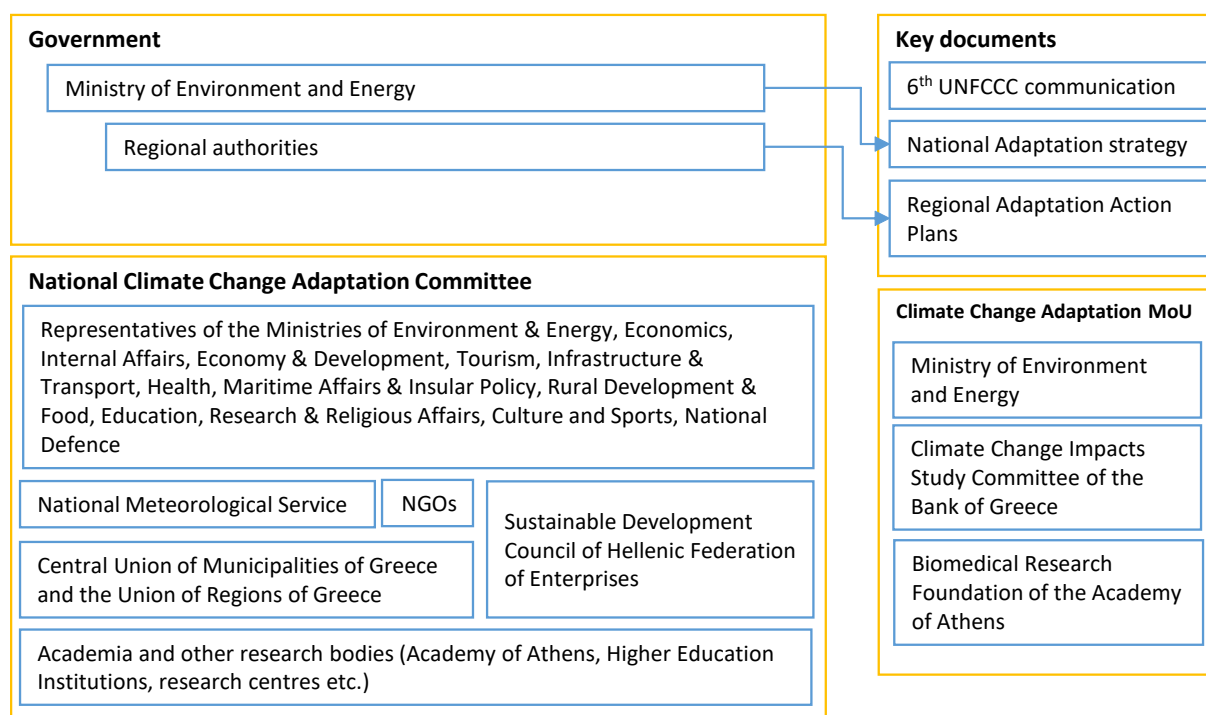
The Hellenic Institute of Transport, CERTH-HIT, contributed to the publication of [adaptation strategies for the transport sector](#), in the context of the WEATHER project, while a number of researchers have contributed to the UNECE report from 2013 on [Climate Change Impacts and Adaptation for International Transport Networks](#). The broadband sector is not involved in the federal or regional authority climate change adaptation plans or initiatives organised by governmental bodies. For urban development, the objective of the [Urban Proof project](#) is to strengthen municipal resilience to climate change by providing a powerful tool to support informed decision-making. There is also reference to climate change adaptation in the Integrated Urban Intervention Plan for Athens, Western Athens, Piraeus, and Larissa. In the energy sector, and under the Competitiveness Entrepreneurship and Innovation operational programme, funding is provided for two energy projects, of which both are required to implement climate adaptation measures following the realisation of climate risk and vulnerability assessments. The water sector is lacking extensive adaptation measures for infrastructure projects, but there is a growing body of research to estimate impacts and suggest adaptations, such as a report in 2014 by the Bank of Greece examining [the effect of climate change in surface and subway water bodies](#). In the waste sector, the Operational Programme "Transport Infrastructure, Environment and Sustainable Development will implement two major projects for the collection and treatment of sewage in the Koropi and Paiania areas. The mandatory vulnerability and risk assessments will offer more insight into the vulnerability of the sector.

There are three case studies identified as infrastructure projects addressing climate change adaptation in Greece; evaluating the use of a [hydropower dam](#), and the adaptation measures through two large transport projects, namely the [Patras-Pyrgos motorway](#), and [Attica Tollway](#).

## 2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

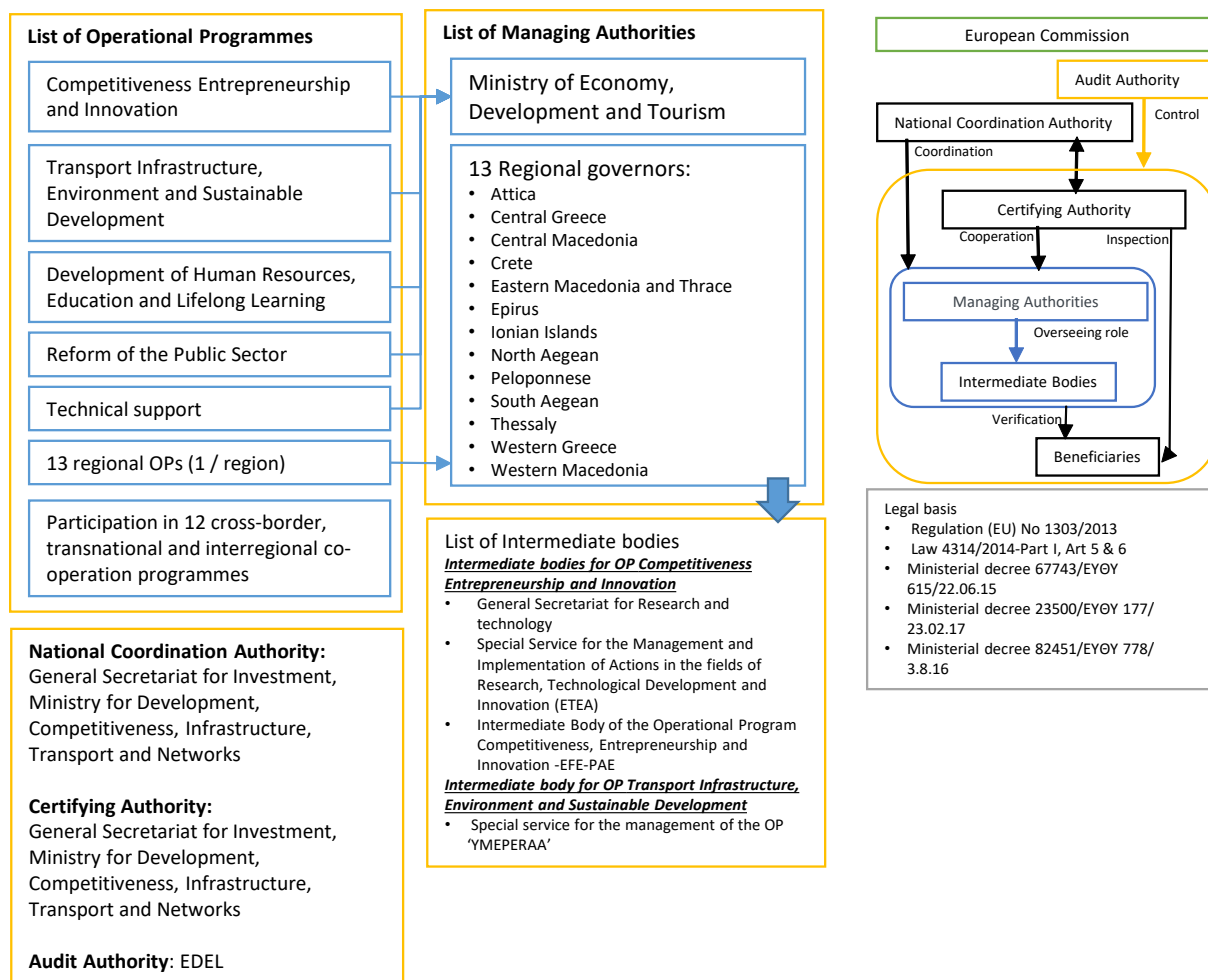
The main responsibility for climate adaptation policy lies with the Ministry of Environment and Energy. The Ministry is responsible for the development, evaluation and revision of the [National Adaptation Strategy](#), while the 13 Regional Authorities for the development, evaluation and revision of the Regional Adaptation Action Plans.

A National Climate Change Adaptation Committee, set up in August 2017, acts as the formal advisory body of the Ministry of Environment and Energy for climate adaptation policy design and implementation. The Ministry of Environment and Energy has signed a Memorandum of Understanding (MoU) with the Climate Change Impacts Study Committee of the Bank of Greece and the Biomedical Research Foundation of the Academy of Athens through which they have committed to undertaking climate change adaptation actions. The drafting of the first National Adaptation Strategy was part of this MoU.



The European Structural and Investment Funds have an important role in the adaptation efforts of Greece due to the legal requirements for major infrastructure projects to include climate adaptation measures in order to withstand the impacts of climate change. The ESI Funds for infrastructure investments are absorbed by five centralized operational programmes and 13 regional operational programmes. The five centralized operational programmes have Management Authorities within the Ministry of Economy, Development and Tourism, while the remaining programme correspond to the 13 regions of Greece and are managed by the office of each regional governor. The Managing Authorities delegate roles to Intermediary Bodies, who verify the work of the Beneficiaries. Beneficiaries are inspected by the Certification Authority which cooperates with the Managing Authorities and their Intermediary Bodies. A national Coordination Authority supports the communication between these bodies and the whole process is overseen by a Control Authority.





### 3. RESOURCES

This country report has reviewed the currently available resources in Greece 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

<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

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:

<b>Resources</b>	<b>Explanation</b>
<b>Data Availability</b>	The availability, accessibility and applicability of data on climate projections and impacts, on past and historic events, on geophysical parameters, on long-term scenarios, on economic, environmental and social impacts, etc.
<b>Methodologies</b>	The existence of quantitative or qualitative methodologies (a system of processes, a set of principles and rules) for integrating climate change adaptation in the development of infrastructure projects.
<b>Tools</b>	The availability of tools for planning, evaluation, impact estimation (i.e. software, maps, computer simulations, long term climate forecasts etc.) to assist with the adaptation of infrastructure to climate impacts
<b>Guidance</b>	The provision of guidance on how to use methodologies (i.e. for conducting climate change vulnerability and risk assessments) or develop the required infrastructure project documentation relating to climate adaptation.
<b>Design Standards</b>	The availability of published engineering design standards (i.e. by BSI, DIN, ISO) for infrastructure projects that include sections or appropriate provisions to ensure resilience to climate change impacts
<b>System</b>	The institutional and legal framework that the formal authorities work with to deliver their primary responsibilities for climate adaptation, infrastructure, and management of European Structural and Investment Funds
<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. The [Ministry of Environment and Energy](#) collaborates with institutes such as the Climate Change Impacts Study Committee of the Bank of Greece, the National Technical University of Athens, the National Meteorological Service, the Hellenic Statistical Authority, other co-competent Ministries, etc. to collect, process and assess data on climate change risks, vulnerabilities and impacts. Climate risk and impact data are provided in the National Adaptation Strategy and the 6<sup>th</sup> National Communication to the UNFCCC in terms of total economic damage from climate change with and without adaptation measures. The [National Climate Change Adaptation Strategy \(summary in English\)](#) is a key reference document and a source of useful relevant data.

The Climate Change Impacts Study Committee (CCISC) of the Bank of Greece has developed [two major reports](#) and [studies per sector](#) that provide forecasts of climatic and environmental changes, assesses their implications for the Greek economy and estimates

the cost of action. The CCISC report on “the environmental, economic and social impacts of climate change in Greece” includes valuable data and provided the basis for building the National Adaptation Strategy. The CCISC studies provide a wealth of references to scientific programmes and data sources, which were used for their development. The majority of climate-related data can be found via [the National Meteorological Service](#), while researchers use an international database, such as those of the European Environment Agency, the World Bank, the project [CORDEX](#) (Coordinated Regional Climate Downscaling Experiment) offers a widely used database for downscaled projections.

There are useful data on climate adaptation to be accessed via decentralised sources, such as the [Hellenic Institute of Transport](#) and the University of the Aegean through the [ERA BEACH project](#). Sea level data are available from the Permanent Service for Mean Sea Level ([PSMSL](#)) and wave regime data are sourced from the Environmental Monitoring System [POSEIDON](#) of the Hellenic Centre for Marine Research. Satellite data are provided by the Greek private company TERRA SPATIUM. The [BeachTour Database](#) provides data on beach dynamics for effective management, such as information on the natural spatial features (length, width, material, etc.) of all coastal areas of Greece, with human intervention (i.e. technical works) and activity (tourism and residential development). Additionally, the [Copernicus project](#) provides valuable geospatial data.

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. For major infrastructure projects implemented in Greece, the climate vulnerability and risk assessments are carried out based on the methodology suggested by the guide [Climate Change and Major Projects, EC 2016](#). Other Operational Programmes with Major Projects (excluding phased projects) are expected to be identically addressed. The [Institute of Environmental Research and Sustainable Development](#) of the National Observatory of Athens is one of the institutes undertaking climate impact assessments and climate vulnerability assessments. The [Risk and vulnerability assessment](#) presented in the [National Adaptation Strategy](#) used an activity/output based method for allocating regional and sectorial damage costs, following the estimates of the [2011 Bank of Greece study](#). The National Adaptation Strategy provides a list of methods that are considered appropriate for assessing future relevant investments.

The methodologies used in Greece include Cost Benefit Analysis (i.e. The IPCC CM), Cost Effectiveness, Risk Assessment (SURVAS), CVAT (Community Vulnerability Assessment Tool), CV&A (Community Vulnerability and Adaptation Assessment and Action), Multi-criteria Decision Analysis, Environmental Impact Assessment, Strategic Environmental Assessments and Sustainability Impact Assessments. The management frameworks used include [DPSIR](#) (Drivers-Pressures-State-Impact-Response), SPM, COSMO, SPIM (South Pacific island), and [DESSIN](#) (Demonstrate Ecosystem Services Enabling Innovation in the Water Sector).

The scientific literature includes a number of methodologies on the impacts of, and adaptation to, climate change in coastal areas. The [BeachTour](#) project developed a methodology to identify ‘best practices’ in science-driven coastal monitoring, management, and decision-making, aiming to relate beach vulnerability to economic losses and suggest effective adaptation measures. Methodologies for socio-economic

impact assessment of climate change [adaptation](#) and [sea level rise impacts](#) are both found in the context of the coastal adaptation project [ERA BEACH](#). A [socioeconomic approach](#) is also included and based on the 3S (Sea-Sun-Sand) model. A number of scientific papers illustrate these methodologies in detail, i.e. [Monioudi et al., 2017](#), [Karambas, Th.V. \(2015\)](#), [Velegrakis AF et al., \(2008\)](#). Finally, the [THESEUS project](#) for coastal risk assessment identifies innovative technologies for safer European coasts in the context of climate change impacts.

### **3.3. Tools**

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

The National Adaptation Strategy provides references for tools that are available in the sectors of biodiversity, water, and health. The [CYPADAPT Multi-Criteria Analysis tool \(direct download link\)](#) has been designed to allow for the prioritisation of measures for adapting to climate change impacts. It was developed by the Unit of Environmental Science, School of Chemical Engineering, and National Technical University of Athens. The Institute of Environmental Research and Sustainable Development of the National Observatory of Athens offers the interactive climate vulnerability map [CLIM-RUN](#).

Due to the exceptionally long coastline, and its relation to the tourism industry, a number of tools have been developed in Greece with applicability to coastal areas. The [THALIS - CCSEAWAVS tool](#) is estimating the effects of climate change on sea level and wave climate of the Greek seas, coastal vulnerability, and safety of coastal and marine structures, while defining Flood and Erosion Vulnerability Indexes. [ERA BEACH](#) offers an assessment of island beach erosion due to sea level rise.

Specifically for the evaluation of climate change impact vulnerability of beaches, researchers are using the Beach Optical Monitoring System (BOMS), the WICIR (Wave Induced Circulation), a wave induced circulation model and SEDTR (SEDiment Transport). The estimation of the financial costs and benefits of adaptation measures are derived using cost-benefit analysis (CBA), cost-effectiveness analysis (CEA) and multi-criteria analysis (MCA).

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. At the governance level, the ministerial decision 11258/2017 (Governmental Gazette, issue B, 873/2017) contains guidelines specifying the content of the Regional Adaptation Action Plans, in accordance with article 43 of Law 4414/2016 (Governmental Gazette, issue A, 149/2016). The [National Climate Change Adaptation Strategy](#) and the Regional Adaptation Action Plans are the key guidance documents for ensuring the functioning of infrastructure in the context of climate change. The National Climate Change Adaptation Strategy is an overarching policy document, which defines the goals, principles and priorities of adaptation and lists potential adaptation measures (actions)

for all environmental and socio-economic sectors that are likely to be significantly affected by climate change in Greece. The Regional Adaptation Action Plans examine the potential measures/actions included in the National Adaptation Strategy based on the particular regional circumstances, priorities and needs and develop concrete regional action plans.

For major projects, project developers are usually outsourcing the study on climate change risk assessments and vulnerabilities to environmental consultants, who make use of EU-level resources, including the [DG CLIMA 2016 Guidelines](#) "outlining climate change related requirements and guidance for major projects in the 2014-2020 programming period".

### **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 National Organisation of Standardisation ([ELOT](#)) 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).

A study on climate adaptation by [Dianeosis \(2017\)](#) "[Climate Change Impacts on Development](#)" examined the inclusion of climate adaptation requirements in standards specified by law and applicable to either infrastructure or infrastructure-related environmental studies. It concludes that while there are provisions in all categories of projects to address climate change causes, there is no perspective in relation to climate adaptation. Environmental standards (EIAs and Flood Protection Plans) are not directly addressing climate change as a matter of concern as their specifications were written in the past when the issue was not topical. In spatial planning (also at the regional level), climate adaptation appears at the target level, but not at the operational level (actions and plans). Climate adaptation is currently absent in urban planning.

### **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 first [National Strategy for Adapting to Climate Change](#) (NAS) has been adopted by the Law [4414/2016](#) (Articles 42 - 45). Significant responsibilities have been assigned to the 13 Regions which need to develop climate adaptation action plans. The NAS has a 10-year implementation horizon, it should be reviewed and revised by 2026.

A National Climate Change Adaptation Committee has been established, it is chaired by the Minister of Environment and Energy, and includes representatives of all competent ministries, the regional and local government, the National Meteorological Service, the academic and research community, NGOs and the national enterprises federation. It is the central advisory body of the State for the coordination, monitoring and evaluation of climate change adaptation policies.

The Regional Adaptation Action Plans are the key tool for ensuring the sustainability of infrastructure against climate change and their content has been specified in [Ministerial Decision 11258/2017](#), which set out the [content requirements for Regional Adaptation Plans](#). The Regional Adaptation Action Plans are the responsibility of the 13 Regions of Greece and will aim to develop specific actions and adaptation measures. Priority actions and adaptation projects identified in the Regional Adaptation Action Plans will be mainly implemented through the European Structural and Investment Funds 2014-2020.

In the context of ESIF funding and in regards to the adaptation to climate change of Major Projects, Environmental Impact Studies requirements have been transposed following the adoption of Law 4014/2011 and the Ministerial Decision 17025/2014. Climate change adaptation is mentioned and measures are offered in the following strategic documents:

- National Strategic Reference Framework (NSRF) 2014-2020
- Rural development Plan 2014-2020
- Operational Program for Transport Infrastructure, Environment and Sustainable Development 2014-2020 (2014)
- Operational Program for Competitiveness Entrepreneurship and Innovation Development 2014-2020 (2014)

All Regional Operational Programmes include objectives (axes) on climate change adaptation.

The revised EIA directive has been transposed to Greek law [ΦΕΚ 988, 21/03/2018](#), according to which, every project needs to describe the impacts on land, including any possible climate impacts and climate adaptation considerations.

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***

The main responsibility for climate adaptation policy lies with the Ministry of Environment and Energy. The National Adaptation Strategy was drafted as part of a MoU with the Climate Change Impacts Study Committee (CCISC) of the Bank of Greece and the Biomedical Research Foundation of the Academy of Athens.

The National Climate Change Adaptation Committee has been assigned important coordination responsibilities and it is expected to fulfil an important role in the delivery of climate adaptation actions in Greece.

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

In the context of the ESI Funding, the various organisations involved in the management of funds are required to undergo an evaluation process. There are three units within Managing Authorities (Infrastructure, Transport, and Environment) responsible for submitting to the EU the required information for the Operational Programmes' Major



Projects. The [management and control system for ESI Funds](#) is available and presented in detail from the Ministry of Economy and Development.

Greece has five national operational Programmes, 13 Regional Programmes (one per region) and is participating in 12 cross-border, transnational and interregional co-operation programmes. The managing Authority for the five national OPs is the Ministry of Economy, Development and Tourism, while the Management of the regional OPs rests with the Regional governors. The intermediary bodies for the OP Competitiveness Entrepreneurship and Innovation are the General Secretariat for Research and technology, the Special Service for the Management and Implementation of Actions in the fields of Research, Technological Development and Innovation (ETEA), the Intermediate Body of the Operational Program Competitiveness, Entrepreneurship and Innovation -EFE-PAE. For the OP Transport Infrastructure, Environment and Sustainable Development, the Intermediary body is the Special service for the management of the OP 'YMEPERAA'. The National Coordination Authority is the General Secretariat for Investment at the Ministry for Development, Competitiveness, Infrastructure, Transport and Networks; the Certifying Authority is the General Secretariat for Investment at the Ministry for Development, Competitiveness, Infrastructure, Transport and Networks; and the Audit Authority is EDEL.

### **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.

The Ministry of Environment and Energy observes that climate change risk assessments and climate change adaptation measures are emerging in project assessments. However, they will be more clearly featured in Environmental Impact Assessments following the transposition of the [EIA Directive](#) in [national legislation](#).

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

From a research perspective, there are little resources in the relevant institutions (financial and other) to conduct the required research in the field of climate adaptation. Due to the limited administrative and financial resources available, the Ministry of Environment and Energy has submitted a proposal in the September 2017 LIFE Climate Action Integrated Projects Call to improve the coordination of the National Adaptation Strategy and the Regional Adaptation Action Plans. The proposal aims to:

- build capacities and foster cooperation at local, regional and national level,
- allow information, knowledge and good practices sharing through an online platform
- implement and disseminate pilot projects and best practices,
- strengthen the existing monitoring and reviewing framework and
- identify funding priorities for implementing climate change adaptation in the post-2020 (new EU programming period).

#### **Effective collaboration**

The National Climate Change Adaptation Committee includes representatives of all competent ministries, the regional and local government, the National Meteorological Service, the academic and research community, NGOs and the national enterprises federation. The composition of the National Climate Adaptation Committee reflects the need for the horizontal coordination of sectoral policies, for vertical coordination among

different levels of government, as well as and for involving non-governmental authorities on all aspects relating to climate change adaptation. No information on its functioning has been available at the time of writing.

### **Financial resources**

The [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming period for Greece. Concerning major projects, by early 2018, there have been 80.9 Million EUR approved for Network Infrastructures in Transport and Energy; 30 Million EUR for Low-Carbon Economy; 22.6 Million EUR for Information and Communication technologies; 30 Million EUR in Environment Protection & Resource Efficiency; and 6 Million EUR for Climate Change Adaptation & Risk Prevention. The [dataset will be updated regularly](#) to reflect changes in the programme lists and major project notifications.

According to the [ESIF-viewer](#), Greece is planning investments of 347 Billion EUR. Projects under the Thematic Objective 5 on promoting climate change adaptation, risk prevention and management will be receiving 5 041 Million EUR, with an additional 54 598 Million EUR approved for Network Infrastructures in Transport and Energy (Thematic Objective 7); 24 714 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6); and 11 420 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 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>

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<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>



## **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**

The 2011 report from the Climate Change Impacts Study Committee of the Bank of Greece on Climate Change Impacts and adaptation includes a [Transport study](#) and makes use of scenarios from the IPCC and the [PESETA report](#), which integrates a set of high-resolution climate change projections and physical models into an economic modelling framework to quantify the impacts of climate change on vulnerable aspects of Europe. The Hellenic Institute of Transport, CERTH-HIT, contributed to the publication of [adaptation strategies for the transport sector](#) in 2011, in the context of the WEATHER project, while a number of researchers have contributed to the UNECE report from 2013 on [Climate Change Impacts and Adaptation for International Transport Networks](#). The [mowe-it](#) project also provides valuable information for the adaptation of the transport sector.

In the ESIF programming period 2014 – 2020 the Operational Programme Transport Infrastructure, Environment and Sustainable Development is expected to implement 14 major projects in the transport sector (specifically, five motorways, five railways and four metro projects).

- Thessaloniki Metro Extension to Kalamaria
- Metro Thessaloniki Main Line (Project 2)
- Athens Metro extension Haidari to Piraeus & Athens Metro Rolling Stock
- Improvement / upgrade of the western internal ring Thessaloniki K16 Interchange up to K5 (Papageorgiou Hospital)
- Westward extension of Tramway to Piraeus- Phase B

Most of these major projects are phased interventions whose studies were written prior to the adoption of the climate adaptation requirements for vulnerability and risk assessments. An attempt was made to study how climate change adaptation could be integrated into the Major Project of the Patras – Pyrgos motorway during the preparation process of the relevant documentation based on the guide [Climate Change and Major Projects, EC 2016](#) (more information can be found in the case studies section).

### **Railway infrastructure**

See section above on Road infrastructure. No railway specific guides or documents on climate adaptation have been retrieved from desk study or interviews.

### **Airport infrastructure**

No specific strategy on making Greek 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.

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<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.

### **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 sector has not been considered a priority in the reports and studies from the Climate Change Impacts Study Committee of the Bank of Greece, nor specifically addressed in the legal texts. For the programming period 2014-2020, Greece is expected to receive [320 Million €](#) on broadband investments, including infrastructure investments. There are currently five ongoing projects in the context of the [Digital Single Market](#), supported by EU funds, all of which have submitted their funding applications in the previous programming period of 2007 – 2013 and as such are exempt from the requirement to conduct vulnerability and risk assessments.

The Managing Authorities of the Operational Programme Competitiveness Entrepreneurship and Innovation are involved in the following three projects implemented in the programming period 2014 – 2020:

- Regional Broadband Extension
- Super-Fast Broadband
- Broadband Network Development in White Rural Areas (split into two 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*.<sup>6</sup>

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.

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

In regard to urban planning documents, a study by [Dianeosis \(2017\) "Climate Change Impacts on Development"](#) examined the inclusion of climate adaptation wording and provisions in strategic planning documents that are relevant for infrastructure projects. There is a reference to climate change adaptation in the documents for Integrated Urban Intervention Plan for Athens, Western Athens, Piraeus, and Larissa. Climate adaptation is also referred to in the General Framework of Spatial Planning and Sustainable Development (2008), in the New Framework of Spatial Planning and Sustainable Development for Athens – Attika (2014), and finally in the 2016 Evaluation and Review Studies of the Regional Frameworks for Spatial Planning and Sustainable Development of North Aegean, Western Greece, Western Macedonia, Central Macedonia, Eastern Macedonia-Thrace, Epirus, Ionian Islands, and the Peloponnese.

The objective of the [Urban Proof project](#) is to strengthen municipal resilience to climate change by providing a powerful tool to support informed decision-making in the planning for climate change adaptation. The project is co-funded by the European Union through LIFE14 - Climate Change Adaptation (CCA). The World Bank offers a web toolkit '[Guide for Climate Adaptation in Cities](#)'.

For coastal cities, the [BeachTour](#) and [ERA BEACH](#) projects identified that there are historically sporadic actions to address local impacts of beach erosion, mainly through the construction of breakwaters for coastal projects. The categorisation of possible adaptation actions has been developed by the Intergovernmental Panel on Climate Change (IPCC), 2007, 2013 which includes the alternatives of protection, accommodation, and retreat. For Greek beaches, mainly protective measures are chosen and in particular, the options are limited to soft measures (artificial coast sand replacement) and hard measures (breakwaters). The choice is made with appropriate economic tools such as CBA (cost-benefit analysis).

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, ...).

The [Operational Programme Transport Infrastructure, Environment and Sustainable Development](#) is expected to implement one major project in the energy sector (a district heating project).

Under the [Competitiveness Entrepreneurship and Innovation operational programme](#), funding is provided in the 2014 – 2020 period for two energy projects:

- The Interconnection of Cyclades Islands with the National Mainland Interconnected Transmission System
- The 2nd Upgrade of the Liquefied Natural Gas Terminal at Revithoussa

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.

Extensive adaptation measures for infrastructure projects are lacking in the water sector, but there is a growing body of research to estimate impacts and suggest adaptations. The Climate Change Impacts Study Committee of the Bank of Greece issued a report in 2014 examining [the effect of climate change in surface and subway water bodies](#). A number of tools and the corresponding methodology have been used from the scientific literature. For example [Ganoulis and Skoulikaris \(2017\)](#) made use of the Climate Local Model (CLM) tool, developed by the Max Planck Institute for Meteorology, in combination with the hydrological model MODCOU (MODélisation COUplée) in order to simulate the spatial and temporal relationship between precipitation and the evolution of the water table and river flows under climate change conditions. National research bodies have participated in the [DESSIN](#) project for ecosystem services and innovation in the water sector. [Skoulikaris & Ganoulis 2017](#) have realised economic assessments of multi-purpose hydropower projects under climate change conditions.

The Operational Programme Transport Infrastructure, Environment and Sustainable Development is expected to implement five major projects in the water sector (three urban wastewater management projects, one flood control project and one water supply project). These major projects are phased interventions whose studies were drawn up prior to the adoption of the climate adaptation requirements for vulnerability and risk assessments.

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 the current study, no waste sector specific guides, tools or other documents on climate adaptation were identified or suggested by the interviewed organisations. But waste infrastructure needs to comply with environmental legislation, such the Landfill Directive and the Industrial Emissions Directive.

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 transposed into national design standards with KYA 29407/3508/2002 (ΦΕΚ 1572 Β) «Μέτρα και όροι για την υγειονομική ταφή των αποβλήτων» 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

Study on hydropower dam and other water uses	
Project description	The Aristotle University of Thessaloniki evaluated the impacts of climate change on a hydro power plant, and on the relevant uses of water for power, irrigation, water supply and natural processes.
Photograph	N/A
Budget	N/A
Climate Change Vulnerability and Risks	Due to climate change, water availability for different uses such as domestic water supply, hydropower production, and agricultural irrigation could be significantly reduced in the near future mainly in regions with arid and semiarid climate.
Climate change adaptation measures	The report suggested an adaptation management model, to modernise agriculture irrigation methods, and to create smaller water collection dams downstream to serve secondary uses.
Good practice	The project evaluated the economic viability and sustainability of the dam, estimating the necessary CAPEX and OPEX, as well as the compensation to the agriculture community and the costs to repair the environmental damage.
Further information	<a href="#">Skoulidakis &amp; Ganoulis 2017</a>

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

Patras – Pyrgos motorway	
Project description	The building of a new high speed motorway from Patras to Pyrgos in western Peloponnese
Photograph	N/A
Budget	64 – 74.4 Million EUR (estimation)
Climate Change Vulnerability and Risks	<p>The most common and significant climate change vulnerabilities have been:</p> <ul style="list-style-type: none"> <li>• Damage or total destruction of the infrastructure due to extreme weather events and floods</li> <li>• Damage to road surfaces due to dry weather conditions</li> </ul>
Climate change adaptation measures	The following measures are incorporated: (a) Suitable construction materials used for road surfaces, (b) Fire protection measures, (c) Design techniques concerning stream and river crossings (long bridges), (d) Design provisions made for at least a 50-year recovery period, (e) Installation of SCADA (Supervisory Control and Data Acquisition) systems.
Good practice	Climate adaptation measures have been included in the planning and design of the motorway, such as anticipating on increased water volumes when designing bridges and selecting road surface materials that can cope with extreme temperature fluctuations.
Further information	The construction company's website on the project <a href="#">Patras-Pyrgos motorway</a>

Attiki Odos / Attica Tollway	
Project description	Attica tollway ("Attiki Odos"), one of the most modern roadways in Greece, is located at the greater Athens area. It has a total length of 65 km, within a service/side road network of 150 km. The managing company incorporates effective climate change adaptation measures since the projected climate change will affect road infrastructure, causing asphalt rutting, melting, thermal expansion of bridge joints, landslides, bridge undermining and general structural damage and it is, thus, crucial to prepare for such effects.
Photograph	N/A
Budget	N/A
Climate Change Vulnerability and Risks	Currently, adaptation responses include flood protection in 67 km of the whole network, pavement maintenance, installation and operation of environmental (e.g.

	meteorological) monitoring stations and proactive management.
Climate change adaptation measures	To address extreme rainfall events and flooding, an extensive stormwater and flood protection scheme have been included in the design for the collection of the superficial runoff, as there are few remaining natural receptors in this area. In addition, a network of meteorological stations positioned along the road provides real-time information on the prevailing weather conditions and keeps records of extreme events.
Good practice	Attica tollway is an existing road, and it shows that adaptation measures can also be applied on existing infrastructure, such as in the maintenance of the road and through the installation of monitoring stations. Climate change complicates road asphalt maintenance, as more frequent maintenance cycles are required. Maintenance costs can increase 4 or 5 times in the case of already damaged pavements, so it is important to monitor the state of the road. In addition, a network of meteorological stations positioned along the road provides real-time information on the prevailing weather conditions and keeps records of extreme events. Generally, the approach is proactive, risk factors for different scenarios are assessed and the condition of the road is evaluated on a day-to-day basis, as well as following extreme events. The objective is to create a resilient road through prevention and/or modification of equipment and materials that will be able to minimise impact of climate change effects.
Further information	<a href="http://en.aodos.gr">http://en.aodos.gr</a>





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