



Climate change adaptation of major infrastructure projects

Country report for Cyprus

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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 projects¹ or other projects funded by the ESI Funds through the requirement to conduct climate change vulnerability and risk assessments. In coordination with the ESI Funds, and complimentary to them, the LIFE fund in addition assists in the realisation of the climate change adaptation objectives. Climate change analyses (such as vulnerability and risk assessments) are also sporadically found to be undertaken for infrastructure projects that are financed outside the framework of EU funds.

This report for Cyprus 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;
- **Case studies:** Current practice in adaptation and resilience of infrastructure projects.

Country Overview

Cyprus' [National Adaptation Strategy](#) and the [National Adaptation Action Plan](#) were approved in 2017. The [Ministry of Agriculture, Rural Development and Environment](#) is the central body coordinating the adaptation policy-making process. The [Department of Environment](#) supervises the implementation of policy and the adoption of European policy and legislation on the environment. The [National Council for Research and Innovation \(NCRI\)](#) and the [Cyprus Scientific Council \(CSC\)](#), are the main bodies responsible for strategy and planning. The [Strategic Plan](#) of the [Ministry of Environment](#) examines the need to enhance the institutional capacity and improve the effectiveness of the Department for Climate Change Adaptation. It comments on the lack of an integrated automation system, restricting the efficiency of the [Department](#).

National data relating to climate change can be found at the [Department of Meteorology](#), the [Department of Air Quality](#) and from the [Meteorological Service](#). Additional climate change adaptation data can be found on the Cyprus [National Open Data Portal](#). [CYPADAPT](#) contains a database which has been developed with the aim to provide

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

information on adaptation measures applied worldwide. The [CYPADAPT](#) methodology is developed in line with the [Intergovernmental Panel on Climate Change](#) framework, for assessing policies against climate change adaptation needs as part of a project. A [risk assessment](#) methodology (produced by the Horizon2020 "BINGO project Deliverable 4.1: Water Sector Risk Assessment"), aims to create adaptation strategies for water management. [CYPADAPT](#) also developed a [multi-criteria analysis \(MCA\) tool](#) for the selection of the most appropriate set of [adaptation options](#). [DARECLIMED](#) is a [CYI](#) project which aims to create a climate data repository and knowledge sharing platform, and to improve data availability for the Eastern Mediterranean region. [CYI](#) uses meteorological, hydrological and climate models as tools for estimating the impacts, the vulnerability and risks from climate change and for developing climate adaptation options. [CIRIA](#) has produced a number of guidance documents covering a range of opportunities and challenges related to water management. Guidance on natural water retention measures are available at the NWRM [EU Platform](#), where the focus is on green infrastructure. 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 2016 [Climate Change Risk Assessment](#) provides an overview per sector of potential risks and opportunities of climate change for Cyprus until 2100. It has focused on 11 priority sectors, including infrastructure. The critical infrastructure of Cyprus has been developed near the coastal area, except for Lefkosa (Nicosia) which is located near the centre of the island. Rising sea levels will lead to further erosion and heightened safety threats for infrastructure such as Larnaca airport. The [Flood Risk Management Plan](#) identifies a significant risk of flooding due to urbanisation, and foresees measures to enhance the resilience of road infrastructure in these affected areas. The [Flood Risk Management Plan](#) includes a total of 38 actions covering all aspects of flood risk management (e.g. actions to increase knowledge, the development of information and best practices in the management of flood risk etc.). The [Cyprus Climate Change Risk Assessment Report](#) mentions how Nicosia is vulnerable to urban heat island (UHI), whereby an area experiences elevated air temperatures. A [Vulnerability assessment](#) on energy demand due to climate change in Cyprus includes a variety of measures that Cyprus is taking to increase the supply and resilience of domestic energy in response to the increased risk of damage and the increased demand for heating and cooling. The broadband and waste sectors are not involved in the national or regional authority climate change adaptation plans or initiatives organised by governmental bodies.

A number of case studies on climate adaptation have been provided in the country report for Cyprus, describing a [transnational network of innovation for agriculture](#) in the Mediterranean, and knowledge and innovation transfer project ([AQUA KNIGHT](#)), and the project [AGWATER](#) for sustainable agricultural production under climate change.

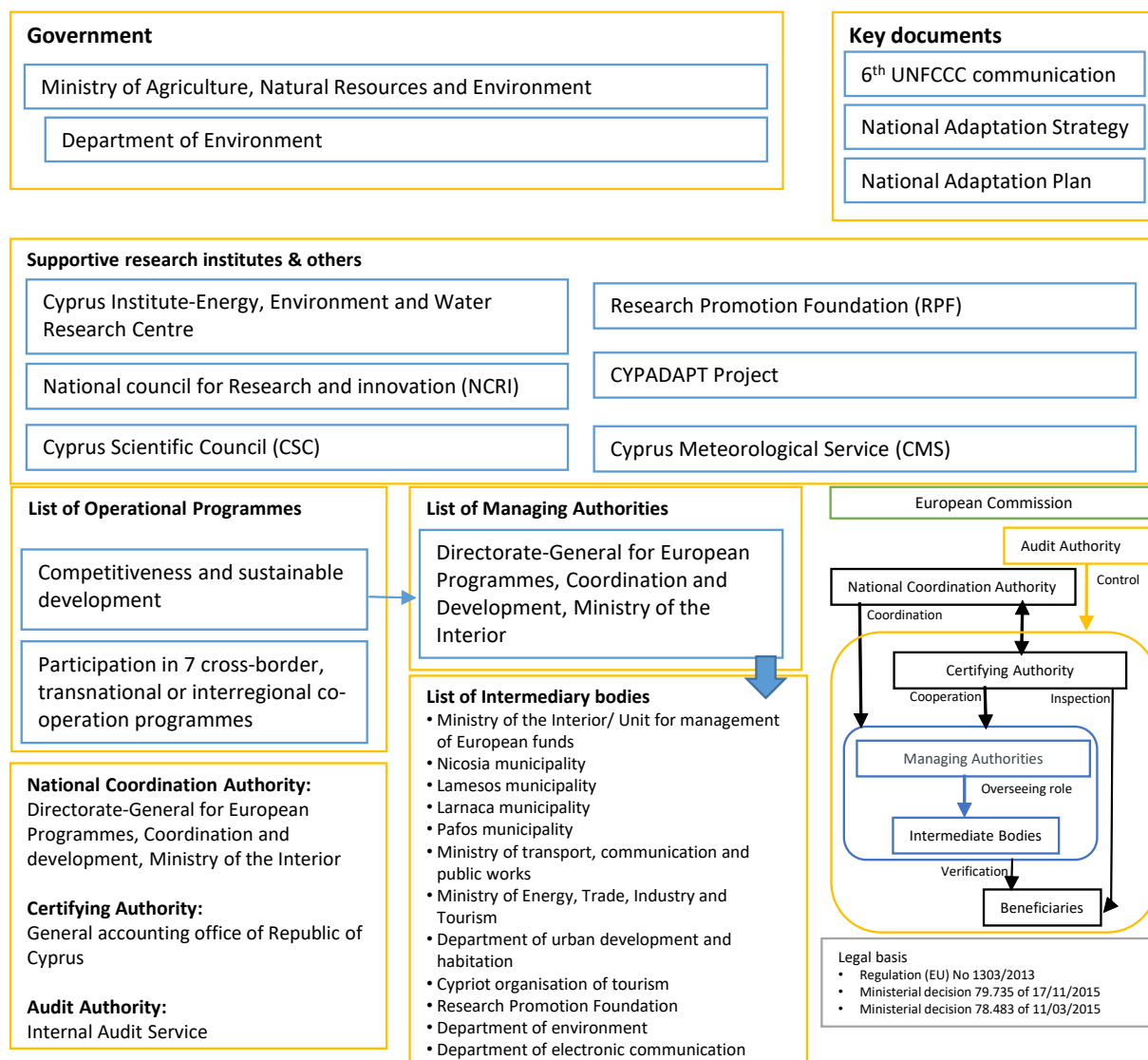
2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

The [National Adaptation Strategy](#) of Cyprus is based on the [Cyprus Climate Change Risk Assessment](#) and on [CYPADAPT](#)². The [National Adaptation Action Plan](#) (NAAP) was approved in May 2017. The [Ministry of Agriculture, Natural resources and Environment](#) is the central body coordinating the adaptation policy-making process and has lead the preparation and adoption of a NAS.

The [Department of Environment](#) supervises the implementation of policy and the adoption of [European policy](#) and legislation on the environment. Moreover, the

² CYPADAPT aims to outline knowledge about current climate variations; describe future changes projected for the 21st century; characterize adaptive capacity to cope with present-day climate; provide estimates of potential impacts under future climate change; assess the relative vulnerability of different systems, sectors or communities to climate change; and propose appropriate measures for adapting to climate change

department chairs the Committee for Environmental Impact Assessment. The [Meteorological Service](#) provides services and information related to weather and climate in all areas of economic and social activity in Cyprus.



A CYPADAPT Adaptation Steering Committee was established in November 2011 to facilitate and monitor the progress of the Strategy. The Committee was further divided into thematic sub-committees. The Department of Environment was the coordinator, bringing together government departments, local authorities, universities, research institutions, consultants, NGOs and consumer organisations.

ERDF is mainly absorbed through the Operational Programme "Competitiveness and Sustainable Development", managed by the Ministry of the Interior. Cyprus also participates in seven cross-border, transnational or interregional co-operation programmes. The Managing Authority of all infrastructure-related projects is the Coordination and Development department in the Directorate-General for European Programmes at the Ministry of the Interior. A large list of intermediary bodies are also involved in the process.

3. RESOURCES

This country report has reviewed the currently available resources in Cyprus for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis³ for ESIF-funded projects, through the processes of vulnerability and risk assessments which are, broadly:

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

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

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

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

³ 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

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. Climate change adaptation information is currently recorded within the respective Ministries, the [Ministry of Agriculture, Natural resources and Environment](#) and the Department for the Environment; the central web portal or repository for all climate change adaptation-related data or for infrastructure projects within Cyprus is currently under development.

National data relating to climate change can be found at the [Department of Meteorology](#) and the [Department of Air Quality](#). Additional climate change adaptation data can be found on the Cyprus [National Open Data Portal](#). The [Statistical Service of Cyprus](#) (CYStat) maintains a database of statistics relating to Cyprus's economy, society and environment. The exact content of these databases was not examined in the context of the present study.

The Department of Fisheries and Marine Research (DFMR) carries out research and monitors marine ecology and biodiversity, the coastal/marine water quality and the marine aquaculture.

There are a number of research institutes that cover issues relating to climate adaptations, including:

- The Agricultural Research Institute (ARI), which conducts research in agriculture, plant and livestock science, proposes and evaluates new scientific and technological methods and suggests new procedures for the sustainable utilisation of natural resources and the improvement of animal and plant production.
- The State General Laboratory (SGL), which carries out research to support the development and application of policies and to provide solutions to existing or emerging problems mainly in the areas of food safety, environment and public health.
- The Cyprus Oceanographic Centre, which carries out ocean research and studies, and forecasts and monitors the deep sea water characteristics. It has developed and operates the Cyprus Coastal Ocean Forecasting and Observing System (CYCOFOS) and the online marine database Cyprus Oceanographic Online Database (BYTHOS) providing scientific data on Eastern Mediterranean.

[CYPADAPT](#) contains a database which has been developed with the aim of providing information on adaptation measures applied worldwide. The adaptation measures are categorised based on the sector to which they are applied (agriculture, water, health, energy etc.).

For the dissemination of information on climate change adaptation, Cyprus developed the CYPADAPT portal. The platform was designed to be a knowledge base and communication platform for adaptation, linked to Climate-ADAPT and other platforms. The Ministry's Department of Environment launched an online blog in Greek (ClimateCY), where news, information and positions relating to adaptation are gradually being uploaded. However, the most recent updates identified were from 2012.

The observed and potential future climate change in Cyprus have been produced as part of the [CYPADAPT](#) project. Academic literature exists on climate change vulnerability, including the consideration of economic assessments of value at risk ([Zachariadis, 2012](#)). In general, regional climate models consistently predict an overall warming and drying of Cyprus with significant impacts to human health, energy use, water resources and other socio-economic sectors.

Cyprus' [Sixth National Communication](#) provides a national assessment of climate risk and vulnerability, with information on sectoral measures for adaptation. Data produced by

climate models are uploaded to databases working on international projects. The most important of these databases is that of the project [CORDEX](#) (COordinated EXperiment on climate change), where national data are uploaded by the [Cyprus Institute](#) (CYI).

Data for the water sector, in the context of climate adaptation, is provided within the [BINGO](#) project using the [COSMO-CLM regional climate model](#), and the CYI.

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

The [CYPADAPT](#) methodology is developed in line with the [Intergovernmental Panel on Climate Change](#) framework for assessing policies against climate change adaptation needs as part of a project. Cyprus's first detailed Climate Change Risk Assessment (CCRA) was then published in 2016. It provides an overview of potential risks and opportunities of climate change for Cyprus until 2100 and its findings will inform the development of adaptation plans by the Government and the competent authorities. The vulnerability assessment has focussed on 11 priority sectors. These include water resources, land use, seaside areas, biodiversity, forestry, agriculture, fisheries, tourism, energy, infrastructure and public health.

Both the vulnerability assessment and the adaptation measures refer to all the policy areas of Cyprus that are – or expected to be – affected by climate change. The categorisation of the adaptation policy areas are based on the 2009 White Paper of the European Commission entitled "[Adapting to climate change: towards a European framework for action](#)".

A [Risk Assessment](#) prepared by the [Ministry of Agriculture, Rural Development and Environment](#), specifically assesses the magnitude of current climate related risks for economic, social and environmental systems, and how these interact with the climate and the relative importance of climate versus other drivers of change.

3.3. Tools

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

[CYPADAPT](#) developed a [multi-criteria analysis \(MCA\) tool](#) for the selection of the most appropriate set of [adaptation options](#). This MCA tool processes stakeholders' evaluations on the proposed adaptation measures and produces alternative adaptation scenarios, based on the degree of vulnerability of the system to climate change, the weights assigned to the evaluation criteria and the weights assigned to the different stakeholder groups (competent national authorities, relevant national authorities, research institutes, non-governmental organisations, sectoral unions and associations and, civil society organisations).

[CYI](#) uses meteorological, hydrological and climate models as tools for estimating the impacts, the vulnerability and risks from climate change and for developing climate adaptation options. [DARECLIMED](#) is a [CYI](#) project which aims to create a climate data repository and knowledge sharing platform, to improve the availability of data relevant to climate change assessments for the Eastern Mediterranean region.

Cyprus also makes use of other adaptation tools. The [Weather Research and Forecasting \(WRF\)](#) model is a weather prediction system designed both for research and operational forecasting application. WRF can produce simulations based on actual atmospheric conditions (i.e., from observations and analyses) or hypothetical scenarios. [Hydrological WRF-HYDRO](#) was designed to enhance the accuracy of hydrometeorological forecasts, using science-based prediction tools. Past projects include flash flood prediction and regional hydroclimate impact assessments. The [COMBINE](#) project coordinates existing research groups to advance Earth System Models (ESMs) for greater accuracy within climate projections.

EIONET provides [Flood Maps](#) which are publically available, mapping areas of potential significant flood risk. EIONET also contains Flood Risk Management Plans.

For a continual update of available tools, the reader is referred to the European Climate Adaptation Platform [Climate-ADAPT](#), which has a dedicated tools section.

3.4. Guidance

Guidance is an essential requirement to ensure consistency in applying methodologies and tools. The [CYPADAPT](#) project reviews and evaluates the existing adaptation measures implemented in Cyprus aiming at reinforcing the adaptive capacity of different sectors in Cyprus. They are reviewed and evaluated on the basis of their effectiveness, viability and their contribution to climate change adaptation.

Wider guidance is also available. [CIRIA](#) has produced a number of guidance documents covering a range of opportunities and challenges related to general water management, such as sustainable urban drainage systems. Guidance on natural water retention measures are available at the NWRM [EU Platform](#), where the focus is on green infrastructure applied to the water sector, which permit to achieve and maintain healthy water ecosystems.

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

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

Cyprus' [National Adaptation Strategy](#) was approved in April 2017. It is based on the [Cyprus Climate Change Risk Assessment](#) which made an assessment of the current and future vulnerability of Cyprus to climate change, while for the identified key vulnerabilities, the available adaptation measures for addressing them were evaluated and prioritized. Under the Climate Change Risk Assessment (Contract No. 22/2014), specific reports were prepared for the built environment sector, the water sector, the transport sector, for floods and coastal erosion, for the energy sector, for the business, industry and services sector, and more that are not found online but can be requested from the Department of Environment of the Ministry of Agriculture, Rural Development and Environment.

The [National Adaptation Action Plan](#) (NAAP) was approved in May 2017 and foresees approximately 250 measures, actions and practices for the effective climate change adaptation of each of the eleven policy areas: water resources, soils, coasts, biodiversity, agriculture, forests, fisheries and aquaculture, public health, energy, tourism and infrastructure. For each of the above-mentioned policy areas, Sectoral Adaptation Plans are under preparation. The NAAP was developed in the framework of Action 5 of the [CYPADAPT](#) project and constitutes the framework of action for the effective preparation and proofing of the country against the observed and expected changes in climate and covers a 5-year period (October 2014 – September 2019).

As the revised EIA Directive is in place, the Cypriot authorities are expected to start harmonising national legislation and mainstream adaptation.

Responsible authorities

The [Ministry of Agriculture, Rural Development and Environment](#) is the central body coordinating the adaptation policy-making process. The [Department of Environment](#) supervises the implementation of policy and the adoption of European policy and legislation on the environment. Moreover, the Department chairs the Committee for Environmental Impact Assessment.

The [National Council for Research and Innovation \(NCRI\)](#) and the [Cyprus Scientific Council \(CSC\)](#), are the main bodies responsible for strategy and planning. The NCRI has exclusive responsibility for the adoption of long-term strategies in research and innovation, while the CSC constitutes the advisory scientific board to the government.

The [Meteorological Service](#) handles issues related to weather and climate of Cyprus. It provides services and information related to weather and climate in all areas of economic and social activity in Cyprus.

Management of the ESI Funds

Cyprus has a national Operational Programme on Competitiveness and sustainable development, and is participating in seven cross-border, transnational or interregional co-operation programmes. The Managing Authority of the OP is the Directorate-General for European Programmes, Coordination and Development at the Ministry of the Interior, while the list of Intermediary bodies includes the Unit for management of European funds at the Ministry of the Interior, the municipalities of Nicosia, Larnaca and Pafos, the Ministry of transport, the Ministry of Energy, Trade, Industry and Tourism, the

Cypriot organisation of tourism, the Research Promotion Foundation and more. To ensure the functioning of the ESIF system in Cyprus, National Coordination Authority is the Directorate-General for European Programmes, Coordination and development at the Ministry of the Interior; the Certifying Authority is the General accounting office of Republic of Cyprus; and the Audit Authority is the Internal Audit Service.

3.7. Institutional Capacity

The institutional challenge for climate change adaptation is that climate policy is a cross-cutting issue, and requires co-operation across a large number of institutions. To be effective in delivering climate change adaptation a minimum level of capacity is needed on leadership, technical and human resources, effective collaboration, and financial support.

Technical and human resources

Almost all higher academic institutions in Cyprus have research in all fields of climate change, including climate modelling and forecast, adaptation and impacts and particularly mitigation.

The [CYPADAPT](#) project was initiated in September 2011 through coordination between the Department of Environment, Ministry of Agriculture, Natural Resources and Environment of Cyprus, whilst the National Technical University of Athens and the National Observatory of Athens are project partners. The project was co-financed by the LIFE+ programme, the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU. The project strengthened and increased Cyprus' adaptive capacity to climate change impacts through the development of the National Adaptation Strategy. Cyprus is well equipped with methodology documentation, tools and guidance to prepare climate adaptation measures and policies.

Cyprus' Sixth National Communication ([UNFCCC](#)) states that nearly all higher academic institutions in Cyprus have research across climate change activities, including climate modelling and forecasting, adaptation and impact analysis. [The Cyprus Climate Change Risk Assessment Evidence Report](#) summarised the adaptive capacity of Cyprus in dealing with severe climate effects, such as heat waves.

The [Strategic Plan](#) of the [Ministry of Environment](#) examines the need to enhance the institutional capacity and improve the effectiveness of the [Department for Climate Change](#) Adaptation. It comments on the lack of an integrated automation system, restricting the efficiency of the Department, both internally and regarding the appropriate, full and timely provision of information to the public. Understaffing is an important parameter that deters the effective functioning of the Department. The problem has recently been reinforced by recent freezing of recruitments and promotions.

Further space for improvement has been identified in the context of the [evaluation](#) on the implementation of the Operational Programme "Competitiveness and Sustainable Development", which includes the thematic objective of climate adaptation. The general remarks are that, while it is functioning well, some more efforts are required to increase the efficiency of procedures and their effectiveness.

Effective collaboration

The various research and government institutions in Cyprus are performing well and collaborating effectively in regards to climate adaptation according to relevant persons from national authorities interviewed in the context of this study. It is reported that there is good capacity, both on governance (regular meetings with representatives from all

relevant government and ministerial departments, but also from local authorities), and on research capacity (the [Cyprus Institute](#)).

Transboundary cooperation to address common challenges with relevant countries is conducted bilaterally and further planned in the cross border cooperation programmes based on an assessment of common priority sectors and risks such as floods. Recent natural disasters, such as floods, hailstorms and sleet have drawn more attention to the transboundary issues both in terms of preventive and relief actions. Macro-regional strategies in preparation will also take climate change related risks and impacts into account when planning common projects to address various challenges shared in the region.

National Adaptation Platform is a developing knowledge base and communication platform for adaptation and aims to support Cyprus in adapting to climate change. The potential users are the government, the local authorities, universities, research institutions, NGO's and other stakeholders and citizens, who will access and share information and views on many different issues concerning adaptation options, climate impacts on, and vulnerability of, regions and sectors, case studies, research activities, legislation, financing opportunities, tools for adaptation planning, and other useful links.

Since March 2013 the Planning Bureau in cooperation with the RPF and the Cyprus University of Technology is preparing the Smart Specialization Strategy which is a new innovation policy concept designed to promote the efficient and effective use of investment in research, including the European, Structural and investment funds.

Financial resources

The [ESI Funds are enabling the development of major projects](#) in the 2014 – 2020 programming. Concerning major projects, by early 2018, there have been 4.1 Million EUR approved for Network Infrastructures in Transport and Energy and another 4.1 Million EUR in Environment Protection & Resource Efficiency. The [dataset will be updated regularly](#) to reflect changes in the programme lists and major project notifications.

According to the [ESIF-viewer](#), Cyprus is planning investments of 726 Million EUR, with 135 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6) and 74 Million EUR for Information and Communication Technologies (Thematic Objective 2). The shares within these Thematic Objectives that may relate to climate adaptation are unknown.

The [EEA and Norway Grants](#) have allocated 7.85 Million EUR for the period 2009 – 2014, and 11.5 Million EUR for the period 2014 – 2021, with unclear shares for climate adaptation.

Since 2006, 69 projects directly or indirectly relevant to climate change have been funded by various Programmes and Actions of the National Framework Programme for Research and Technological Development (DESMI). The total contribution of the Research Promotion Foundation for these projects was 8.8 Million EUR.

4. SECTOR OVERVIEW

4.1. Introduction

Since 2014, the requirements for major projects to obtain ESIF funding⁴ demand that project applications integrate climate change considerations⁵, such as a vulnerability and

⁴ http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm

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*.⁶

4.2. Transport

Investments in the transport sector are very diverse, covering roads (including bridges and tunnels), inland waterways, rail, ports / airports, and public transport infrastructure. Any disruption caused in this sector can affect many other sectors (economic and societal) directly. Potential threats are sea-level rise and extreme weather events, such as extended heat waves, flooding, heavy rainfall or storm, and landslides amongst others. Extreme weather events are a potential threat to both infrastructure and operation of the transport system.

Road infrastructure

In April 2017, the Managing Authority notified the European Commission of its intention to modify the Operational Programme Competitiveness and Sustainable Development 2014-2020 to include the Major Project on the second Road Phase that connects Limassol Harbour to the Limassol-Pafos motorway. The relevant Decision was taken at the meeting of the Monitoring Committee of the Program on 30/9/16.

Regarding the road network, there is a difference in physical vulnerability between the different classes (local roads as opposed to the motorways that are being designed and constructed with a greater heat-resilient specification than is standard for other roads). In the [Framework of the Floods Directive](#), areas have been identified with a potential significant flood risk. In these areas, there is a risk of flooding of the existing road network but the extent is not known due to lack of analytical data. Some of the major areas of flood risk include:

- A3 Motorway Larnaka Airport (The Ormideia River); and

⁵ 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>

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

- A1 Motorway Nicosia (The Vathias and Garyllis River)

The [Flood Risk Management Plan](#) (2007) foresees measures to enhance the resilience of road infrastructure to flooding in these affected areas.

[The Paphos District of Western Cyprus](#) is considered to be the most landslide-prone terrain in Cyprus. The high winter rainfalls which occur in the highlands in Paphos have a profound effect on the initiation and/or reactivation of landslides. Again, due to lack of available data, they have been unable to predict the length of road potentially affected by landslide and winter precipitation. There is high likelihood of damage to road infrastructure due to higher temperatures and in these cases heat-resilient materials can be applied on planned construction works.

A Public Works Department report '[Road network maintained by Public Works Department](#)' (2013) provides various statistical data and [an Assessment of Cyprus' Vulnerability](#), which includes the development of the National Adaptation Strategy.

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

Railway infrastructure

There is no railway transportation in Cyprus.

Airport infrastructure

A rise in sea level will also lead to further erosion and heightened safety threats for infrastructure such as Larnaca airport. It is expected that projected sea level rise will not be a major threat to Larnaca airport until 2080, and so is not a current priority.

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

4.3. Broadband

The International Telecommunication Union has issued the recommendation L.1502 "[Adapting information and communication technology infrastructure to the effects of climate change](#)" for the purpose of identifying climate threats and their impact. L.1502 supports Resilience by design in identified risky areas, and proposes changes to equipment installation standards to ensure protection from more frequent extreme weather phenomena and their impacts. The European broadband sector standardisation bodies have not prepared vulnerability assessment and risk management framework for dealing with climate change in broadband projects. The broadband sector is not specifically targeted in the climate change adaptation documents published by Cyprus (including [CYPADAPT](#)).

It is a general best practice for operators to use flood mapping information from environmental agencies to safeguard new planned data centres from flooding. As Belgium supports the integration of climate change adaptation in European standards, developments for e.g. design standards on datacenters will be adopted when in place at EU level.

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*.⁷

With regard to EU funding of broadband infrastructure in Cyprus, there is comprehensive guidance provided in the report "[European Funding for Broadband 2014 – 2020](#)". This report states that European Structural and Investment Funds are the largest EU public funding source that supports broadband investment. The report also states that the 2014 - 2020 total budget for broadband deployment in Cyprus is approximately €19 Million. [Another report](#) includes information on best broadband practices and current projects worldwide.

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

4.4. Urban Development

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

The critical infrastructure of Cyprus has been developed near the coastal area, except for Lefkosia (Nicosia) which is located near the centre of the island. According to the [Flood Risk Management Plan](#), there is a significant risk of flooding due to urbanisation. In other words, not coastal flooding but flooding of pumping stations and other inland areas.

[A Cyprus Climate Change Risk Assessment Report](#) mentions how Nicosia is vulnerable to urban heat island (UHI), whereby an area experiences elevated air temperatures. Appropriate adaptive design through new building regulations could reduce the risk of the overheating of buildings (effective summer shading, appropriate use of building insulation etc.). Changes in climate are likely to influence both the heating and cooling energy demand within buildings.

There are various published reports on the urban heat island phenomenon within Nicosia in particular. These include:

- Theophilou M.K., Serghides D., 2015. Estimating the characteristics of the Urban Heat Island Effect in Nicosia, Cyprus, using multiyear urban and rural climatic data and analysis. *Energy and Buildings*, Volume 108, pp. 137–144
- Santamouris, M., 2014. On the energy impact of urban heat island and global warming on buildings. *Energy Build.* 82, pp. 100-113;
- Theophilou M.K., Serghides D., 2014. Heat island effect for Nicosia, Cyprus. *Advances in Building Energy Research*. Volume 8, Issue 1, pp. 63-73 58.

Under prolonged hot, dry conditions, evapo-transpiration of the green space slows down, eventually shutting down if the vegetation becomes completely parched. Consequently, the cooling effect of the green space is effectively nullified. Without adaptation, this could become an increasingly frequent occurrence as summers become hotter and drier. [The](#)

⁷ 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.

[Review of Impacts and Outline of an Adaptation Strategy report](#) suggests various measures that could be taken, for example green areas and water harvesting in order to reduce the higher and drier temperatures, but none of these measurements have been put in place.

The [Climate Change in Cyprus: Impacts and Adaptation Policies. Cyprus Economic Policy Review](#) includes adaptation policy suggestions, but they have not been implemented thus far. The [CYPADAPT](#) (LIFE10 ENV/CY/000723) published a report titled "Development of a national strategy for adaptation to climate change adverse impacts in Cyprus", which comments on the climate change impact, vulnerability and adaptation assessment for the case of Cyprus.

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, ...).

With growing dependence on air conditioning, frequent heat waves during summer could result in increased demand for energy production and even cause loss of life if power supplies fail. The main vulnerability priorities identified in [The Cyprus Climate Change Risk Assessment Evidence Report](#) (Energy Sector) are related to the energy demand for cooling and heating, which is directly affected by climate change and, to the efficiency of thermal power plants, which is not expected to be significantly affected by climate change. Additional pressures - especially during the summer - are the energy demand for drinking water production from seawater desalination plants (to reduce the dependence of drinking water on rainfall) and for irrigation (for longer periods through pressurised irrigation systems and long conveyance pipe works) due to decreasing precipitation.

[A Vulnerability assessment](#) on energy demand due to climate change in Cyprus includes a variety of measures that Cyprus is taking to increase the supply and resilience of domestic energy in response to the increased risk of damage and the increased demand for heating and cooling. More information on the impact of climate change on the energy sector is provided in the report "[Forecast of electricity consumption in Cyprus up to the year 2030: The potential impact of climate change](#)" (2010).

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

4.6. Water

Investments in the water sector are linked to efficient water supply (including reduction of leakage), waste-water treatment and water reuse as well as the implementation of [River Basin Management Plans \(RBMP\)](#) to ensure integrated water management at the river basin scale. Important threats are linked to water quantity (droughts and floods) as well as quality (water pollution). Climate change can have an impact on both water quantity and quality. 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 scenario's. 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.

[The Cyprus Climate Change Risk Assessment Evidence Report \(Water Sector / Floods and Coastal Erosion\)](#) comments on how water resources of Cyprus are considered vulnerable to climate change, since they are limited due to the semi-arid climate that characterises the Mediterranean island.

The First [Flood Risk Management Plan](#) and its Programme of Measures enforced in 2016, provides actions to be undertaken during the period 2016-2021 in relation to the Flood Risk Management in Cyprus. The adopted programme of measures includes a total of 38 actions covering all aspects of flood risk management (e.g. actions to increase knowledge, the development of information and best practices in the management of flood risk etc.).

[The Water Development Department](#) is responsible for development, planning, implementation and maintenance of water resources. It does not include the drainage of urban areas, a problem in Cyprus due to the lack of storm water drainage systems. The Municipalities Law allocates jurisdiction to municipalities to "*construct, maintain and operate storm water drainage systems*".

A flood management system currently in place is the [urban watercourse in Nicosia](#). The municipalities have designed a storm drainage system that takes into consideration the whole catchment area, up to the main river itself. The drainage has to pass under roads and utility services (as it is implemented in an urban area) and therefore the pipes are made from reinforced concrete in order to support the existing structures.

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.

No documents or information on climate adaptation targeting waste management infrastructure specifically was retrieved from interviews or desk study. The waste sector is only considered in its contribution to greenhouse gas emissions. Nevertheless, waste management plants and landfills are subject to (EU) environmental legislation, such as the Landfill Directive and the IED.

[Directive 1999/31/EC on the landfill of waste](#) requires that landfills are situated and designed in such a way that safeguard against pollution of the soil, groundwater or surface water. This requirement is translated into [national design standards](#) for the construction of landfills that include the consideration of temperature, precipitation extremes and flooding where relevant.

Large waste treatment plant are subject to [Directive 2010/75/EU on industrial emissions](#) (IED), which requires as a general principle that necessary measures should be taken to prevent accidents which may have environmental consequences, and to limit those consequences. This requires that a structured management plan should be available that includes and mitigates hazards such as extreme weather conditions (e.g. flooding, very high winds). In the [BAT reference document \(BREF\) on Waste Treatments Industries](#), some information is provided on the impact of certain climatic conditions (e.g. the impact of higher temperature on biofilter performance, aerobic decomposition, etc.). Although climate change is not specifically addressed.

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

5. CASE STUDIES

5.1. Case studies of climate adaptation projects

Creation of a transnational network of innovation and experimentation pools for agriculture in the Mediterranean islands

Project description	The general objective of the project is the creation of a new frame of cooperation between islands for innovation in agriculture, mobilising the « pools of competencies » scattered in the insular MED area. The project belongs to Axis I – Strengthening innovation capacities, Objective 1.2 of the MED Program: « Strengthening strategic cooperation between economic development actors and public authorities ». The main achievement is the elaboration of a methodology answering these large objectives for agriculture in the islands. The working programme follows a logical frame divided in three steps: - Component 3 : “comparative analysis of innovation”, with identification of priority fields (phase 3.1), and of the best practice related to these fields (phase 3.2), - Component 4 : “elaboration of the methodology” built on the bases of the best practice identified (phase 4.1) and tested in each island through pilot projects (phase 4.2), - Component 5 : “inter-island strategy for innovation in agriculture”, with an application in each island (phase 5.1), and “creation of the transnational network of inter-island pools of competencies” (phase 5.2).
Photograph	n/a
Budget	€1.2 billion
Climate Change Vulnerability and Risks	No specific assessment of vulnerability to climate change Increased awareness of and education in climate change adaptation
Climate change adaptation measures	Developed systems for information exchange on agricultural adaptation Developed strategies and measures for adapting to a changing climate
Good practice	Develops vulnerability and risk assessment using existing standardised methods

Further information	http://www.programmemed.eu/index.php?id=5175&L=1
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Aqua knowledge and innovation transfer for water saving in the Mediterranean basin (AQUA KNIGHT)

Project description	Mediterranean water resources are under stress, especially in the south and east. Water demand constantly increases, while water use efficiency can still be considered as limited. Policies aiming at improving usage efficiency and reduced losses and poor usage, are urgently needed. AQUAKNIGHT focuses on optimising consumption and minimising the Non-Revenue Water (water not metered or billed to consumers) through the implementation of five pilot projects in the cities of Limassol (Cyprus), Genoa (Italy), Alexandria (Egypt), Tunis (Tunisia) and Aqaba (Jordan).
Photograph	n/a
Budget	€2 billion
Climate Change Vulnerability and Risks	Not specifically carried out
Climate change adaptation measures	<p>Development of a manual of best practices for reducing commercial water losses in the water networks of the Mediterranean area</p> <p>Increase of water utilities staff knowledge and capacity to reduce water losses with the consequent benefits in operational and financial terms</p>
Good practice	<p>Application of international best practice to evaluate and control water losses in the selected pilot areas</p> <p>Wide dissemination of best practice to control and manage water losses and make sure that tools reach a wide group of stakeholders in the participating countries and in other Mediterranean countries</p>
Further information	http://www.enpicbcmmed.eu/

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

Options for sustainable agricultural production and water use in Cyprus under global change ("AGWATER")

Project description	<p>The Cyprus University of Technology, along with various Partners conducted a two-year study for sustainable water use within Cyprus. The overall goals of this project were:</p> <ul style="list-style-type: none"> To provide recommendations for climate change adaptation for the agricultural sector in Cyprus and the wider Mediterranean region;
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	<p>and</p> <ul style="list-style-type: none"> To establish a consortium of excellence in natural resource management research in Cyprus for tackling the challenges imposed by climate change. <p>The AGWATER project aimed to model agricultural, water productivity and economic indicators for all agricultural production systems in Cyprus, under different policy, economic and climate scenarios, for the 2020-2050 future period. To do so a number of datasets and scenarios were developed in five Work Packages, as described in this summary:</p> <ul style="list-style-type: none"> A digital soil map and soil property database of Cyprus at 1:25,000 scale; An agro-climatological characterisation and agro-meteorological database for Cyprus; A characterisation of agricultural production systems and an assessment of the effect of climate on potato and barley production, based on long-term research trials; Policy and economic scenarios for 2020-2050; and Climate change projections for 2020-2050
Photograph	n/a
Budget	€68,440
Climate Change Vulnerability and Risks	Agriculture in Cyprus is constrained by high temperatures and limited and highly variable rainfall. Irrigation water supplies provide an important contribution to crop production, but water resources are limited. This situation is expected to worsen in the future, as a result of global climate change.
Climate change adaptation measures	A daily soil water balance model was used to compute agricultural production and water use performance indicators for 333,216 registered crop plots in Cyprus. These plots cover a total area of 124,568 ha; 27,678 ha irrigated and 96,890 ha rain-fed. Soil physical data were obtained from the new digital soil maps for each plot. Similarly, a 30-year record of daily precipitation and reference evapotranspiration data was extracted for the climate grid cell that covered the plot. The climate datasets included a gridded data set developed from observations for the 1980-2010 reference period statistically downscaled climate projections for 2020-2050 of three Regional Climate Models (CNRM, KNMI and METO-HC) for the medium A1B emission scenario.
Good practice	<p>A primary aim of AGWATER was the establishment of a database of the basic daily climatological parameters. Furthermore, the second objective of the work package was the spatial interpolation of the climatic parameters in order to create different climate surfaces.</p> <p>The research outputs are brought together in the Cyprus green-blue-water model, which use a consistent computational framework and modular structure, to analyse the effects of the 3x3x3 matrix of policy and economic scenarios under the climate change projections for 2021-2050. A set of agricultural production and water use performance indicators are computed by the model, including green and blue water use (m³/ha), crop yield (ton/ha), crop water productivity (kg/m³), subsidy support (€/ha), net value of crop production (€/ha) and economic water productivity (€/m³). All indicators are computed and mapped at the field, community, agro-climatic zone and country level, to</p>

	facilitate the extraction of policy recommendations.
Further information	https://www.cyi.ac.cy/images/AGWATER_Scientific_Reports/Project_Summary_def.pdf

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