Portugal's Adaptation Communication to the United Nations Framework Convention on Climate Change

Adaptation communication, referred to in Article 7, paragraphs 10 and 11 of the Paris Agreement

The guidelines outlined in Annex of Decision 9/CMA.1 have been used to inform this submission

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Contents

1. National circumstances, institutional arrangements and legal frameworks

1.1. National circumstances

Mainland Portugal's climate, according to Koppen's classification, is divided into two regions: one with a temperate climate with rainy winters and hot, dry summers (Csa - Hot-summer Mediterranean climate) and another with a temperate climate with rainy winters and hot, dry summers (Csb - Warm-summer Mediterranean climate). The proximity to the Atlantic Ocean and the Mediterranean strongly influences the climate of mainland Portugal. Although the most inland regions are only about 220 km from the coast, some are influenced by the Iberian Peninsula's continental mass, which gives them less rainfall (Portugal is a country with an average rainfall of circa 900 mm) and a greater annual temperature range than the coastland. The Mediterranean influence is particularly relevant in the summer and south and east of the territory, causing high temperatures and low rainfall, leading in this way to desertification processes. The general climate conditions in the Azores Archipelago are determined by its geographical situation in the context of the global atmospheric and oceanic circulation and by the effect of the enormous mass of water that surrounds it, reflected by the low-temperature range, high rainfall, relative humidity, and persistent winds. The Madeira Archipelago is geographically located in the subtropical region, presenting a mild climate in winter and summer, except in the higher areas, where lower temperatures are observed.

Regarding the demographic dynamics of relevance to adaptation matters, it is important to highlight the following aspects: the concentration of the population along the coast between the largest metropolitan areas, increasing its exposure to urban heat islands, flash floods, landslides and coastal risks; depopulation of the interior and ageing of the age structure, implying a reduction in agroforestry activity and an increase in the risk of forest fires; intense seasonal population movements, which increase vulnerability in the regions most sensitive to droughts, in a country whose resident population reached 10,347,892 inhabitants in 2021. The highest population density is found in the coastal strip between the country's two main metropolitan areas, where about 45% of the total population resides, despite only 6% of mainland Portugal's entire region.

The national economic structure has undergone a progressive process of tertiarization, and, in 2017, 68.9% of the population worked in the tertiary sector. The highest tertiarization rates, above 80%, are registered in the regions of Lisbon and Algarve, mainly due to tourism activity. Regarding land use and land cover, the dominant occupations in mainland Portugal are forest (39% of the total area) and agriculture (26% of the total area). The areas of wildwoods, agroforestry systems, and pasture occupy 12%, 8% and 7%, respectively, which attests to the relevance of the rural regions (around 92% of the total area), hence the historical importance of the risk of rural fires in mainland Portugal. Irrigation is a fundamental component to ensure the viability of agriculture, without which it is not possible to enhance the vegetative development of spring-summer crops and, consequently, to obtain income levels that fix agricultural populations, and contrary the progressive depopulation of rural regions of the interior. The forestry sector is a significant exporter with high added value that generates significant employment, however, the majority of forest areas are not actively managed, and extensive areas are abandoned, which contributed to increase the risk of wildfires, and the spreading of invasive species and plagues. The difficulties in the implementation of forest management policies are aggravated by the fragmentation of rural property (only 3% of forest areas belong to the Portuguese State). Although much less significant in terms of occupied space, urban areas present specific risks and potential human damage higher than those of rural areas.

1.2. Legal and policy frameworks and institutional arrangements

Legal and policy frameworks and regulations

The National Energy and Climate Plan 2021-2030 (PNEC 2030) is this decade's primary national energy and climate policy instrument and it was approved through the Council of Ministers Resolution n.º 53/2020, of 10th of July. The Ministerial Commission for Climate Action (CAC) is responsible for the political coordination of PNEC 2030, in charge of supervising and monitoring its implementation and the achievement of the established targets.

The Portuguese long-term vision for mitigation has been set in the Carbon Neutrality Roadmap 2050 (RNC2050), approved by the Council of Ministers nº. 107/2019, of 1st of July, which constituted the Portuguese Long-Term Strategy submitted to the European Commission and to United Nations Framework Convention for Climate Change (UNFCCC).

Portugal also has a revised NAS - National Adaptation Strategy (ENAAC 2020, approved by the Council of Ministers Resolution n.º 56/2015, of 30th of July) (English version in Annex 1), focusing on improving the articulation between domains (particularly those of transversal nature), on the integration in sectoral policies, and the implementation of adaptation measures.

The Adaptation to Climate Change Action Programme, approved by the Resolution of the Council of Ministers Nº. 130/2019, of 2nd of August (English version in Annex 2), complements and systematises the work carried out in the context of ENAAC 2020, focusing on its second objective: to implement adaptation measures.

1.2.1. Overview of institutional arrangements and governance at the national level

Climate vulnerability and risk assessment

The first integrated assessment of impacts and adaptation measures in Portugal – SIAM - Climate Change in Portugal. Scenarios, Impacts and Adaptation Measures – was completed in 2002. With the approval of the National Adaptation Strategy (NAS), a monitoring and reporting system of adaptation actions was established. It is the competence of each of the NAS sectorial working groups to identify and assess each sector's significant impacts, vulnerabilities, options, and adaptation measures. In the Interim monitoring reports of the NAS, it is possible to evaluate the evolutionary dynamics associated with climate impacts, risks, and vulnerabilities. The research developments and improvement of knowledge on climate change risks have been therefore integrated in the climate vulnerability and risk assessments that constitute the starting point of the elaboration of the various sectoral and subnational adaptation plans and strategies. In addition, in 2014 and 2019, it was carried out the National Risk Assessment led by the civil protection authority that already included the dimension of climate change. .

Planning, implementation, monitoring, evaluation and revision of adaptation policy

The Ministerial Commission for Climate Action (CAC) seeks to enhance the involvement and promote the accountability of the various sectors to greater integration of climate policy in sectoral policies. It is composed of government departments from relevant sectors, promoting policy coordination, a greater dynamism and sectorial responsibility. It is chaired by the Minister of the Environment and Climate Action, and includes government departments from the areas of energy, spatial planning, finance, agriculture, sea, economy and innovation, transport, health, tourism, civil protection, regional development, local administration, foreign affairs and cooperation, education and science, and representatives of the regional governments of the Azores and Madeira. CAC is responsible for: a) Providing political guidance in the context of

climate change; b) Promoting the articulation and integration of climate change policies in sectoral policies; c) Following the implementation of sectoral measures, programmes, and actions.

At a lower level on the NAS governance structure, the aim is to promote greater involvement of the relevant authorities and articulation with the Autonomous Regions of the Azores and Madeira, a better interaction between sectoral groups and between the various administrative levels. The NAS coordination group is composed by: a) the Portuguese Environment Agency, which chairs; b) The coordinators of thematic areas; c) the coordinators of sectoral working groups; d) the representatives of the Autonomous Regions of the Azores and Madeira; e) the representatives of the National Association of Portuguese Municipalities.

The operationalisation of the NAS required the creation of a flexible and dynamic structure, organised into six thematic areas[1] and nine priority sectors[2]. The thematic areas promote coherent vertical integration of the different scales needed for adaptation (from international to local) and horizontal integration (between sectors and organisms) through the coordination and development of specific work of multisectoral nature (cross-cutting approaches). The coordination of each one is shared between the Portuguese Environment Agency (NAS general coordinator), and the entities with specific thematic competences, acting as facilitators. In addition to the entities that coordinate the sectoral groups (that include sectoral stakeholders) of the different priority sectors, other entities or personalities identified as relevant for the implementation of the NAS also participate in the work, contributing to a broader co-responsibility and the co-construction of the priority measures to be developed. The priority sectors correspond to strategic domains for the promotion and implementation of adaptation in Portugal.

Integration of climate change impacts and resilience into environmental assessment procedures

The Environmental Assessment procedures consider national and territorial adaptation planning instruments; current and future climatic vulnerabilities through historical data on the climate and the occurrences of extreme weather events; environmental, social and economic impacts and consequences, considering CC scenarios; key risks/impacts of CC in the project; assessment if pre-existing vulnerabilities to CC will be exacerbated; alternatives more resilient to climate pressures and/or allowing a more significant climate vulnerability reduction; critical thresholds that compromise the project or the environment, forcing the adoption of adaptation measures; minimisation measures based on NAP for the relevant vulnerabilities or impacts.

Integration of climate change impacts and adaptation planning into disaster risk management frameworks and vice versa

One of the NAS sectoral groups is the “Safety of People and Assets” coordinated by the civil protection authority. On the other hand, the adaptation unit of the Portuguese Environment Agency responsible for the general coordination of the NAS follows under the Sub-Commission of the National Civil Protection Commission responsible for the operationalization of the National Platform for Disaster Risk Reduction (PNRRC) that puts in practice the Sendai guidance.

In addition, the National Risk Assessment was prepared in 2014 and reviewed later in 2019, following the "Risk Assessment and Mapping Guidelines for Disaster Management" issued by the European Commission (document SEC (2010) 1626 final, 21.12.2010), which aims to

[1] Research and innovation, financing adaptation, international cooperation, mainstreaming adaptation – spatial planning, and mainstreaming adaptation – water resources.

[2] Agriculture, biodiversity, economy, energy, forests, health, safety of people and assets, transports and communications, and coastal areas and sea.

promote the better application of the precautionary principle, contributing to the adoption of measures to reduce the risk of major accident or disaster inherent in each activity. In this assessment, the natural, technological, or mixed hazards that may affect the national territory were identified and characterised. The National Risk Assessment took into consideration, for the applicable risks, the impact of climate change and the resulting scenarios, indicating tendencies to worsen or mitigate risks.

1.2.2. Overview of institutional arrangements and governance at the sub-national level (where "sub-national" refers to local and regional)

Legal requirements and strategic documents

The NAS empowered regional and local stakeholders, assisting sectors, public administration and policymakers in its implementation (integration of adaptation in sectoral policies and territorial programs and plans). Regional governments and the association of Portuguese municipalities participate in the NAS governance structure, considering their specific competencies and the importance of sub-national levels in terms of climate change impacts, and the respective adaptation response. The thematic area dedicated to the integration of adaptation into spatial planning also enables governance arrangements at subnational level.

Networks or other collaborations on adaptation across national authorities

One of the main objectives of the Portuguese climate policy is to ensure participation in international negotiations, responding to international commitments of cooperation and support to developing countries in this field, privileging priority countries, according to the principles and priorities defined in the Strategic Concept of Portuguese Cooperation (2014 - 2020).

The Unit for the Coordination of Operational Strategy for Humanitarian and Emergency Action promotes action in the case of Portugal's public aid to developing countries that require humanitarian and emergency action following losses and damage resulting from natural disasters caused by extreme weather events.

Since 2016 Portugal and Spain has strengthened relations between the national adaptation units improving the exchange of information and identification of priorities and common actions in the field of shared risks associated with the impacts of climate change.

Good practice examples of networks or other collaborations on adaptation across local and regional authorities

Created in December 2016, adapt.local - Network of Municipalities for Local Adaptation to Climate Change constitutes a partnership led by municipalities but involving higher education institutions, research centres, non-governmental organisations, and companies. Recently, Intermunicipal Climate Change Adaptation Plans have been developed, promoted by sub-regional structures. The networks formed in their elaboration integrate multiple local, sub-regional and, in some cases, national actors, contributing to a closer working relationship and partnership between authorities of different scales of action.

2. Impacts, risks and vulnerabilities

2.1. Climate monitoring and modelling framework

Main activities on climate monitoring, modelling, projections and scenarios

The Portuguese Institute of Sea and Atmosphere (IPMA) is responsible for making observations for meteorological and climatological purposes. IPMA is responsible for deploying, operating, and maintaining the national network of meteorological stations; it is also responsible for archiving and quality control of meteorological observations. The Portuguese Environment Agency keeps records of historical flood marks and its network of meteorological and hydrological monitoring stations. These data are available on the SNIRH - National Information System on Water Resources.

Additionally, IPMA launched OBSERVA - a voluntary cooperation platform where private individuals can associate their weather stations and report extreme weather events. Also, a register of weather extremes is available.

Within the scope of the active provision of climate services on a global scale, IPMA integrates into its mission the collection and exchange of climate data and the research and creation of climate information products for distribution to more differentiated users. Under the guidance of the Global Framework, the IPMA has already established protocols and the exchange of data between meteorological services and other organisations and the development of products and provision of services, driven by the desire to improve access and benefit of users of climate information. With this purpose – and following a policy of gradual opening of meteorological data to civil society – IPMA is currently creating products and services tailored to users' needs, which will be integrated into its website. Some of the services already provided are drought monitoring and the fire risk index. Another example is the Climate Portal (Portal do Clima), the reference source of information for Portugal's future climate, a platform that includes climate indicators in climate change scenarios based on CORDEX data.

The Climate Portal provides the projections for the periods 2011-2040, 2041-2070 and 2071-2100 for the two concentration scenarios RCP4.5 and RCP8.5 for over 40 climate variables available on the site aggregated into the following groups: temperature, precipitation; wind speed; relative humidity; global radiation; temperature range, drought index; aridity index; evapotranspiration; fire risk index, and; climate classification. Besides the grid with ~12km resolution, the Climate Portal also provides the results in an aggregated format for the class 3 of the Nomenclature of Territorial Units for Statistics.

The National Civil Protection Authority has a national database on disaster response and damage since 2006 and publishes this information on Civil Protection event yearbooks.

Main approaches, methodologies and tools, and associated uncertainties and challenges

The development of the Climate Portal was one of the projects resulting from the AdaPT Programme's activities. This programme was designed to financially support activities on "Adaptation to Climate Change" in Portugal guided by the terms established in the Memorandum of Understanding between Portugal, Norway, Iceland, and Liechtenstein, under the European Economic Area Financial Mechanism (EEA Grants).

This project aimed to produce and publish an internet portal on Climate in Portugal, constituting an easily accessible platform for the public to disseminate the results obtained in the project, namely: historical series, climate change at the regional level and climate indicators for specific sectors in Portugal.

The project used past climate data and the IPCC AR5 climate projection data (CORDEX project) for dissemination through the website. This task involved all necessary calculations for the aggregation of data at NUTS3 level for the periods 2011-2040, 2041-2070 and 2071-2100, including on the estimation of aggregated indicators (e.g., drought index, meteorological fire risk).

Different global and regional numerical climate models and their main features were analysed. Global climate models (GCMs) are based on general physical principles of fluid dynamics and thermodynamics and originate from numerical weather prediction. GCMs describe the interactions between the components of the global climate system, the atmosphere, the oceans, and a basic description of the earth's surface (i.e., aspects of the biosphere and lithosphere, relevant to the surface and energy balance). Sometimes they may be referred to jointly as Atmosphere-Ocean GCM (AOGCM). Regional climate models (RCM) have higher resolution over a limited area. A regional climate model is a numerical model for predicting a region's climate; such models are usually determined from GCMs, with horizontal resolutions of tens of kilometres, using the GCMs to define initial time-varying boundary conditions and surface boundary conditions. They include the effect of greenhouse gases and aerosol forcing and are determined statistically or dynamically.

Regional climate models (RCM), forced by global climate models (GCM), allow solving physical processes on smaller scales and therefore with increased detail and realism compared to global model results. The global model, which describes the large-scale effects and atmospheric circulation processes, determines the sequence of meteorological events that characterise a particular region's climate. These features are the result of greenhouse gas emissions, variation in solar activity and volcanic eruptions. RCMs, forced with the consequence of GCMs, allow the study of regional processes and generate information at relevant scales for vulnerability, impact, and adaptation studies.

Each of the regional climate models, RCM, was forced by different model forcers (CNRM-CM5, ICHEC-EC-EARTH, IPSLCM5A- MR, HadGEM2-ES, MPI-ESM-LR). Two RCM (the CCLM and RCA4 models) were forced with three different GCMs, providing information from 1971 to the end of the 21st century.

Using the regional CORDEX simulations performed for the European domain (EURO-CORDEX), it was identified the simulations' characteristics, namely spatial and temporal resolution. A set of regional simulations from the CORDEX project, performed for the European domain (EURO-CORDEX), with a spatial resolution of 0.11º (~12 km) and a daily temporal resolution: the control period (1989-2008; assessment scenario); the historical period (1971-2005); two emission scenarios from the IPCC AR5 report: RCP 4.5 and RCP 8.5 (2006-2100).

For this portal, the following EURO-CORDEX variables were selected: Maximum surface temperature (K); Minimum surface temperature (K); Precipitation (kg/m2/s); Wind speed m/s; Relative surface humidity (%) (not available in all models); Surface downwelling solar radiation (W/m2); Surface upwelling solar radiation (W/m2).

These variables were used as the basis for all the indicators provided by the project. Using these data, numerical calculation processes were developed and implemented, allowing the generation of results related to estimating the current climate and future scenarios in Portugal.

The results presented reflect the analysis defined in different periods, called "climatological normal", represented by a group of 30 years; 1971-2000, 2011-2040 (Near future), 2041-2070 (Intermediate Future) and 2071-2100 (Far Future).

The climate information relating to the observations comes from the matrix information of the Climate Atlas of Continental Portugal 1971-2000. The data used were obtained from the

interpolation of the average values in 1971-2000 of the climatological parameters air temperature and precipitation, observed in 61 stations and 260 udometer stations. The multivariate regression method with altitude and distance from the coast and normal kriging of the residuals were used for the average values of minimum, maximum, and average air temperature and total precipitation. Normal kriging was used to interpolate the number of days for the different values indicated in the portal (e.g., minimum, maximum temperature and rain). The manual modelling of the experimental variogram was aided and optimised using the analysis of several types of error obtained by cross-validation.

According to the project requirements and the existing limitations in terms of simulations for climate scenarios, the variables, and indicators to be made available on the climate portal were identified, as well as the associated statistics, covering: temperature; precipitation; wind intensity; relative humidity; global solar radiation; daily temperature range; drought index; aridity index; evapotranspiration; fire risk index.

The uncertainty component was analysed by the project team, even considering that the current generation of climate models can faithfully represent aspects of the climate. However, as the global climate system is overly complex, involving processes in various Spatio-temporal scales, it has become necessary to include different simplifications that give rise to uncertainties in future climate projections.

Uncertainty is inherent in all projections of the future and is not peculiar to climate modelling. Climate change and the impacts associated with uncertainties are related to the future trajectory of emissions, resulting from the global development of technology, the energy consumption of the world's population and many other socio-economic factors, as well as the limitation of climate models, due to the limited knowledge of the climate system and the necessary simplifications in climate models.

One way to validate the results obtained using CORDEX data and the calculations performed on them is to compare the modelled data with the observed data. To this end, we used the empirical data in 4 locations on the mainland. This choice was based on meteorological/climatological stations with records for the study period and the territory's spatial representation, considering the known climatological regions.

The modelled data were obtained using the same methodology adopted in all processes. For this validation process, the mean value of the 4 points of the matrix around the meteorological/climatological station's location were used. The statistics corresponding to the models (modelled history and projections) are calculated from each of the models' average values according to the period indicated (annual, monthly, or seasonal).

2.2. Climate projections

In several studies, Southern Europe and the Iberian Peninsula are highlighted as among the regions in Europe potentially most affected by climate change, facing a variety of potential impacts such as increases in the frequency and intensity of droughts, floods, flash floods, heat waves, rural fires, erosion and coastal overtopping.

The most severe climate scenarios for Portugal (RCP8.5, IPCC AR5) predict that the temperature increase may reach +5°C in 2100 (applicable to a minimum, average and maximum temperatures), particularly during summer and in the Portuguese interior (see figure 1). The higher temperatures are reflected in an increase of very hot days (Tmax 35°C), especially in the southern interior, an increase in the number of tropical nights (Tmin 20°C) and longer and more

frequent heat waves, especially in the north-eastern interior. For the RCP4.5 scenario, the average temperature increases could vary between 2°C and 3°C in Portugal.

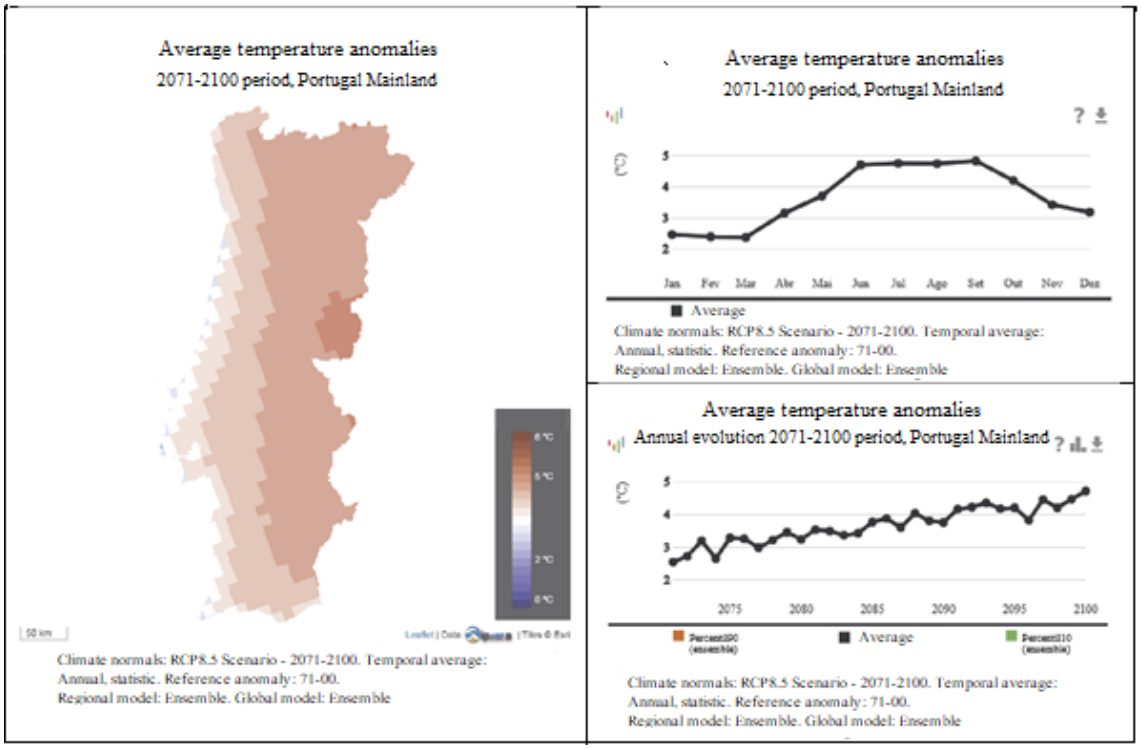

Figure 1 - Average temperature anomalies (reference 1971 -2000) for 2071 -2100, RCP8.5 and the regional and global model ensembles.

Source: http://portaldoclima.pt/

Although precipitation scenarios are more uncertain, precipitation patterns are also expected to change, with significant reductions in annual values across the territory (figure 2), with losses of between -10% and -50% by the end of the century in spring, summer and autumn consistent across most climate models for the RCP8.5 scenario (Soares *et al*. 2017[3]). In addition, an increase in the number of extreme precipitation events is projected at the expense of a reduction in days with low to medium/high precipitation (Soares *et al*., 2017[4]). Equivalent conclusions of lower magnitude are obtained for the RCP4.5 scenario (Soares *et al*., 2017[4]). Thus, an increase in the seasonal variability of precipitation and the extension of the dry season from summer to spring and autumn can be expected. Also it is expected an increased probability of prolonged droughts.

[3] Soares PMM, Cardoso RM, Lima DCA, Miranda PMA (2017) *Future precipitation in Portugal: high-resolution projections using WRF model and EURO-CORDEX multi-model ensembles.* Clim Dyn 49: 2503 -2530. doi: 10.1007/s00382-016-3455-2.

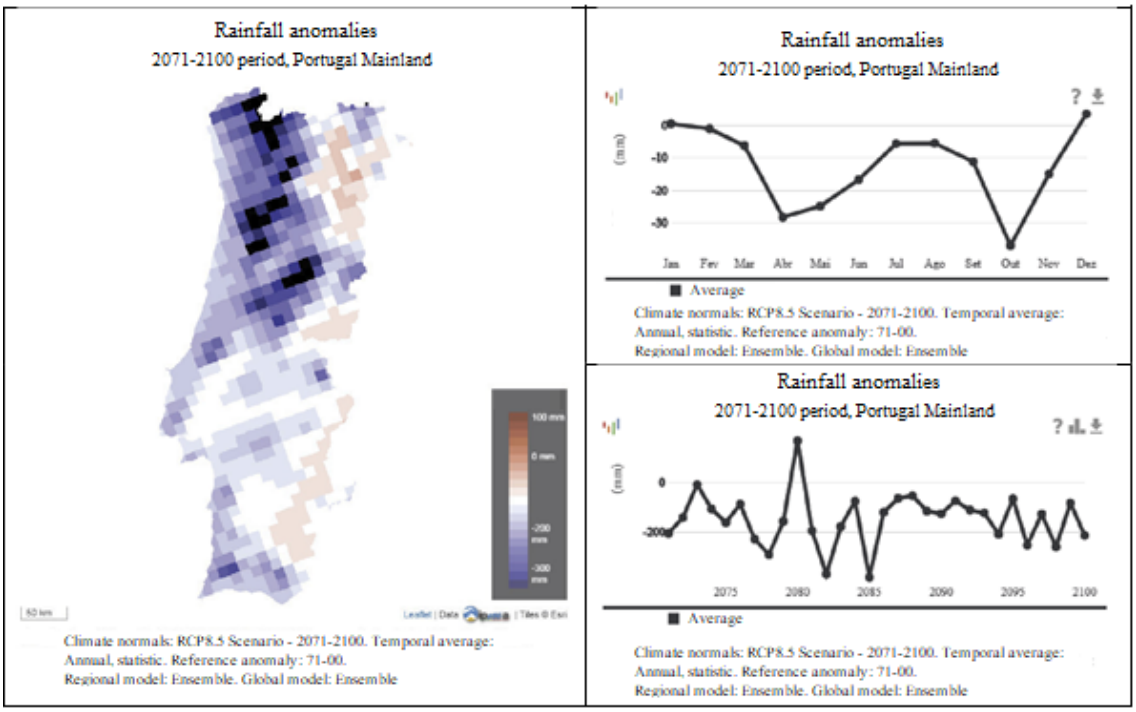

Figure 2 - Rainfall anomalies (reference 1971 -2000) for 2071-2100, RCP8.5 and the regional and global model ensembles.

Source: http://portaldoclima.pt/

2.3. Climate change impact and vulnerability assessment (CCIVA)

Regarding the impact on the distribution of ecosystems, a marked change in vegetation structure and composition is expected with consequences for biodiversity. In the northern and central coastal regions, dominated by mixed hardwood forest, a decrease in species more demanding in moisture is expected, with an increased mortality of older and less resistant trees. The regions of Minho, Douro Litoral and the mountain areas may benefit from a possible increase in biological diversity. The eucalyptus forests in the interior may be abandoned and replaced by wildwoods due to their low capacity for natural regeneration. The pine forests may persist or tend to be replaced by wildwoods due to fires recurrence, in which case preservation of biodiversity is expected. Regarding cork oak forests, a drastic reduction in biological diversity is anticipated due to the intensification of desertification processes in the most arid regions.

A considerable increase in demand of energy for cooling in the summer months is expected, associated with the projected increase in temperatures and the frequency, duration, and severity of heatwaves and tropical nights. Nevertheless, a significant part of the population - the neediest - may have difficulty adapting to these changes, given the characteristics of a great part of the residential buildings and the lack of financial capacity to invest in their thermal comfort and installation and use of climatization systems.

As for agricultural productivity, a reduction in productivity is expected in any of the projected climate scenarios and in all crops, except pasture and forage.

Regarding migratory movements, climate change may contribute to accentuating the process of population loss in the rural areas of the interior and the progressive concentration of the population on the coastline and in the metropolitan areas of Lisbon and Porto. This trend may

also be reinforced by movements originating abroad, with an increase in the influx of immigrant populations from regions more vulnerable to climate change.

Part of the national territory is already threatened by desertification, with soil degradation due to the influence of several factors, including climate variations and human activities. In the climate scenarios of the Climate Portal, the areas susceptible to desertification and erosion increase concerning the present in the west and north inland region.

The rise in temperature and the prolonged periods of drought are also likely to be responsible for the increase in the number of rural fires, especially the number of large forest fires (>= 10,000 ha), that spread by canopy and become practically uncontrollable under certain atmospheric conditions. The risk associated with these occurrences has increased dramatically, imposing extremely high social and economic costs on the country. 2017 was a landmark year, recording the largest burnt area since 1995 and becoming the most tragic year ever, with more than 100 human lives lost.

Although there is no exact quantification available to estimate the impacts of extreme weather events and the trends observed in recent years related to climate change, Portugal has estimates of 60-140 million euros in annual costs associated with forest fires, of around 290 million euros associated with the 2005 drought (the most severe this century), and circa 200 million euros from the 2012 drought (mainly in terms of agricultural production losses). Climate change tends to increase or accelerate other risks, where natural and anthropogenic factors combine, for example, in terms of coastal erosion or forest fires.

The reduction in annual precipitation, the increase in its variability and the consequent change in the flow regime will reduce river flows, affect the recharge of aquifers, and even dry out the sources of essential rivers in the Iberian Peninsula for longer or shorter periods. These changes may be accompanied by water quality problems, intensification of drought events and increased pressure for desertification, increasing biodiversity loss associated with altered ecosystem structure and dynamics. This reduction in precipitation will also affect aquifers' recharging, enhancing the degradation of the quality of surface and underground water resources. Even so, the territory will remain vulnerable to flooding, given the projections of an increase of the number of days with heavy precipitation.

The new temperature and precipitation regimes associated with climate change imply: an increase in the number of heatwave occurrences, their duration and intensity; an increase in the number and intensity of major rural fires, and; extreme, unpredictable, intense, and localised meteorological phenomena, such as torrential rain, hail, cyclones and tornados. In addition to the tendency for heatwaves to become more intense and frequent or spatially extensive, it is also predicted that there will be a change in their seasonal distribution. Although heatwaves typically occur in the spring and summer, this phenomenon is expected to gain equal importance in the autumn.

In this context, climate change scenarios predict a significant increase in meteorological conditions conducive to large areas of fire across the Iberian Peninsula, namely the whole of Portugal.

The coastline is also particularly vulnerable to coastal erosion and coastal overtopping with very significant and severe effects. This is due to sea-level rise, hourly rotation of the mean wave direction on the west coast, and storm surge regime (despite uncertainty about the future evolution on this last point). These factors aggravate coastal swelling and flooding by allowing waves to break closer to the coast and transfer more energy to the beach, in addition to the deficit in river sediment inputs available for coastal drift. The effects of coastal erosion and overtopping are further enhanced by the characteristics of the anthropogenic occupation of the

territory's coastal strip that substantially increases the risk of socio-economic costs of climatic phenomena. Despite the uncertainty, the rise in sea level by the end of the 21st century is expected to be 0.5 meters higher, possibly reaching values in the order of 1 meter above the 1990 level. The rise in sea level also increases the risk of saline contamination of coastal aquifers, estuaries, and the final stretches of rivers, impacting some water supply systems.

3. National adaptation priorities, strategies, policies, plans, goals and actions

Adaptation priorities

The main priorities for Adaptation are: strengthen resilience and national capacities on adaptation; Ensure committed participation of Portugal at the international level in terms of compliance with conventions, negotiation and cooperation; Stimulate research, innovation and knowledge production on climate change and develop a knowledge base to support public policymaking; Involve society in the challenges of climate change, promoting individual and collective action; Increase the effectiveness of information, report and monitor systems; Ensure effective governance conditions and ensure the integration of the climatic objectives in the various sectoral domains (mainstreaming).

Summaries of national strategies, policies, plans and efforts

The policy framework for climate change adaptation is built upon two main strategic instruments – the NAS and the NAP – complemented by subnational and sector-specific policies and plans. The adaptation governance framework and domains addressed are primarily established in the NAS - National Adaptation Strategy (ENAAC 2020). This instrument is complemented by the NAP - National Adaptation Plan (Action Programme for Climate Change Adaptation - P-3AC) that establishes the adaptation action priorities, systematizing many of the adaptation measures defined in the different subnational and sectoral adaptation plans and strategies.

NAS, approved by the Resolution of the Council of Ministers No. 56/2015 proposes to improve the level of knowledge on climate change, promote the integration of climate adaptation in the various public policies and operationalisation instruments, placing greater emphasis on the implementation of adaptation measures. The NAS promotes, through working groups and thematic areas, the coherent vertical integration of the different scales necessary for climate adaptation, from international to local, and prioritises its mainstreaming in various sectoral policies and the implementation of adaptation measures, based on technical and scientific knowledge and acceptable practices that are being developed.

NAS is guided by three main objectives:

- Improving the level of knowledge on climate change - updating, developing, and promoting understanding on climate change and assessing its potential risks, impacts and consequences, including those related to extreme weather events.
- Implement adaptation measures - assess current adaptive capacity and prioritise the implementation of adaptation options and measures that moderate future negative impacts and/or help take advantage of opportunities arising from climate change.
- Promote the integration of adaptation into sectoral policies - promote the integration and monitoring of the climate change adaptation component (mainstreaming) in the most

relevant public and sectoral policies, including spatial planning and sustainable urban development policies and their territorial planning and management instruments.

The Adaptation to Climate Change Action Programme - P-3AC (NAP) complements and systematises the work done in the context of the NAS, aiming at its second objective, the implementation of adaptation measures. NAP elects eight direct intervention lines in the territory and infrastructures, complemented by an additional line of action of transversal nature, seeking to respond to Portugal's significant impacts and vulnerabilities. The definition of these lines of action resulted from the screening and prioritisation of the various adaptation measures listed in sectoral, municipal, and inter-municipal planning exercises. These comprehend actions for wildfire prevention, soil conservation and improvement, sustainable water use, ecosystems resilience, heat waves prevention, invasive species, diseases and pests, flooding protection, coastal protection and capacity building, awareness and tools for adaptation. The lines of action and measures to reduce vulnerabilities to climate change recorded in the NAP constitute the benchmark for national action on climate change adaptation, without prejudice to the guidelines contained in the NAS, and should integrate, among others, the sectoral planning and preparation of financing instruments to be developed under the Multiannual Financial Framework 2021-2027.

The National Energy and Climate Plan 2020-2030 (PNEC 2030) is the main instrument of national energy and climate policy for the next decade towards carbon neutrality in 2050. PNEC 2030 also has extended the validity of the NAS until 31st of December 2025. PNEC 2030 has a chapter dedicated to "*Resilience and capacity to adaptation to climate change*" as a co-benefit of decarbonisation and energy transition and stressing the symbioses between adaptation and mitigation.

It shall be stressed that the Portuguese carbon neutrality goal in 2050 has been established in the Resolution of the Council of Ministers n.º 107/2019, which as above mentioned it also approved the Carbon Neutrality Roadmap 2050 (RNC2050) that constituted the Portuguese Long-Term Strategy submitted to the European Commission and to United Nations Framework Convention for Climate Change (UNFCCC). The strategic vision of RNC2050 is based in 8 premises from which should be stressed: "*Contribute to national resilience and capacity to adapt to vulnerabilities and impacts of climate change*".

Following a similar approach, the National Adaptation Roadmap 2100 (RNA 2100) is being drawn up and is expected to be completed in 2023. The RNA 2100 will update the knowledge of climate projections for Portugal and respective impacts in key sectors, for different Greenhouse Gases (GHG) concentration scenarios. RNA 2100 will result in regional adaptation narratives, with a view to stablish climate change adaptation guidelines for spatial planning and programmes, including at sub-national level. The roadmap will also help to identify investment needs and costs, including costs of inaction. In this way, strategic adaptation projects and measures will be identified to further support the adaptation policies on the ground.

4. Provision of support to developing country Parties

4.1. General Information

Portugal as an Organisation for Economic Cooperation and Development (OECD) and OECD/DAC (Development Assistance Committee) Member State, tracks development financing according to the Creditor Reporting System (CRS) directives and provides information on climate financial flows based on the OCDE 'Rio markers' methodology for climate change mitigation and adaptation. *Camões – Instituto da Cooperação e da Língua I.P.* (Institute for Cooperation and Language) is the coordinating entity for development cooperation and responsible for the CRS reporting.

In addition to the Portugal's Official Development Assistance (ODA) data provided by OECD/DAC, and regarding transparency principles and best practices a more detailed and in-depth analysis of the Portuguese ODA (ptODA), can be found in the following web address: http://coop.instituto-camoes.pt/bdcoopfrontend

The ptODA has been focused mainly in the lusophone developing countries, in particular the Portuguese Speaking African Countries (PALOP) and Timor-Leste, according with the Portuguese Strategic Concept for Development Cooperation 2014-2020. Although environment and climate change are already part of the mentioned cooperation for development strategy, a new Cooperation for Development Strategy for 2021-2030 is being developed and will reaffirm the development policy alignment with the latest environmental and climate change international framework.

Cooperation – policies, priorities and programmes in Portugal

Portugal continued to prioritize cooperation activities towards its partner countries, namely the PALOP. However action in new geographies have been added in the last years, such as in North Africa and Latin America regions.

The Strategic Cooperation Programmes (*Programas Estratégicos de Cooperação* – PEC) established with each partner country are focused, both in terms of geography and sectors of concentration, to ensure a better structure and larger-scale interventions for enhancing development impact. Cooperation for development interventions are tailored to partner countries needs and fully aligned with their national development strategies. It should be stressed that it is the partner country that promotes the interventions and presents them to Portuguese Cooperation (PtC) for financing and has to demonstrate how the intervention contribute to meet its specific policies, priorities and strategies. The partner country is also responsible for the selection process of the entity that will execute each action.

4.2. Finance

General Information

As already mentioned, ptODA features a regular and strong geographical concentration in the PALOP countries (Portuguese speaking African Countries) and in Timor-Leste, in line with the geographical priorities set out in the Strategic Concept of Portuguese Cooperation for 2014-2020, which can be found at https://www.instituto-camoes.pt/images/cooperacao/160208B_ConceitoEstrategico_bilingue.pdf

Portugal, as a member country of the OECD/DAC, reports ODA finance flows in compliance with the CRS directives.

The main focus of bilateral PtODA are education, health, security and justice, with a view to sustainable development and fight against poverty. However, following the OECD/DAC recommendations, Portugal has sought to develop wherever possible the integration of environmental and Climate Change (CC) issues in the activities targeted at other sectors.

4.3. Provision of financial resources

Between 2017 and 2019, the PALOP focus remains and can also be underlined the support given to Cuba and Tunisia in this period. The Bilateral Climate support given in 2017 and 2018 totalized 4 382 724,89 USD. In 2019 the Bilateral Climate support given reached 3 235 358,78 USD. This amount concerns only to the Bilateral action, which main objective are Climate Change actions.

In 2020 Portugal has began to apply a coefficient approach complementary to Rio Marker methodology[4]. In 2020 the bilateral PtODA for climate change reached the amount of 1 504 701,99 USD.

Regarding the Multilateral Cooperation, the total amount disbursed reached in 2017 the amount of USD 60 742 591,59 largely due to three major transfers to World Bank, African Development Bank and Inter-American Development Bank.

In 2018, the total amount disbursed was USD 40 048 551,87 and this value was distributed by several international organizations, such as: World Bank; African Development Bank; Asian Development Bank; Inter-American Development Bank and Asian Infrastructure Investment Bank.

In 2019 the amount disbursed for multilateral institutions was 39 310 632.49 USD, including 223 434.46 USD for Specialized United Nations bodies. In 2020 the multilateral financing reached the total amount of 1 573 835,86 USD, including 62 234,76 USD for Specialized United Nations bodies and 1 139 601,1 climate specific financing for Green Climate Fund.

Regarding the resources effectively addressed to the needs of non-Annex I Parties with regard to climate change both adaptation and mitigation, it should be highlighted that all the bilateral interventions financed by Portuguese Cooperation are proposed by the partner countries which are also entirely responsible for their design.

4.4. Development assistance for adaptation

In general, Portugal has been paying particular attention to Adaptation to climate change, especially its mainstreaming into Development Cooperation (DC), thus seeking to follow international guidelines.

Between 2017 and 2019 the bilateral flows for adaptation added up to 5 616 398,1 USD considering only principal objective. In 2020 the amount disbursed targeting adaptation was 1 031 604,55 USD.

In its efforts to strengthen its work on adapting to the negative impacts of climate change and reinforcing resilience, Portugal has been also involved, together with other EU Member States,

[4] Coefficient:

Climate Change

Markers	Mitigation	Adaptation	Cross-cutting	Total
2 M & 0 A	100%	0%	0%	100%
1 M & 0 A	40%	0%	0%	40%
0 M & 2 A	0%	100%	0%	100%
0 M & 1 A	0%	40%	0%	40%
2 M & 1 A	100%	0%	0%	100%
1 M & 2 A	0%	100%	0%	100%
2 M & 2 A	0%	0%	100%	100%
1 M & 1 A	0%	0%	40%	40%

in the implementation of projects in the modality of delegated cooperation (on behalf of the EU). In this respect, Portugal under the modality of delegated cooperation, has implemented in Timor-Leste a climate change program, between 2014 and 2018, together with GIZ and the local Ministry of Agriculture and Fisheries and is currently implementing FRESAN -"Strengthening Resilience and Food and Nutritional Security in Angola" project in the provinces of Huíla, Cunene e Namibe, together with local authorities of agriculture, environment and health (detailed information in the European Commission reports).

4.5. Provision of new and additional resources

As an EU Member State, Portugal made the commitment to mobilise 0.15% to 0.20% of its GNI as ODA allocated to Least Developed Countries (LDC) by 2030. It also endorsed the commitment derived from the 2014 ministerial-level meeting of the Development Assistance Committee (OECD/DAC) to focus the support from member countries on countries most in need (which includes Fragile States, LDC and Small Island Developing States (SIDS)).

The Portuguese Environmental Fund was established in 2017. The purpose of this instrument is to support national environmental policies for the pursuit of Sustainable Development Objectives, contributing to the achievement of national and international objectives and commitments, in particular those related to climate change, water resources, waste and nature conservation and biodiversity.

One of the domains that is clearly identified as action domain of this Fund is international cooperation in the field of climate change, in accordance with the compliance of international commitments.

Bearing in mind that financing ODA projects is not a core objective of Portuguese Environmental Fund and that this financing resources is complementary to conventional ODA flows, Portugal considers that the financing provided by the Portuguese Environmental Fund to activities that aim to promote the sustainable development and welfare of developing countries, consequently, is new and additional to the current sources of ODA flows. Hence, regarding climate change adaptation bilateral cooperation of a total amount of 6.6 million USD, 5.3 million USD is new and additional.

As already above mentioned, it should be highlighted that all the climate actions financed by Portuguese Cooperation were proposed by the partner countries which are also entirely responsible for their design. As a donor country, Portugal appraises the intervention proposals taking into account their relevance, efficiency, problems addressed, viability, sustainability, results, accountability and also the adequacy of the technologies supposed to be developed and/or transferred, as well as capacity building components and also the indicators for monitoring and evaluation.

4.6. Technology Transfer

In several cases an intervention being implemented by the PtC under the context of ODA involves technology transfer, in terms of practices and appropriate processes to each area of the intervention as well as the necessary knowledge to implement these technologies. However Portugal is still considering ways to address the systematic collection of data regarding technology transfer.

5. Implementation of adaptation actions and plans

5.1. Progress and results achieved

5.1.1. State of play of the implementation of measures planned under 'Strategies and Plans', including an overview of the subnational level and the disbursement of funding to increase climate resilience

In recent years we have seen important progress in the implementation of adaptation measures. European Union funds have contributed significantly to this fact.

In the case of the agriculture and food/rural development sector, the Rural Development Programme (PDR 2020) supported with €1746.5 million the adaptation of agriculture/forest to Climate Change (54.5% of total funding to agriculture and forests). This amount was distributed as follows: 0.5% (Knowledge); 12.2% (Investments); 1.6% (agricultural risks); 13.4% (forestry); 48.8% (agro-environmental measures and climate); 23.5% (Areas with constraints). In the case of the P-3AC (NAP) the relative support translated into 31% (Fires); 16% (Soil); 16% (Water); 18% (Biodiversity); 8% (Diseases/plagues); 6% (Floods); 6% (Knowledge); 15% (Others).

A significant support was destined for the elaboration of subnational plans. Presently all Portuguese territory has (or is developing) a subnational adaptation strategy based on comprehensive climate change risk assessment leading to the identification of adaptation measures. Most of these subnational plans are now in their implementation phase with many of its actions being developed. A robust monitoring framework is needed to keep track of the implementation of these actions. The limitations at present only allow us to have broader view of adaptation implementation based on the monitoring of the programmes funded by the European Structural and Investment Funds, and other sources of funding such as the EEA grants (e.g. Environment Programme) and the national Environmental Fund that releases diverse calls, some of which related to adaptation.

The Environmental Fund is the main Portuguese Fund created to support environmental policies pursuing sustainable development goals, contributing to the fulfilment of objectives and commitments associated with climate change, supported interventions in urban green spaces that mitigated the effects of heat islands and allowed the intervention of obsolete irrigation systems, leading to water savings.

At national, regional, and local levels, there are guidelines to help ensure that the inclusion of climate change resilience is incorporated into territorial plans where the buildings sector is addressed in more detail.

The Autonomous Region of the Azores proceeded with the Regional Programme for Climate Change (PRAC – Portuguese acronym), approved by the Regional Legislative Decree Nº. 30/2019/A, 28th of November, which encompasses mitigation and adaptation. PRAC allowed improving the level of knowledge on climate change in the Region through the studies of current and future vulnerabilities and the definition of adaptation measures for the most relevant sectors. PRAC Implementation is still at an early stage, so there are few adaptation measures under implementation.

The Autonomous Region of Madeira has continued the regional policies and programs that promote the increase in the improvement of the level of knowledge of climate change, having implemented, throughout this period, several measures and concluded vital projects to improve adaptation to climate change, making the Region more resilient and better prepared for the challenges posed by climate change. Regarding the promotion of the integration of adaptation in sectoral policies, during this period, several plans were produced, directed to various sectors,

elaborated following the need for adaptation and integration of climate action policies, which will regulate the future development of those specific sectors.

5.1.2. State of play of the implementation of measures planned under 'Strategies and Plans': spending earmarked for climate adaptation including in disaster risk management

The Operational Programme for Sustainability and Efficiency in the Use of Resources (POSEUR) was partially funded by the EU Structural and Cohesion Funds and its Thematic Objective 5 aims to strengthen national adaptive capacity. Its Priority Axis 2 - Adaptation to climate change and risk prevention and management, includes two investment priorities (IP): 5.1. Support for investment for adaptation to climate change; 5.2. Promoting investments to address specific risks, ensure disaster resilience and develop disaster management systems.

In 2019, 8 calls for proposals were opened in these two IP. 34 applications were approved, absorbing a total Cohesion Fund amount of €48 million. At the end of 2019, 413 operations were supported, with a total eligible cost of €485 million and a Cohesion Fund allocation of €398 million. The financial implementation rate of Axis 2 at the end of 2019 was 47% of the programmed fund, translating into €231 million and CF of €198 million. Climate change adaptation measures and prevention and management of climate-related risks such as erosion, fires, floods, storms, and drought were supported, including awareness-raising, civil protection and disaster management systems and infrastructure.

The Environmental Fund finances adaptation operations aimed at implementing material measures recommended in local or regional planning exercises, namely that reduce or minimise climate risks associated with flood events and increase the resilience of infrastructures and ecosystems, species, and habitats.

5.1.3. State of play of the implementation of measures planned under 'Strategies and Plans': the share of spending used to support climate adaptation in each sector

The expenditure programmed and committed in the PDR2020 for the priorities of adaptation to Climate Change, between 2018 and 2020 (as of September 30), in the field of agriculture and food/rural development, was increased (15% and 18%, respectively), with an additional execution of €728 million towards the targets set in the P-3AC (NAP). The share of investment supporting adaptation to climate change (additional investment for making a project - which would have been carried out anyway - climate change resilient) translates in absolute terms to €2.412 million (total programmed for Climate Change Adaptation Priorities), calculated following Regulation.

Greater availability of EU funds is noted to increase forests' resilience with particular focus after the fires that occurred in PT in 2015 and 2017.

Regarding measures to increase resilience to climate change in the marine and fisheries sector, the significant contribution of the selected operations to the fight against climate change is worth highlighting, translating into €54.7 million. The part of the investment supporting adaptation to climate change (an additional investment for making a project resilient to climate change) translates, in relative terms, into about 26%.

With the specific objective of rehabilitating and improving buildings' concerning energy and water performance it was created the support programme "More Sustainable Buildings", in 2020, and it has been financing 890 applications, amounting to €1.75 million.

In 2020, the Environmental Fund financed applications with the objective to implement adaptation measures that guarantee the improvement of the adaptive capacity and increase the territory's resilience to the impacts of climate change and applications made under the "Village Condominium", the Integrated Support Programme for Villages located in forest territories, to ensure the management of fuels around settlements in areas of high forest density and increased number and dispersion of small rural settlements.

5.1.4. Progress towards reducing climate impacts, vulnerabilities and risks

Regular assessments of impacts, vulnerabilities, and risks to assess progress in reducing them is still ongoing work.

The indicators and values of the monitoring parameters of P-3AC (NAP) have not yet been updated. The indicators and most of the targets of P-3AC (NAP) come directly from funding programmes (e.g., those funded by the European Structural and Investment Funds) and sectoral plans and strategies (e.g., PNUEA - National Plan for Efficient Water Use). The updating of some of the indicators will be carried out in collaboration with the sectoral working groups in the context of the NAS.

5.1.5. Progress towards increasing adaptive capacity

Regular evaluations of adaptive capacity to assess progress in increasing it has not yet been possible to implement.

Nevertheless, it is essential to highlight the very positive evolution of the national territory coverage by climate change adaptation strategies and plans. Until 2015 only three municipalities had elaborated adaptation plans and strategies. Since then, this coverage has expanded considerably, first as a result of the ClimAdaPT.Local project funded by EEA Grants and the Environmental Fund, followed by the European Regional Development Fund (ERDF) funding provided by the Operational Programme for Sustainability and Efficiency in the Use of Resources, along with strategies and plans funded by the municipalities themselves. At the end of 2020, the number of municipalities covered by climate change adaptation plans or strategies (of municipal and/or inter-municipal or metropolitan scope) was 271, corresponding to 88% of Portuguese municipalities.

5.1.6. Progress towards meeting adaptation priorities

It is still necessary to implement regular assessments of compliance with adaptation priorities to evaluate progress.

The main progress in achieving the three key objectives of ENAAC are:

(i) for 'Improving knowledge', the publication of the Climate Change Research and Innovation Agenda, which reflects on the challenges for Climate Change Research and Innovation activities, considering multiple chains of complex interactions between natural and human systems;
(ii) for 'Implementing adaptation', the publication of P-3AC (NAP);
(iii) for 'Mainstreaming Adaptation', the publication of the PNPOT - National Programme for Spatial Planning Policy, a territorial development instrument of strategic nature that establishes the great options with relevance to the organization of the national territory, consubstantiates the framework of reference to be considered in the elaboration of other

Territorial Management Instruments, and constitutes an instrument of cooperation with the other MS. Climate change was taken as a transversal theme and integrated into the different themes diagnosed, in the environmental, social and economic areas, assessing the impact of global scenarios applied to the national territory, and seeking to indicate the direction that some variables take in the region.

5.1.7. Progress towards addressing barriers to adaptation

There are regular assessments of how and what to extent the adaptation barriers are being overcome and which ones have not yet been implemented. However, the main obstacles to adaptation are identified.

Regarding the lack of funding for adaptation P-3AC (NAP) has defined priorities and mobilised financing and it can be used as a reference for preparing the next Multi-Annual Financial Framework and other funding instruments (e.g., the Environmental Fund and the EEA Grants Environment Programme).

Concerning the lack of information very significant progress has been made with the publication of the Climate Portal and the beginning of the development of the National Roadmap for Adaptation 2100, a large-scale exercise to assess the impact, vulnerability, and risk of climate change in the national territory.

As for the lack of adaptive management capacity, Portuguese municipalities' coverage by adaptation strategies and plans has increased from only 1% to 88% in the last six years.

5.1.8. Steps taken to review and update vulnerability and risk assessments

The National Roadmap for Adaptation 2100 (ongoing until December 2023) will update and deepen for the XXI century the first assessment of risk and vulnerability of the Portuguese territory carried out under the SIAM I and II projects (2002 and 2006). These served as a basis and were complemented by the sectoral reports of the first NAS and its respective progress report. The Portuguese Environment Agency also promoted the Flood Risk Studies, associated with the Flood Risk Management Plans, which allowed updating the information on the susceptibility to flooding risks.

The National Authority for Emergency and Civil Protection published in 2019 the update of the National Risk Assessment, which generally maintains the structure of the previous 2014 assessment and was prepared following the "Risk Assessment and Mapping Guidelines for Disaster Management" issued by the European Commission (document SEC (2010) 1626 final, 21.12.2010).

5.1.9. Steps taken to review and update national adaptation policies, strategies, plans, and measures

In 2010 Portugal approved its National Strategy for Climate Change Adaptation – ENAAC (NAS). The first phase of ENAAC's work took place between 2010 and 2015 with the following objectives: i) Information and knowledge: to keep up-to-date and available scientific knowledge; (ii) reducing vulnerability and increase responsiveness: in an integrated manner, defining measures to minimize the effects of climate change; iii) Participate, raise awareness and disseminate: raise awareness of climate change and its impacts; (iv) International cooperation: supporting the most vulnerable countries, in particular within the framework of

the Community of Portuguese-Speaking Countries. The work of the various sectoral groups and a progress report were developed that highlighted the strategic nature of the work carried out, but also identified its limitations.

The first review of ENAAC (NAS) was promoted in 2015, bridging the gaps and capitalizing on the strengths and opportunities identified. The ENAAC 2020 (NAS) defines an organisation model that clearly promotes articulation between various sectors and stakeholders, pursuing priorities of certain thematic areas and the three objectives of the strategy: i) Improving the level of knowledge on climate change; (ii) Implement adaptation measures; iii) Promote the integration of adaptation into sectoral policies. ENAAC 2020 (NAS) will be into force until 2025.

The same applies to the Action Programme for Climate Change Adaptation – P-3AC (NAP), which was published in 2019. It complements and systematizes the work carried out in the context of ENAAC 2020 (NAS), focused on its second objective: to implement adaptation measures.

The subnational strategies are all relatively recent.

5.1.10. Overview of good practice with regard to steps taken to review and update subnational adaptation plans, policies, strategies and measures

The sub-national strategies are all relatively new. Thus, they were not reviewed.

The project ClimAdaPT.Local was crucial for capacitation of local and regional authorities on adaptive management. In this project several training events for local officers led to the development of 27 Local Adaptation Strategies. The project provided guidance manuals that support almost all sub-national adaptation strategies in place and in preparation, ensuring harmonization between them and granting the opportunity to better articulate them with the national adaptation policy framework. The project gained a significant political dimension that promoted the establishment of a National Network of Municipalities for Adaptation to Climate Change.

5.2. Cooperation on enhancing adaptation at the national, regional and international level, as appropriate

Cooperation with Union Member States, international cooperation, and with regional and international organisations to enhance adaptation action at the sub-national, national, macro-regional and international level

Portugal has been implementing climate change policies that have successfully guaranteed compliance with the objectives established under various international commitments. International cooperation on climate change is aimed at responding to international commitments to support developing countries under the UNFCCC and its Kyoto Protocol, and the Paris Agreement, focusing on priority countries for Portuguese cooperation, according to the principles and priorities set out in the Strategic Concept of Portuguese Cooperation (2014-2020), approved by the Council of Ministers Resolution N.º 17/2014). In this framework, the thematic area dedicated to international cooperation on adaptation has been promoting cooperation work with other countries on the issues necessary for implementing ENAAC 2020 (NAS) and equivalent strategies in those countries and regions of the world.

5.3. Barriers, challenges and gaps related to the implementation of adaptation

Challenges, gaps and barriers to adaptation

In Agriculture and rural development, the main challenges are to guarantee water for multiple uses, to reduce knowledge gap of risks and water availability, and to improve the programme coordination and governance.

In Forest, the main challenges are lack of financial and human resources specialised in adaptation to face the scale of the climate risks.

In Tourism, it is fundamental to improve training of technicians/decision-makers and to produce adequate risk mapping and legislation.

In Energy, new requirements and planning are needed. Screening of policy measures through climate-proofing could be used to test alignment with adaptation. Continue to work on climate-sensitive energy supply and demand models and energy system scenarios on time scales consistent with climate change.

In Health, it is essential to create adequate indicators and train professionals to establish correlations between risk/preventive measures/mitigation.

In Safety of People and Assets, it is essential to promote better coordination and involvement of the relevant entities and in-depth knowledge of data on losses and damage associated with extreme weather events.

Adaptation can occur in anticipation of impacts through spatial planning and by adapting urban spaces to climate events. Urban spatial planning and construction will incorporate adaptation responses: restrictions on new construction, planned setback(s) and accommodation measures, reduction of the urban heat island effect, urban water cycle management and energy and water use efficiency in all activities, buildings and infrastructure.

Finally it also represents challenges and barriers to adaptation the lack of sectoral and intersectoral coordination in the sense of operational articulation to fulfil strategies, programmes and plans, registering a reduced sharing of data, systematised and updated information on actions and projects under development. Implementing the measures recommended in the plans and strategies for adaptation requires adequate funding. Portugal is solving these issues through its ENAAC (NAS) governance structure.

5.4. Good practices, lessons learned and information-sharing

5.4.1. Good practices and lessons learnt

Area of good practices	*Good practices and lessons learnt, including at sub-national level*
Efforts to integrate climate change adaptation into development and sectoral policies; plans and programs	Sector "Agriculture": The definition of adaptation priorities carried out in a participatory manner; the creation of knowledge transfer platforms and the National Competence Centre for Climate Change in the Agroforestry Sector (knowledge coordination and dissemination); the effort made by public actors responsible for the definition of policy and management of community support to improve the quality of monitoring and evaluation of the measures of the funding instruments for adaptation.

Area of good practices	*Good practices and lessons learnt, including at sub-national level*
Institutional arrangements and governance at the national level	Sector "Biodiversity": The various sectoral strategic instruments promote an intricate relationship between biodiversity protection and ecosystem restoration, with the achievement of climate change adaptation objectives, halt and reverse biodiversity loss and achieve neutrality in land and soil degradation.
Stakeholder engagement	Sector "Tourism": The good practices underway in the sector, and which we hope will be densified in the future, contribute directly towards attracting more sustainable tourism, insofar as, as we know today, the tourists themselves are also increasingly sensitive to these issues.
Efforts to integrate climate change adaptation into development and sectoral policies; plans and programs	Sector "Energy": Good practices and lessons: an increasing focus on increasing the resilience of infrastructures by operators; greater integration of adaptation in sector emergency planning (operators' contingency plans, more significant capacity building); consideration and greater visibility of adaptation to climate change in plans and programmes associated with national policies.
Integration of indigenous; traditional and local knowledge into climate adaptation	Sector "Forests": following the fires, the development of various actions to produce forest reproductive material, reinforcing the focus on more adapted native species (strengthening the respective harvest and production in public nurseries); the implementation of primary and secondary networks of fuel management strips; the implementation of symbolic initiatives, such as the CELPA Projects: Best Eucalyptus; Clean & Fertilise Programme and the Replant Programme.
Climate risk communication	Sector "Health": Improved risk communication, information and training for the population. The progressive participation of the various public health services and departments, especially the financial area and the area of projects and applications, in collaboration with other entities, has allowed for the maximisation of results (health gains resulting from the better articulation of services).
Disaster risk reduction and management; innovative adaptation solutions and innovative financing mechanisms	Sector "Safety of people and assets": Creating the Sub-Commission of the National Platform for Disaster Risk Reduction, where several good practice guides were produced: i. Handbook "Resilient Cities in Portugal 2018" with measures to promote resilience at the local level; ii. Guidance Guide for the Constitution of Local Platforms for Disaster Risk Reduction"; iii. Guide "Good Practices for Resilience of Critical Infrastructures"; iv. Guide Flood Risk Management. Good Practice Support Document
Disaster risk reduction and management; innovative adaptation solutions and innovative financing mechanisms	Sector "Transport": Good practices and lessons: i. Increase the frequency and areas of deforestation and vegetation cutting around infrastructure; ii. increased frequency of inspections carried out on transport infrastructure; iii. Increase in the frequency of maintenance interventions, namely in engineering structures and hydraulic crossings; iv. increased frequency of maintenance interventions in stabilising slopes and controlling water runoff.

Area of good practices	*Good practices and lessons learnt, including at sub-national level*
Efforts to integrate climate change adaptation into development and sectoral policies; plans and programs	Sector "Buildings": Good practices and lessons: creating the publication "PDM GO Good practices for Municipal Master Plans", with a thematic section dedicated to climate change that identifies some good national practices: i. Sustainable Construction and Energy Efficiency in Belas Club de Campo, Sintra; ii. Passive House in Ílhavo; iii. Casas em movimento - Arquitetura em Movimento in Matosinhos; iv. Municipal Regulation of Urbanisation and Building in Lisbon.
Efforts to integrate climate change adaptation into development and sectoral policies; plans and programs	Sector "Land use planning": Good practices and lessons: the creation of the publication "PDM GO Good practices for Municipal Master Plans", which points out guidelines and methodologies that should be taken into consideration in the planning processes at the local scale, especially in the PDMs, concerning themes such as "the adaptation to climate change".
Efforts to integrate climate change adaptation into development and sectoral policies; plans and programs	Sector "Urban": The publication "PDM GO Good practices for Municipal Master Plans" identifies the creation of green and blue multifunctional axis for climate adaptation in Amadora, Sintra, and Oeiras. Lessons of experiences: i. adhesion of local actors and the population to new ways of adapting to climate contexts; ii. Assume the structural role of green infrastructure for adaptation; iii. enhance learning capital and collaborative experimentation in city networks

5.4.2. Cooperation with Union Member States, international cooperation, and with regional and international organisations to share information and to strengthen science, institutions and adaptation knowledge

One of the main objectives of the National Climate Policy is to ensure the committed participation of the Portuguese State in international negotiations and cooperation, contributing to the achievement of the Paris Agreement, pursuing ambitious policies consistent with the objectives set at the EU level and responding to international commitments to cooperate and support developing countries in the area of climate change and, in particular, climate adaptation.

In this context, the National Climate Policy promotes the integration of the stakeholders of the International Cooperation thematic area in international networks focused on adaptation to climate change, as well as the exchange of knowledge and the establishment of project development partnerships (sharing of information on acceptable practices and experiences has contributed to strengthening expertise and facilitating the exchange of relevant actors - for example, university professors, researchers, grant holders, etc.).

Also noteworthy in this area, in addition to the numerous contributions prepared and made available by the thematic area within the biannual reports of the EU and OECD, within the scope of PCD (Policy Coherence for Development), is the participation in the LIFESHARA project - Sharing Awareness and Governance of Adaptation to Climate Change (https://www.lifeshara.es/en) , which among other actions provides for the establishment of an Iberian cooperation system between the Adaptation Units to climate change in Spain and Portugal for the identification of risks, vulnerabilities, priorities and joint actions.

In addition to cooperation with the activities of the European Strategy for Adaptation, the European Climate-Adapt platform (http://climate-adapt.eea.europa.eu/), and with national adaptation platforms in other countries, it should be noted the promotion of bilateral relations with Norway, Iceland and Liechtenstein under the AdaPT Programme and the National Roadmap for Adaptation 2100, in which one of the project partners is DSB - Norwegian Civil Protection.

5.5. Monitoring and evaluation

Monitoring, reporting and evaluation (MRE) methodology related to reducing climate impacts, vulnerabilities, risks, and increasing adaptive capacity

The MRE at national level is mainly ensured by the biannual Progress Reports of ENAAC 2020 (NAS) and the Monitoring of P-3AC (NAP).

The biannual progress reports of the NAS are intended to respond to the provisions of chapter 2.5 of ENAAC (NAS). The progress for two years is reported for each of the NAS objectives and recommendations are presented to remedy difficulties or gaps and propose improvements. The reports focus on the various thematic areas and priority sectors, the current state of the art, the degree of integration of adaptation in the various public and sectoral policies and the implementation of adaptation measures.

It is the responsibility of the NAS Coordination Group to ensure the elements for adequate reporting on climate change adaptation to comply with international obligations, namely within UNFCCC and EU regulations.

Reporting is developed through the contributions produced by the various thematic areas and working groups, particularly the thematic area dedicated to funding, implementation, and reporting, to respond to the various international commitments within the established deadlines.

MRE methodology related to the implementation of adaptation actions

It is the responsibility of the entities that make up the NAS Coordination Group, in conjunction with the Portuguese Environment Agency, to contribute to the preparation of monitoring reports and proposals for the review of actions, indicators and targets (see Table 1) and to collaborate in the annual monitoring of P-3AC (NAP), providing relevant sectoral information for indicators and targets, and in the preparation of proposals for coordination mechanisms to be established with third-countries.

The entities responsible for the financial instruments that provide funding for the measures identified in P-3AC (NAP) share with the Portuguese Environment Agency information about their implementation, on an annual basis and accordingly with the appropriate indicators, during the first quarter of the year following their performance.

Table 1. Result indicators and targets defined under the NAP (Adaptation to Climate Change Action Programme - P-3AC).

Result indicator	Target 2020 [5][6]	Target 2030
Municipalities covered by adaptation plans (municipal, inter-municipal or regional)	60%	100%
Municipalities with forest fire defence plans that integrate future climate vulnerability assessments and adaptation measures	2%	100%
Water efficiency in urban consumption	80%	85%
Water efficiency in industrial consumption	85%	90%
Water use efficiency in agriculture	65%	80%
Target population of awareness or dissemination campaigns related to climate change impacts and adaptation measures	5%	25%
Transport infrastructure managing entities that have adaptation plans or contingency plans for extreme events	10%	50%
Energy production, transmission and distribution companies that have adaptation plans or contingency plans for extreme events	25%	100%
Water supply and wastewater treatment companies that have adaptation plans or contingency plans for extreme events	50%	100%
Telecommunications companies that have adaptation plans or contingency plans for extreme events	25%	100%
Continental coastline in a critical state of erosion	16,5%	10%
Irrigated infrastructure area with precision technologies that promote efficient water use	10%	50%
Reduction in the number of people affected by floods in risk areas identified in the Flood Risk Management Plans (compared with the previous cycle of the PGRI)	-	25%
Reduction in the geographical distribution area of invasive alien species (compared to the reference year)	-	10%
Reduction in the number of cases of human vector-borne diseases associated with climate change (decadal average)	-	10%

[5] The reduction targets are set against the reference value indicated in the respective existing sectoral planning instruments.

[6] Where indicators arise from current EU funding programmes, the target refers to the closure year of those programmes.

6. Adaptation actions that result in mitigation co-benefits

Measure type	Measure or action	Administrative level and Sectorial scope
A: Governance and Institutional ↳A1: Policy ↳Revision of policies; laws and strategies	**Study on adaptation and mitigation measures (Plan for the Adaptation of Water Resources Management to Climate Change for the Agricultural Sector)** *(Planned)* This action focuses on elaborating a study on adaptation and mitigation measures, integrated into a more comprehensive exercise called "Water Management Adaptation Plan to Climate Change for the Agricultural Sector".	Regional (sub-national) - Agriculture and food - Water management
	Inclusion of the sustainability dimension in the enterprise classification system *(Studies ongoing)* Inclusion of the sustainability dimension, for example in terms of water efficiency, as a valuing element in the classification system of establishments.	National - Buildings - Tourism
	Definition and implementation of measures and strategies of adaptation of the health sector to climate change *(Planned)* This measure focuses on the definition and implementation of various actions and strategies to adapt the health sector to climate change.	Regional (sub-national) - Buildings - Civil protection and emergency management - Health
A: Governance and Institutional ↳A2: Management and Planning ↳Mainstreaming into existing programs and plans	**Removing constructions** *(Planned)* Removal of constructions on the coastline, located in flood-critical territories	Local - Buildings - Coastal areas
	Public warning systems *(Implemented/completed)* This measure focuses on the implementation of warning systems for the population, an essential tool for raising the population's awareness of self-protection and thus promoting the better application of the precautionary principle, contributing to the adoption of measures to reduce risk.	Multilevel - Civil protection and emergency management

A: Governance and Institutional ↳A2: Management and Planning ↳Creation of technical rules and standards	**Update of the National Risk Assessment** *(Implemented/completed)* This action focuses on updating the National Risk Assessment to carry out a current identification and characterisation of hazards of natural, technological or mixed origin, likely to affect the Portuguese territory, considering, for the applicable risks, the impact of climate change and the resulting scenarios, indicating tendencies to worsen or mitigate the risks.	National - Civil protection and emergency management
A: Governance and Institutional ↳A2: Management and Planning ↳Revision of technical rules and standards	**Risk management** *(Being implemented)* This measure, called "Risk management corresponds to a review of the existing insurance schemes to integrate the risk associated with climate events.	National - Agriculture and food - Finance and insurance
B: Economic and Finance ↳B2: Insurance and transfer instruments ↳Revision of existing insurance scheme/products	**Water retention systems to be used in periods of drought** *(Being implemented)* This measure comprises actions that consider water retention capacity, safe storage, so that it can be used in periods of drought.	River Basin District - Water management
C: Physical and technological ↳C1: Physical ↳Improved physical infrastructure (strictly technical in nature)	**Clearance, river regulation and flood control** *(Being implemented)* This measure comprises a set of structural interventions for clearing, river regulation and flood control in areas of frequent flooding and high damage.	River Basin District - Water management
	Adequate management of extreme flows in areas of frequent flooding with high damage *(Being implemented)* The aim of this measure is to provide a framework for the hydraulic works required for the proper management of extreme flows in areas of frequent flooding with high damage.	Multilevel - Civil protection and emergency management
	Strengthening risk monitoring and warning systems. *(Implemented/completed)* This measure focuses on strengthening monitoring and warning systems on risks to improve the responsible entities' response capacity and as an essential tool to ensure the	Multilevel - Civil protection and emergency management

	population's awareness of self-protection and thus promote the better application of the precautionary principle and anticipation of the response.	
C: Physical and technological ↳C2: Technological ↳Technologies for hazard mapping and monitoring	**Survey of typical native species and establish key reference (indicator) species for arid and semi-arid areas.** *(Planned)* Carry out a survey of typical native species and establish key reference (indicator) species for arid and semi-arid areas. This survey will be especially important for better land use management, particularly in terms of forest management.	National - Biodiversity (including ecosystem based approaches) - Land use planning
D: Nature based solutions and ecosystem-based approaches ↳D1: green ↳Changed land-use management	**Implement mosaics of fuel management plots.** *(Being implemented)* Implement mosaics of fuel management plots in order to improve response capacity and reduce the impact of forest fires.	Multilevel - Forestry
D: Nature based solutions and ecosystem-based approaches ↳D1: green ↳Creation of new green infrastructure	**Resilience of ecosystems, species, and habitats to the effects of climate change** *(Being implemented)* This measure comprises a set of actions contributing to increase the resilience of ecosystems, species, and habitats to the effects of climate change.	Multilevel - Transport
	Climate change adaptation measures associated with freshwater and coastal species and habitats. *(Being implemented)* The aim is to begin implementing 50% of the climate change adaptation measures defined in the sectoral plan, giving priority to those relating to freshwater and coastal species and habitats.	National - Biodiversity (including ecosystembased approaches)
D: Nature based solutions and ecosystem-based approaches ↳D2: blue ↳Improvement of blue infrastructure	**Maintenance of the coastline, through artificial feeding of sediments** (Being implemented)	National - Coastal areas
	System of sustainability indicators for the sustainable management of destinations. *(Implemented/completed)* Implementation throughout the country of a system of sustainability indicators of international reference for the sustainable management of destinations, in partnership with the World Tourism Organisation.	National - ICT (information and comunications technology) - Tourism

E: Knowledge and behavioural change ↳E1: Information and awareness raising ↳Decision support tools and databases	**Monitoring of critical areas, including cliffs, to know the evolution of the territory, its occupation and the status of coastal systems** *(Being implemented)*	National - Coastal areas
	Forest Risks *(Being implemented)* This "forest risks" measure includes actions associated with the prevention of forests against biotic and abiotic agents and the restoration of forests affected by biotic and abiotic agents or catastrophic events.	Regional (sub-national) - Biodiversity (including ecosystem based approaches), - Forestry, - Land use planning - Water management
E: Knowledge and behavioural change ↳E3: Practice and Behaviour ↳Revisions or expansion of practices and on the ground behaviour	**Good Practice Guidelines for Disaster Risk Reduction and Resilience Promotion** *(Implemented/completed)* This measure comprises the development of Good Practice Guides for Disaster Risk Reduction and Resilience Promotion, translating the best lessons from experience to prevent or mitigate disaster risks and their effects.	Multilevel - Civil protection and emergency management

7. How adaptation actions contribute to other international frameworks and/or conventions

Synergies of adaptation actions with other international frameworks and/or conventions

The development cooperation actions that can be reported as official development assistance have demonstrated their contribution to the Sustainable Development goals and presented risk matrices. All Portuguese Cooperation actions that can be marked as adaptation and reported as official development assistance has, by definition, an international dimension as an aid to developing countries. In terms of integrating adaptation to climate change into development cooperation, Portugal, as a Member State of the OECD Development Assistance Committee, defines the degree of integration by applying the Rio marker adaptation to climate change.

In this field, the various activities and actions developed by the Cooperation Working Group of the National Strategy for Adaptation to Climate Change 2020 should also be noted.

Thus, this WG has reported to the European Commission on development support activities related to adaptation (Article 16 of the MMR), namely by participating in the report's preparation, including CTF in 2019 and 2020. It has also been following up on meetings under the UNFCCC and Paris Agreement, particularly SB, on methodologies and approaches to reporting financing for development.

In October 2020, the WG accompanied the 7th EU Expert Meeting on Climate Change and Development and contributed to the reporting on development support for adaptation (7th NC and 3rdRB).

Adopting the Sendai Declaration and the Framework for Disaster Risk Reduction 2015-2030, Portugal has developed efforts and actions that contribute towards the seven goals, four priorities and the guiding principles, namely reducing disaster risk. Recognising the potential impact of disasters and their complexity, Portugal has made increased efforts to reduce the possible effects of disaster risks.

Within the theme of resilient cities, National Authority for Emergency and Civil Protection and the Municipality of Amadora are part of the U-SCORE project, co-financed by the European Commission, which aims to promote good practices between 5 resilient cities. Stoke-on-Trent and Salford, in the United Kingdom, and Jönköping and Arvika, in Sweden, join Amadora, in Portugal, in this challenge, whose objectives are to better prepare cities for an eventual disaster scenario, to be a platform for the exchange of knowledge and experiences between experts in this field, and also to involve other municipalities in action for disaster risk reduction.

8. Local knowledge systems related to adaptation

The context-specific nature of adaptation is quite noticeable in a country like Portugal. Its biogeophysical characteristics, demography and economy vary significantly throughout the country determining the adaptation challenges specific to any given part of the territory. In many cases climate change "just" aggravates already existing risks that stablished communities are familiar with. Often it can be found, among these communities, creative solutions to deal with those risks. Normally, these solutions are well-adjusted to the local circumstances being therefore important to integrate them in the adaptation planning processes.

With this aspect in mind, the process of elaboration of the subnational adaptation strategies had an important dimension of stakeholder and local communities' engagement allowing the possibility of co-creation, identifying relevant elements for assessment of the risks, identifying adaptation options and also ensuring ownership of the subnational strategies by the local communities.

9. Other information related to adaptation

9.1. Key contact details of national coordinator and organisation

Organisation	Portuguese Environment Agency (APA)
Department within the organisation	Climate Change Department
Role of the organisation	Coordinating adaptation policies and responsible for reporting
Contact person	Eduardo Santos/ Ana Daam
Role of the contact person	Head of Department/ Head of Unit
Email address	enaac2020@apambiente.pt
Website	https://apambiente.pt/clima/adaptacao

9.2. Adaptation portals and platforms

Name	Portuguese Environment Agency Portal (Adaptation)
Status	Established
Focus of the portal or platform	Climate change adaptation (measures and solutions), Climate change hazards; impact and/or vulnerability
Weblink	https://apambiente.pt/clima/adaptacao

Name	Climate Portal
Status	Established
Focus of the portal or platform	Climate change hazards; impact and/or vulnerability
Weblink	http://portaldoclima.pt/en/

Title	Good Practice Guides
Year of publication	2018
Publisher	ANPC - NATIONAL PLATFORM FOR DISASTER RISK REDUCTION
Weblink	www.pnrrc.pt

Title	Metropolitan Plan of Adaptation to Climate Change of the Metropolitan Area of Lisbon (PMAAC-AML)
Year of publication	2019
Publisher	Lisbon Metropolitan Area
Weblink	https://www.aml.pt/index.php?cMILID=SUS5B26D38C7E6F8&cMILL=3&mIID=SUS5B26D2AD40BAF&mIN=Elementos%20do%20Plano%3A%20conte%FAdo%20documental%20constituinte%20%28downloads%29&mILA=&cMILID1=SUS57DBD63E8B375&mIID1=1&mIN1=%C1reas%20de%20atividade&cMILID2=SUS5B26D08452B6F&mIID2=SUS5B26D0019A515&mIN2=PMAAC-AML&cMILID3=SUS5B26D38C7E6F8&mIID3=SUS5B26D2AD40BAF&mIN3=Elementos%20do%20Plano%3A%20conte%FAdo%20documental%20constituinte%20%28downloads%29

Title	Intermunicipal Climate Change Adaptation Plan of Central Alentejo (PIAAC-AC)
Year of publication	2020
Publisher	Intermunicipal Community of Central Alentejo
Weblink	https://www.cimac.pt/relatorios/

Title	Spatial Planning in Response to Climate Change: Contribution to the PDMs
Year of publication	2019
Publisher	Lisbon and Tagus Valley Coordination and Regional Development Commission
Weblink	http://www.ccdr-lvt.pt/files/e85da0b52d3e72c3a6aa739bf8b8fc997d87f83c.pdf

Title	PDM GO Good practices for Municipal Master Plans
Year of publication	2021
Publisher	National Land Commission
Weblink	https://cnt.dgterritorio.gov.pt/system/files/grupos_trabalho/NormasEspecificacoesREN_08-02-2020_versao%20a%20publicar%20na%20CNT.pdf

Annex 1

National Adaptation Strategy

Approved by the Council of Ministers Resolution n.º 56/2015, of 30th of July

ENAAC

Estratégia Nacional de Adaptação às Alterações Climáticas

National Strategy for Climate Change Adaptation

Approved by the Council of Ministers
Resolution n.º 56/2015, of 30th of July

apa agência portuguesa do ambiente

REPÚBLICA PORTUGUESA | AMBIENTE E AÇÃO CLIMÁTICA

ENAAC

Estratégia Nacional
de Adaptação às Alterações Climáticas

National Strategy for Climate
Change Adaptation

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Acronyms and abbreviations

ANACOM	National Communications Authority
ANMP	National Association of Portuguese Municipalities
ANPC	National Civil Protection Authority
APA	Portuguese Environment Agency, I.P.
CG	Coordination Group
CLIMAAT	Atlantic Archipelagos Climate and Weather Project
CSF	Common Strategic Framework
DGADR	Directorate- General for Agriculture and Rural Development
DGAE	General Directorate of Economic Activities
DGEG	Directorate- General for Energy and Geology
DGS	General Directorate of Health
DGT	Directorate- General for Territory
ENAAC	National Strategy for Climate Change Adaptation
EU	European Union.
FCT	Foundation for Science and Technology
FPC	Portuguese Carbon Fund
GPP	Planning and Policy Office
GT AGRI	Working Group on Agriculture and Food Safety
GT BIODIV	Working Group on Biodiversity and Natural Heritage
GT ECON	Working Group on Economy, Industry, Tourism and Services
GT ENERG	Working Group on Energy and Energy Security
GT FLORES	Working Group on Forestry and Forestry
GT MAR	Working Group on Sea and Coastal Areas
GT SAUDE	Working Group on Human Health
GT SEGUR	Working Group on Safety of People and Goods
GT TRANS	Transport and Communication Working Group
ICNF	Institute for Nature Conservation and Forests, I.P.
IFAP	Institute for the Financing of Agriculture and Fisheries, I.P.
IFDR	Financial Institute for Regional Development, I. P.
IMT	Institute of Mobility and Transport, I.P.
IPCC	Intergovernmental Panel on Climate Change
IPMA	Portuguese Institute of Sea and Atmosphere, I.P.
LIFE	Financial Instrument for the Environment LIFE
MFEEE	European Economic Area Financial Mechanism
MMR	Mechanism for Monitoring and Reporting.
RAA	Autonomous Region of the Azores.
RAM	Autonomous Region of Madeira.
SIAM	Project "*Climate Change in Portugal, Scenarios, Impacts and Adaptation Measures".*
SP	Scientific Panel.

UNFCCC	United Nations Framework Convention on Climate Change
WG	Sectoral Working Groups

PART A. VISION, OBJECTIVES, STRUCTURE AND ORGANISATION OF WORK

1. INTRODUCTION

The 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that the change in global mean surface temperature is likely to exceed, by the end of the 21st century, 1.5°C compared to 1850-1900. This makes the margin between the 2°C thresholds (relative to the pre-industrial period), beyond which there are agreed dangerous consequences for natural and human systems, increasingly narrow and likely to be exceeded.

Evidence indicates that human interference with the climate system is indeed occurring on a global scale. In turn, recent changes in climate have impacted natural and human systems across continents and oceans.

The impacts of recent extreme events such as heatwaves, droughts, floods and forest fires demonstrate the significant vulnerability and exposure of some ecosystems and many human systems to climate variability. In Europe, these extreme events already have significant impacts on multiple economic sectors and adverse effects on society and health. Portugal is among the European countries with the highest potential vulnerability to the impacts of climate change. Most of the most recent scientific studies point to southern Europe as one of the areas potentially most affected by climate change.

The PESETA II project divided the EU into five major regions, and for southern Europe (Portugal, Spain, Italy, Greece and Bulgaria), it reports potential GDP losses of between 1.8 % and 3 % (respectively for a global average temperature scenario of 2°C and a reference scenario where it could reach 3.5°C without mitigation measures). These economic losses are mainly due to climate change impacts related to agriculture, energy, floods and inundations, forest fires, human health, droughts and coastal zones (Ciscar et al. 2014).

According to that study, the main sectoral impacts projected for Southern Europe (2071-2100) are:

a) Agriculture: decrease in overall crop yields of the order of 10% in the EU, mainly due to a 20% drop in southern Europe (for the reference scenario) and little effect on EU-wide agricultural yields in the 2°C scenario.

b) Energy: decrease in the overall energy demand in the EU by 7% to 13% (respectively for the 2°C scenario and the baseline scenario), mainly due to the decrease in heating needs. A reduction in energy demand is expected in all regions of the EU, except in Southern Europe, where the additional cooling needs would lead to an increase of about 8% (for the baseline scenario).

c) River floods and fast floods: the baseline scenario projects a potential doubling of the damage resulting from river floods and fast flooding in 2080 to circa 11 billion/year. This increase in damage will occur mainly in the United Kingdom and Ireland, and South-Central Europe. The latter could see a considerable increase in damage, totalling €1.3 billion/year.

d) Forest fires: for Southern Europe, the reference scenario projects more than doubling the potential burned area due to forest fires reaching almost 800,000 ha. In the 2°C scenario, this increase is projected to be about 50%.

e) Human health: the reference scenario projects that the number of heat-related deaths per year will double. In the 2°C scenario, although smaller, there is also a projected increase in the number of heat-related deaths for southern Europe.

f) Droughts: Southern European regions will be particularly affected by droughts, facing severe reductions in low flow areas. The EU agricultural area affected by droughts is projected to increase by a factor of 7 to 700,000 km^2/year (baseline scenario). The most significant increase in the area exposed to drought will be in this region, reaching almost 60% of the total affected area in the EU (compared to 30% today). The same scenario indicates that the number of people affected by droughts will also increase from current levels by a factor of 7, reaching 153 million people/year. Half of the total affected population will be in the Southern European region.

g) Coastal areas: The damages associated with sea floods (without adaptation) could triple and reach 17 billion Euros/year in the baseline scenario. This relative increase in damages is greatest in southern Europe, reflected by almost 600%. In the 2°C scenario, associated with smaller increases in mean sea level, the damages are smaller but still substantial, with a projected increase of almost 500% for Southern Europe.

For Portugal, the basic climate information (historical and projections) is provided by the Portuguese Institute of Sea and Atmosphere, I.P. (IPMA). The main national and international reference findings on potential climate change and its impacts in Portugal are those provided by the SIAM I (2002), SIAM II (2006) and CLIMAAT II (2006) projects.

Most of the scenarios presented by these studies project for the period 2080-2100:

i. Significant increase in the average annual temperature in all regions of the country.
ii. Increase of the maximum temperature in summer, on the Portuguese mainland, between 3°C in the coastal area and 7°C in the interior, accompanied by an increase in the frequency and intensity of heatwaves. In the Autonomous Regions of the Azores and Madeira, the increases in maximum temperature are expected to be more moderate, between 1°C and 3°C.
iii. A trend towards a significant reduction in frost days and an increase in the number of warm days and tropical nights.
iv. Increased risk of fire, change in land use and occupation capacities and implications on water resources, due to the change in the thermal climate.
v. Significant changes in the annual precipitation cycle in mainland Portugal and autonomous regions, with trends towards a reduction in precipitation during spring, summer and autumn in mainland Portugal. Some models also suggest the possibility of a decrease in annual rainfall, with the most significant losses occurring in the southern regions of mainland Portugal and Madeira and an increase in precipitation during winter, due to increases in the number of days of heavy rainfall.

These data have been reconfirmed by more recent studies, which state:

a) Results obtained for the future (2071-2100) are consistent with those found in the mid-1970s in Portugal, with a maximum temperature increase of 3.2°C to 4.7°C for summer and about 3.4°C for spring. For the minimum temperature, the results were similar, with summer (spring) increases ranging from 2.7°C (2.5°C) to 4.1°C (2.9°C) (Ramos *et al.* 2011).
b) Significant reductions in total rainfall for 2071-2100, especially in autumn along the Northwest and South of Portugal. An increase in winter precipitation over the Northeast of Portugal (in one scenario) is the most important exception to the overall drought trend. There is an increase in the contribution of extreme precipitation events to the total precipitation, mainly in winter and spring over Northeast Portugal. A projected increase in

the duration of dry spells in autumn and spring, evidencing an extension of the summer dry season into spring and autumn (Costa *et al.* 2012).

c) Increases in the average temperature of more than 1°C by the middle of the 21st century in the Azores and Madeira, reaching values of more than 2.5°C by the end of the century, accompanied by a reduction in annual precipitation of the order of 10% in the Azores but which could reach 30% in Madeira (Tomé 2013).

d) Significant warming trends (2041-2070) are projected for maximum and minimum temperatures on seasonal and daily scales. Seasonal mean maximum and minimum temperatures are positively shifted (2-4°C), especially for maximum temperature in summer and autumn (3-4°C). The projections indicate that daily extremes will become more frequent, especially in the maximum temperature in summer, in the interior of Portugal. Overall, the changes in winter are less pronounced than in the other seasons. However, the increase in the number of hot days in spring and summer, especially in the country's interior, is quite remarkable (Andrade *et al.,* 2014).

All these trends have different territorial and sectoral impacts, implying specific responses and needs. Although there is no exact quantification available to estimate the impacts of extreme weather events and the trends observed in recent years related to climate change, Portugal has estimates that point to 60 - 140 million euros of annual costs associated with forest fires[7], with the drought of 2005 (the most severe of this century) having estimated costs of around 290 million euros[8], and the drought of 2012 damage mainly in terms of agricultural production losses, with estimated costs of 200 million euros plus administrative costs of over 250,000 euros[3].

Climate change enhances or accelerates other risks where natural and anthropogenic factors intersect, such as coastal erosion or forest fires. A systemic and integrated perspective must be assumed in planning, which considers climate change's cumulative and interactive dimension, which entails even greater uncertainty and unpredictability.

Portugal has had a National Strategy for Climate Change Adaptation (ENAAC) since 2010. The Resolution of the Council of Ministers that approved it (RCM no. 24/2010 of March 18) placed

[7] National Strategy for Forests, RCM no. 114/2006.

[8] Drought Assessment Report 2005 - National Drought Commission 2005. 3

Information GPP/2012 based on the work of the Commission for the Prevention, Monitoring and Follow-up of the Effects of Drought and Climate Change, created under RCM No. 37/2012.

Portugal among the 17 European countries that, at the time, indicated having an officially approved Climate Change Adaptation Strategy[9].

However, the growing interest in developing climate change adaptation policies in Portugal and internationally should not be seen as a sign of less interest or consideration for controlling and reducing greenhouse gas emissions. On the contrary, both responses to climate change (adaptation and mitigation) should be framed and integrated to promote the correct planning and development of a resilient, competitive, and low carbon society and economy.

The ENAAC was subject to public consultation between 22 May and 5 June 2015, and the relevant comments received were included in the document. The report of the public consultation is available on the APA website.

1.1 ENAAC 2010-2013: Process and results

The first phase of the ENAAC took place between 2010 and 2013 and produced a progress report publicly presented on October 1, 2013, based on the work of the various sectoral groups and its coordination (conclusions and proposals constitute Part B of this annexe). The Autonomous Regions of Azores and Madeira developed specific work on this matter.

The first phase of the ENAAC had the following objectives:

a) Information and knowledge - keeping scientific knowledge up to date and available.
b) Reduce vulnerability and increase response capacity - in an integrated manner, to define measures that Portugal will have to adopt, as the international community, to minimise the effects of climate change.
c) Participate, raise awareness and disseminate – to raise awareness about climate change and its impacts.
d) Cooperate at the international level - supporting the most vulnerable countries, namely within the framework of the Community of Portuguese Language Countries (CPLP).

A progress report was produced highlighting the strategic nature of the work carried out. Limitations were identified throughout the three-year process. We highlight the creation of the scientific support panel initially proposed and the difficulty in articulating the work of the different

[9] Data from the European CLIMATE-ADAPT platform (http://climate-adapt.eea.europa.eu/countries, accessed 19 January 2014).

sectoral groups to give them coherence and guidance. Likewise, it was concluded that there is a need for greater involvement and empowerment of local agents, namely through a more significant intervention of municipalities, given their competencies in promoting and safeguarding the own interests of their populations in areas that are affected by the effects of climate change, and the strengthening of articulation with the work developed by the Autonomous Regions.

On the other hand, the comprehensive composition of the coordination group, flexibility in the formation of sector groups (allowing each sector to identify the most relevant agents for its case) and a sector coverage defined around the competencies and responsibilities of central administration entities were pointed out as the main positive points that contributed to the strategic objectives of this first phase being globally achieved

In many cases, the sectoral groups presented an exhaustive diagnosis of their vulnerabilities and put forward concrete proposals for action with detailed measures.

2. ENAAC 2020

The ENAAC should evolve towards promoting and assisting the various sectors, the central, regional, and local administration, and policymakers, in finding the means and tools for the transposition from the theoretical plan to the action plan, through a greater focus on the efficient implementation of adaptation measures and promoting their integration in the various sectoral policies and territorial planning instruments.

At the level of ENAAC's governance structure, the aim is to promote greater involvement of the relevant authorities, the articulation with the autonomous regions of the Azores and Madeira, considering, in particular, the national reporting requirements in the matter and better interaction between sectoral groups and between the various administrative levels. The flexible nature of the ENAAC is maintained, allowing for greater involvement of sectorial agents, and broadening the scope of work to areas not previously covered (for example, transport). In this new phase of the ENAAC, the means of communication with the scientific community are also reinforced, integrating it better in the governance structure of the ENAAC.

The alignment of the subsequent phase of the ENAAC work with other exercises, namely with the implementation of the Community Support Framework for the 2014-2020 period (Portugal 2020), which is the privileged financial instrument to support the implementation of adaptation measures, as well as with the European Union Strategy for Climate Change Adaptation[10], will allow the creation of synergies and rationalisation of efforts. **In this sense, the National Strategy for Climate Change Adaptation is defined until 2020, from now on named ENAAC 2020, which gives continuity to work developed under the Resolution of the Council of Ministers No. 24/2010 of March 18.**

Thus, ENAAC 2020 intends to establish a more efficient structure, without duplication of competencies, and systematising knowledge and initiatives on climate change adaptation. The articulation between entities and the harmonisation of procedures is a fundamental aspect of the ENAAC 2020, contributing to disseminating technical and scientific information, monitoring and compilation of good adaptation practices, and establishing priorities for action.

The identification of funding needs and their sources is one of the priorities to be addressed in this period, taking advantage of the possibility of submitting projects to various funding lines, EU or

[10] COM(2013) 216 final of 16 April 2013

national, including the Portuguese Carbon Fund and the different operational programmes defined under Portugal 2020, as well as the LIFE and Horizon 2020 Programmes. In this sense, ENAAC 2020 should guide and support climate change adaptation funding applications and develop an appropriate evaluation and monitoring framework for projects funded under those programmes.

All these aspects that underpin the content and structure of ENAAC 2020 were identified during the work of the 1st phase of the strategy as priority topics to be addressed. In this framework, the opportunity of funding from the European Economic Area (EEA) Financial Mechanism and the Portuguese Carbon Fund (FPC) was taken, giving rise to the AdaPT Programme. Signed in October 2013, this program assumes a leading role in promoting adaptation in Portugal and launching the work recommended in ENAAC 2020, namely by filling the following gaps:

a) Systematisation and dissemination of climatic information.
b) Coordination of the different administrative levels.
c) Capacity building of municipalities in the field of adaptation policies.
d) Raising public awareness with a strategic focus on schools.
e) Creation and development of tools to support sectoral action.

The projects developed in this context should be followed up within the scope of the ENAAC 2020, being a pilot for the development of future projects on a larger scale, namely with recourse to EU and national funding.

In the context of the work on the EU Strategy for Climate Change Adaptation, it is foreseen to participate in the discussions and to integrate the guidelines issued by the European Commission, namely at the level of the follow-up and monitoring framework (*Adaptation Preparedness Scoreboard*), as well as to support the remaining reporting obligations at the EU level, namely those arising from Article 15 of Regulation (EU) No 525/2013 of the European Parliament and of the Council of May 21 (MMR) and the UNFCCC and its Kyoto Protocol.

2.1 Vision

To contribute to the planning and development of a resilient, competitive and low-carbon society and economy, the ENAAC 2020 vision is:

A country adapted to the effects of climate change through the continuous implementation of solutions based on technical and scientific knowledge and good practices.

2.2. Objectives

To achieve its vision for Portugal, ENAAC 2020 assumes three objectives that seek to continue the rationale of the previous phase by seeking a more operational orientation and its implementation.

The objectives of ENAAC 2020 are:

I. **Improving the level of knowledge about climate change.**

II. **Implement adaptation measures.**

III. **Promote the integration of adaptation into sectoral policies.**

The main aspects related to each of these objectives are detailed below.

I. Improving the level of knowledge on climate change:

This objective aims to update, develop, and promote understanding of climate change and assess its potential risks[11], impacts and consequences, including those related to extreme weather events.

The scientific knowledge behind climate change contains inherent uncertainties and presents constant developments in the effects of greenhouse gas emissions on the global climate system and its environmental, social, and economic impacts. However, the distance between global causes and local effects of climate change is a barrier to the perception of the problem, forcing the adoption of the motto «think global, act local». Thus, it is essential to familiarise the population with this issue and provide updated and reliable information on the potential impacts and consequences.

[11] The notion of "Risk" is associated to several definitions, according to different fields of knowledge, and there is not exactly a consensual definition at national and even international level. Throughout the text, the use of terminology associated to "Risk" is based essentially on the following definitions:

i. Climate risk - the risk posed to a human system by a climate-driven event. The level of risk is related to the severity and probability of occurrence of the event and how its consequences may affect the social vulnerability of the human system in question. Risk can be quantified by outcomes, such as mortality and morbidity or economic losses. (Based on Brooks 2003: *Vulnerability, Risk and Adaptation: A conceptual Framework.Tyndall Centre for Climate Change. Working Paper* 38).

ii. Risk: Potential consequences for human lives and property and of uncertain outcome. Risk is often referred to as the probability of hazardous events or trends in such events multiplied by their consequences (IPCC Report - WG II, 2014, free translation).

In this sense, **research, awareness-raising, and monitoring initiatives** fit into this specific objective. In this context, it is vital to **broadening knowledge through research on climate change in Portugal** and its impacts, considering territorial specificities. Alongside this process, the results of research produced, and policies projected in the EU, particularly in Spain, and the rest of the world, should be considered.

This knowledge must be **disseminated through communication platforms and public awareness campaigns**. Additionally, to support research and awareness-raising, it is essential to **establish monitoring, forecasting, warning and response systems to address** the probability of an increase in the intensity and frequency of extreme weather events as well as the potential associated consequences (e.g., forest fires, storms, coastal erosion, floods, droughts, accompanied by loss of life and property).

The assessment of risks associated with climate change is a complex process due to the uncertainties of the scenarios projected for the future and because the impacts give rise to different repercussions depending on the scale and sectors affected. On the other hand, this assessment results from the combination of extreme phenomena of climatic origin with territorial specificities and the characteristics of the elements that may be affected.

At the same time, it is essential to confront the various sectoral and territorial agents with climate scenarios so that they can identify the threats and opportunities that could arise, which depend on the very nature of the activity of the agents (e.g. certain crops or species and habitats are more likely to be affected in periods of drought) and territorial specificities. In this sense, this specific objective proposes creating a database subject to constant construction and updating, which integrates climate-based information, territorial specificities, vulnerability factors, history of impacts, and identifying the possible effects of climate change (including those that constitute opportunities). This database should also integrate the connection to macro-scale issues concerning the Iberian Peninsula (including cross-border issues), the EU, and the rest of the world and constitute a National Adaptation Platform pillar. The result of the achievement of this objective will, in turn, include the essential support for the evaluation of adaptation measures, so it should be made available to the public to inform and empower society in the adaptation process.

II. Implement adaptation measures:

Under this objective, it is intended to assess the current adaptive capacity and prioritise the implementation of adaptation options and measures that moderate future negative impacts and/or help seize opportunities arising from climate change.

The results of the previous objective should support these activities. This 2nd specific objective covers the financing of the measures, the capacity building of the actors involved, and monitoring the actions taken.

The prioritisation methodology should also seek to be in harmony with science, policy, and society. In this sense, participation mechanisms should be promoted in decision-making moments that considers the uncertainties associated with the threats and opportunities arising from climate change on which the measures intend to act.

Two ways will be used:

i) by consultation with sectoral agents (including the results of the work carried out during the first phase of ENAAC), since these are the stakeholders who best know the realities of each area and the barriers and opportunities in terms of implementing adaptation measures.

ii) by collecting information on existing good practices at the national and international level, benchmarking and cooperation to exchange knowledge on good adaptation practices with southern European countries, particularly with Spain, the Maghreb, and others, will allow finding innovative and adequate solutions to the national climate and context.

This specific objective also includes efforts to unblock barriers to implementing measures, including developing funding mechanisms. Thus, it is crucial to establish progress assessment and monitoring procedures to identify constraints hindering the implementation of adaptation in Portugal.

III. Promote the integration of adaptation into sectoral policies

This objective aims to promote the integration and monitoring of the climate change adaptation component ('*mainstreaming*') in the most relevant public and sectoral policies, including spatial planning and sustainable urban development policies and their territorial planning and management instruments. In this sense, adopting procedures aimed at spreading and integrating climate change adaptation concerns in the activity pursued and managed by the various sectoral

agents and levels of territorial administration should be promoted. For that purpose, the revision of sectorial legislation and the elaboration of technical standards and/or guidelines may be considered. In the long term, and as policies mature, they will integrate adaptation more autonomously and effectively. Indeed, given the cross-cutting nature of climate change adaptation, it is essential to inform policymakers and ensure public entities' decision support capacity so that adaptation can be autonomously integrated into the various public policies and instruments and practices of territorial planning and management.

It is also essential to establish a monitoring system for the various *mainstreaming* initiatives, centralising information on the integration of adaptation in the various public policies and territorial programmes and plans pursued by the different public administration entities. This procedure is determinant to facilitate identifying progress indicators of adaptation policies and their monitoring for evaluation and reporting purposes.

Strategic environmental assessment and environmental impact assessment shall ensure that the effects of certain investments, plans and programmes integrate climate change adaptation concerns.

Awareness of the implications of climate change and the progressive adaptation of governance structures to manage this issue will be essential for formulating sectoral policies and territorial plans and programmes perfectly framed in the climate change adaptation process.

2.3 Organisation

The coherent pursuit of the vision and objectives of ENAAC 2020 needs an integrated approach, focused on implementation translatable into concrete actions to be applied throughout the national territory and allowing cooperation with the other EU Member States and multiple international partners.

Operationalising a strategy with these characteristics requires a flexible and dynamic structure to promote the integration of coherent vertical (between scales) and horizontal (between sectors and organisms).

Thus, the implementation of ENAAC 2020 is organised into six Thematic Areas and nine Priority Sectors.

The Thematic Areas promote coherent vertical integration of the different scales required for adaptation (from international to local) and horizontal integration (of the different sectors) through coordination and development of specific work of a multisectoral nature.

The **six Thematic Areas** were selected based on the experience of the first phase of the ENAAC (2010-2013) and the objectives for ENAAC 2020. Priority and transversal Thematic Areas were identified, common to most sectors, such as i) research, ii) funding, iii) international cooperation and iv) communication/dissemination. In parallel, to integrate adaptation into sectoral policies, v) land use management and vi) management of water resources were identified as priority themes, given their strategic and cross-cutting nature in terms of climate change adaptation in Portugal, having been identified in the first phase of the ENAAC the need for a particular approach, based on a better articulation with the sectors involved.

The **nine Priority Sectors** represent the basic working units of the ENAAC 2020, continuing the previous phase, and have now been updated to meet the needs identified. These sectors should also contribute to the work to be developed under the Thematic Areas.

Figure 1 schematically presents the organisation to be implemented in the ENAAC 2020, including the links and integration between the different Thematic Areas and the Priority Sectors.

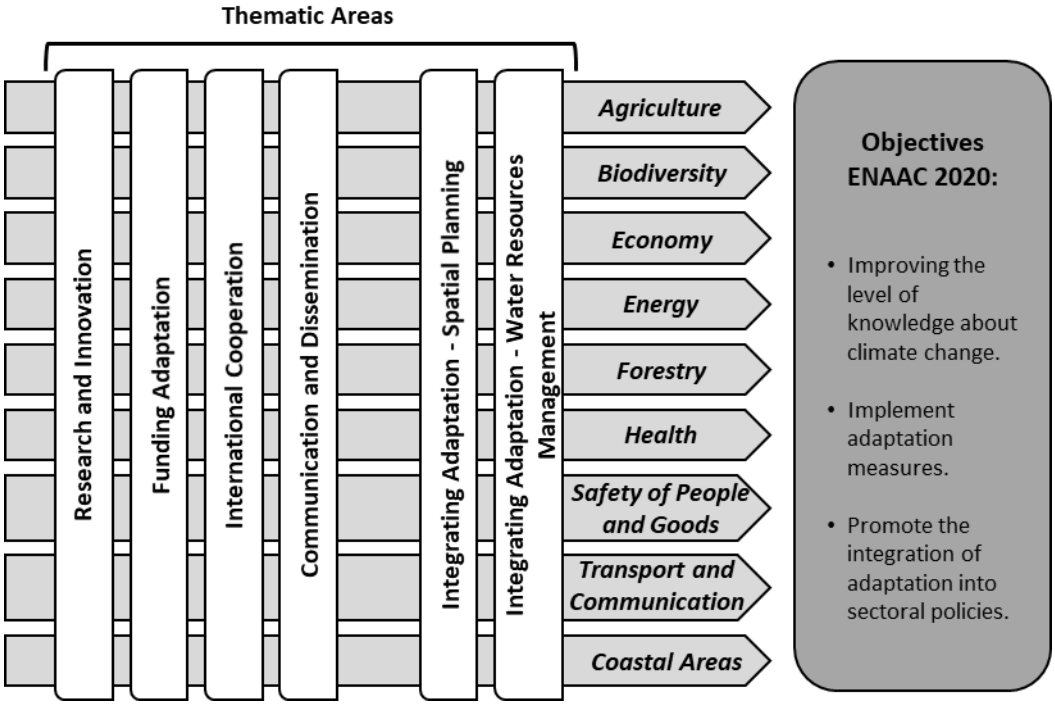

FIGURE 1: REPRESENTATIVE DIAGRAM OF THEMATIC AREAS AND PRIORITY SECTORS

Considering the specific competencies in the matter and the markedly regional and local character in terms of the impacts of climate change and the respective adaptation responses and solutions, the autonomous regions of the Azores and Madeira and the National Association of Portuguese Municipalities are invited to participate in the structures arising from the organisation of the work of the ENAAC, following the provisions of the following points.

2.3.1. Thematic Areas and vertical integration in the ENAAC

The coordination of each of the Thematic Areas will be shared between the Portuguese Environment Agency, I.P. (APA), as general coordinator of the ENAAC and the entity(ies) with specific expertise in the theme in question, acting as facilitators of the work. The different Thematic Areas meet when convened by their coordinators, without prejudice to extraordinary meetings whenever necessary.

Within the scope of the work of each Thematic Area, proposals for action must be considered, including priority transversal and sectorial measures, and the respective financing, regulatory, fiscal and other instruments must be identified, accompanied by indicators and targets, whenever possible and appropriate.

In addition to the entities that coordinate the sectorial groups of the different Priority Sectors, other entities or personalities identified as relevant during the implementation of the Strategy will participate in the work of the Thematic Areas.

For each of the six thematic areas, contributions from sectoral groups and entities or personalities are invited on an *ad hoc* basis, representing specific interests in each of the thematic areas.

Each area must present a **biannual implementation plan** where a realistic set of objectives and activities to be developed during the implementation of the Strategy are duly identified. The first plan must be submitted six months after the beginning of the work of each thematic area, which must occur soon after the designation of those responsible for coordination.

Without prejudice to other equally strategic areas or domains being identified during the implementation of the Strategy, the approach used by ENAAC 2020 is structured in the following six Thematic Areas:

a) Research and Innovation

The Thematic Area on Research and Innovation will promote national science and knowledge in areas relevant to the coherent implementation of the ENAAC 2020. Without prejudice to other priorities that may be agreed upon during the work of the Strategy, this area may:

i) Develop a national agenda of research, innovation, and demonstration priorities on adaptation, which may include the development of a thematic national research programme, including the definition, launching and evaluation of calls for research proposals in this area[12].

ii) To support the signing of cooperation protocols between national and international scientific institutions and the bodies involved in implementing the Strategy.

iii) To support the participation of Portuguese science in national and international projects on themes related to the Strategy[13].

iv) To promote the connection and participation of the agents involved in the Strategy in international networks linked to research and innovation in the field of adaptation and climate change[14].

v) To promote the internalisation of advances in knowledge and innovation by the Portuguese business fabric.

b) Finance and Implement Adaptation

The Thematic Area dedicated to funding, implementation and reporting of Adaptation should focus on the prioritisation and articulation of funds and means available for the consistent funding of adaptation options and measures necessary for the implementation of the ENAAC 2020 and the establishment of effective reporting mechanisms, particularly within the scope of international obligations. Without prejudice to other priorities that will be agreed upon during the work of the Strategy, this area may:

i) Promote the development of selection criteria for funding adaptation projects through EU funds from Portugal 2020.

ii) Contribute to the terms of reference of application programmes.

iii) Seek to develop new funding schemes for adaptation projects supported by the CSF.

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[12] Information on previous Research projects carried out in Portugal since 2005 is available in the InfoBase of the European project CIRCLE-2 (http://infobase.circle-era.eu/).

[13] In particular under the European Union's research funding programme - Horizon 2020.

[14] For example: the EIONET (EEA) and the ETC-CCA (EEA).

iv) Develop appropriate reporting mechanisms, complying with all EU and international obligations on climate change adaptation, including indicators on the use of funds for adaptation[15].

c) International Cooperation

The Thematic Area dedicated to international cooperation on adaptation should promote cooperation work with other countries on the issues necessary for the implementation of the ENAAC 2020 and equivalent strategies in these countries and regions of the world, focusing on priority countries for Portuguese cooperation, according to the principles and priorities set out in the Strategic Concept of Portuguese Cooperation (2020), approved by the RCM No. 17/2014 of March 7. In the case of development projects, the priorities, principles, and international commitments made in this context must be considered. Without prejudice to other priorities that may be agreed upon during the work of the Strategy, this area may:

i) Develop a national agenda of priorities to support development in adaptation.
ii) Ensure participation and articulation with the cooperation coordinating body to guarantee coherence with Portugal's cooperation policies and international commitments.
iii) Establish an Iberian cooperation system for climate change adaptation that supports the articulation of adaptation strategies in Portugal and Spain, promotes integrated intervention in border regions, and boosts the current mechanisms for managing water resources in river basins shared by both countries.
iv) Participate in international networks focused on climate change adaptation promoting the exchange of knowledge and the establishment of project development partnerships.
v) Support active cooperation policies on adaptation by promoting the exchange of knowledge, technology, and good adaptation practices.
vi) Accompany the development of international indicators for monitoring the adaptation component in development support projects, considering the lessons learned from the application of the indicators currently recommended.
vii) Support reporting on national cooperation activities on adaptation.

[15] Namely those related to the funds: CSF; CSF; LIFE+; MFEEE.

d) Communication and Dissemination (National Adaptation Platform)

The thematic area is dedicated to the promotion and dissemination of knowledge on Adaptation. It will support the development, systematisation, and dissemination of information necessary for decision-making. Without prejudice to other priorities that are agreed upon during the work of the Strategy, this area may:

i) Develop a National Adaptation Platform that centralises information, progress, and stakeholder interaction on climate change adaptation in Portugal, taking into account the possible connection to similar platforms in Europe and the rest of the world[16].
ii) Promote the collection, systematisation, and visualisation of knowledge.
iii) Make the necessary climate information and decision support tools on adaptation freely available in the public and private sector.
iv) Adopt communication plans aimed at raising the general public's awareness of climate change.

e) Integrating Adaptation into Spatial Planning

The Thematic Area dedicated to integrating Adaptation into Spatial Planning should promote introducing the adaptation component in policy and territorial management instruments at all relevant scales for a coherent implementation of the ENAAC 2020. To achieve this, it should include the capacity building of sectoral actors regarding the territorial integration of specific adaptation measures, considering the threats and opportunities associated with the effects of climate change.

This area should promote the inter-sectoral articulation of the main constraints and opportunities for adaptation to ensure compatibility between the different sectoral adaptation measures. In parallel, this thematic area should, among other things, promote:

i) The dissemination of information and other resources that guide the various sectoral agents in the active management of climate change adaptation in their activities in a way that fits local and regional specificities.
ii) The analysis and mapping of hazards with a climatic origin as well as the consequent modification and adaptation of the main instruments of territorial policy and management.
iii) The development of technical guidelines to ensure the integration of climate change adaptation into territorial management instruments.

[16] For example through coordination and cooperation with the activities of the European Adaptation Strategy, the European Climate-Adapt platform (http://climate-adapt.eea.europa.eu/) and national adaptation platforms in other countries.

iv) The integration of climate change adaptation in the Action Programme of the PNPOT.

v) The integration of climate change adaptation in Sustainable Urban Development Agendas.

(f) Integrating Adaptation into Water Resources Management

The Thematic Area dedicated to integrating Adaptation in Water Resources Management should promote introducing the adaptation component in national water resources policy, planning and management instruments at relevant scales for a coherent implementation of the ENAAC 2020. The scope of this Thematic Area shall also include capacity building of the various sectoral actors on adaptation, considering the spatial variability of risks and opportunities associated with the effects of climate change on water resources. Without prejudice to other priorities that will be agreed upon during the Strategy's work, this area must promote the sectoral assessment and the inter-sectoral articulation of the main constraints and opportunities for adaptation related to the management of water resources, including the following actions:

i) Incorporate the adaptation component into the main water policy, planning and management instruments.

ii) Promote the dissemination of information on water management

iii) Propose and monitor the implementation of measures to adapt to climate change in their activities, taking into account the specificities of river basins adaptation measures in the field of water resources management.

2.3.2. Priority sectors and horizontal integration in the ENAAC 2020

The ENAAC 2020 promotes a coherent horizontal integration of adaptation by developing activities, and specific work in nine priority Sectors through the Sectoral Working Groups (WGs) identified in 2.3.2.2.

2.3.2.1 Competencies of Sectoral Working Groups

Taking into consideration the vision, objectives, and Thematic Areas of ENAAC 2020, each Sectoral Working Group has the following competencies:

a) Promote the identification, analysis and assessment of the main impacts, vulnerabilities, options, and adaptation measures for each sector.

b) Involve the various sectoral stakeholders in the activities of the Working Groups.

c) Promote the integration of adaptation into all relevant policies and sectoral planning instruments.
d) Identify knowledge needs and gaps relevant to the sector.
e) Promote the development and evaluation of sectoral studies on adaptation, including the identification of funding sources and monitoring and evaluation mechanisms.
f) Submit plans and reports of activities, as established by the Strategy's coordination.
g) Contribute actively to the work of the different Thematic Areas by the objectives of the strategy.
h) Articulate, when necessary, with other Working Groups.

2.3.2.2 Coordination of Sectoral Working Groups

A Sectoral Working Group will be created for each of the priority Sectors[17], coordinated by the respective central administration body (or bodies) with competencies in that sector (Annex I).

The different Sectoral Working Groups shall meet whenever necessary when convened by their leaders. They shall be set up within a maximum of two months from the date of designation of the coordinating officers.

Each Sectoral Working Group shall define, in its regulation or in another form deemed appropriate, its structure, modus operandi, competencies and specific objectives beyond those explicitly referred to in the Strategy.

Without prejudice to other equally strategic sectors or areas being identified during the Strategy, the following nine priority sectors and respective Sectoral Working Groups (WGs) are recognised for the promotion and implementation of adaptation in Portugal:

a) Agriculture (GT AGRI)

The scenarios of climate evolution for Portugal until the end of the 21st-century point to progressively more unfavourable conditions for agricultural activity due to the reduction of precipitation and the increase in temperature, the worsening of the frequency and intensity of extreme events, and the increase in susceptibility to desertification.

[17] These sectoral working groups are created under ENAAC 2020 although they may, where possible, continue the work of the previous sectoral groups (2010-2013).

In recent decades, agriculture has been severely affected by climate change, especially by droughts and other extreme events.

The recent development of scientific knowledge on climate has made it possible to reduce the uncertainty associated with its future evolution, namely for Portugal, highlighting the unavoidable need for action to adapt society to the new conditions.

Water availability and irrigation capacity, soil fertility and erosion prevention, risk management in the face of extreme events and increased climate variability, changes in phytosanitary and animal health systems in the front of increased conditions favourable to organisms harmful to crops and plants and animals, as well as the availability of animal and plant genetic heritage, adapted to the new climate conditions, constitute the main critical factors for the adaptation of agriculture to expected climate change.

The action necessary to meet these challenges implies the broad involvement of all sectoral agents according to their nature and responsibilities: agricultural producers and their organisations, the scientific community, civil society organisations and public administration.

This action will be based on a vision that promotes the important role of this sector: safeguarding the capacity of agricultural areas to provide the multiple goods and services that contribute to the sustainable development of the country, reducing vulnerability to climate change.

b) Biodiversity (GT BIODIV)

Biodiversity is the primary support upon which mankind's survival and the global economy rest. Climate change is the latest global threat to biodiversity and potentially one of the most relevant. This new threat acts directly, and sometimes irreversibly, on species and ecosystems and, above all, indirectly, enhancing and aggravating the effects of other threat factors already identified. It is possible to verify that some species and ecosystems demonstrate a capacity for natural adaptation. In contrast, others show negative impacts, namely reducing population numbers and disrupting the supply of services by ecosystems. Thus, climate change, in addition to affecting individual species and the health of ecosystems, also affects the goods and services provided to humans by ecosystems.

While climate change impacts biodiversity, biodiversity and its associated ecosystem services have a recognised role in reducing climate change.

The impacts of climate change are thus a new challenge for nature conservation, including the need to balance the natural adaptation of species and ecosystems with planned adaptation aiming, among others, at objectives such as increasing ecosystem resilience, controlling invasive species and maintaining the economic and environmental value of ecosystems.

c) Economy (industry, tourism and services) (GT ECON)

The industrial sector's importance in the national economy and the vulnerabilities to which it may be subject to the expected/predictable impacts resulting from climate change mean that adaptation measures must be developed to minimise potential damage.

The evolution and consequences of climate change make the industry sector and its sub-sectors one of the most vulnerable, so we believe that concerns should be focused on the supply of raw materials and the geographical location of industrial units/complexes.

On the other hand, at the Commerce and Services sector level, it can be observed that these have assumed growing importance and weight in the national economy and are equally vulnerable to the effects of climate change as they are, in their great majority located in sensitive areas. The location factor may imply restrictions on citizens' access to certain goods and services, so it is important and urgent to safeguard these situations, creating conditions for the implementation of adequate adaptation to the impacts caused by climate change.

The impact of climate change will affect, in particular, countries with a strong economic dependence on the tourism sector, such as Portugal. As an activity subject to strong competition between destinations, it depends on territory and climate as basic "raw materials" for this sector.

Climate change, which is expected to trigger changes such as the loss of biodiversity, coastal erosion and consequent landscape degradation, or even an increase in the incidence of diseases transmitted by specific organisms, is a growing concern for tourism today.

For example, with the increase in the average sea level, "sun and beach" tourism will be strongly affected by the predictable disappearance of beaches, and the scarcity of water could make certain tourist activities that depend on it unviable.

Besides the direct harmful effects that climate change may have on this sector, it should also be ensured that, in the future, they do not compromise its development and economic growth. Therefore, it is necessary to consider strategies that incorporate the most suitable mitigation and adaptation measures as mechanisms to respond to this challenge.

d) Energy and energy security (GT ENERG)

The energy sector is of unavoidable importance, given its structuring nature and systemic interdependence with other sectors of the economy. As such, it is also a determining area to be considered from the perspective of an adaptation strategy, both on the energy supply side and the demand side, given that any vulnerabilities may have a multiplying effect resulting from cascading failures, with repercussions on other sectors of activity and concomitantly on consumers. In this sense, integrated contingency plans are essential, allowing for the depreciation of these failures and consequently the number of consumers affected, especially when the dimension of the impact requires the prioritisation of energy supply to a specific type of consumer (e.g. hospitals, security forces, fire brigades or other critical centres).

Indeed, on the supply side, the energy sector value chains have specific areas of risk and vulnerability, both in terms of fixed infrastructures (related to electricity generation activities, supply of raw materials and production and dispatch of oil products and natural gas) and linear infrastructures (transport and distribution of electricity and transportation of fuels). On the demand side, abnormal increases in energy consumption (e.g. electricity demand for heating and cooling for cold and heat waves) may occur. They will also have to be managed in the context of related adaptation measures.

To mitigate the negative effect of the risks, the companies of the energy sector have been developing measures and actions of climate change adaptation, which are essentially framed in the anticipatory adaptation, i.e., they constitute a planned and anticipated response that avoids and minimises the need for significant investments in the emergency area. Nevertheless, the sector's adaptation effort should continue to be undertaken soon to better adapt to climate change by companies and society in general. It should also be noted that in terms of managing the adaptation plans of the energy sector infrastructures, the interconnection with the adaptation plans of other sectors becomes relevant and conditioning, namely:

a) Management of water resources, in terms of their characterisation, availability and restrictions on use.
b) Management of transport routes and port facilities, in terms of their planning and adaptation.
c) Emergency Management, at the level of emergency and contingency plans.

e) Forestry (GT FLORT)

Forests constitute the basis of a sector of the economy which is a major exporter, with high added value and which generates employment. In addition to their economic importance and as a promoter of social cohesion, forests play essential roles in protecting soil and water, supporting biodiversity and combating desertification. However, climate change's direct and indirect impacts on forest systems may compromise their capacity to provide a wide range of goods and services.

Among the main impacts of climate change is the worsening of the meteorological conditions favourable to the occurrence of fires, increasing the risk associated with this abiotic agent and the increased risks associated with pests and diseases. Less perceptibly and immediately, the change in the geographical distribution of species' ecological niches will potentially translate into the loss of vitality of stands and the productivity of forest stands.

Measures for adaptation of forests to climate change should aim at maintaining the capacity to sustainably provide a broad set of goods and services by reducing the vulnerability of forests and society, reducing risks and increasing their adaptive capacity. Advanced knowledge of climate change, monitoring and assessing its impacts accompanied by action on forest systems aimed at reducing risks and increasing resilience guide forest adaptation measures to climate change.

f) Human Health (GT HEALTH)

With climate change, social and environmental determinants are potentially affected and pose health risks. Examples are the increase in diseases associated with air pollution and aeroallergens, extreme events (floods and droughts), increased frequency and intensity of heatwaves, changes in the distribution and incidence of vector-borne diseases and changes in water availability and quality and harmful infections, among others.

Climate change can lead to significant changes in geographical and seasonal distribution and the spread of vector-borne diseases. These diseases are of great importance and, in mainland Portugal, the most worrying are associated with the *Aedesaegypti* mosquito (especially dengue). *Aedes* species are present in nearby regions - *Aedesaegypti* in the Autonomous Region of Madeira and *Aedesalbopictus in* Spain.

With increasing temperatures, as consequence of climate change, the number of months favourable for developing these vectors is predicted to increase, consequently increasing the risk of diseases transmitted by them.

In this context, it can be said that climate change and the expected effects on the distribution and prevalence of diseases in Portugal may lead to the emergence of new demands on health systems, requiring adaptation work that must be carried out as early as possible to prevent and reduce the extent of the effects on the population.

g) Safety of People and Goods (GT SEGUR)

The climate change scenarios modelled for the national territory impose that an adequate adaptation of the Civil Protection System be articulated by the increased probability of occurrence of extreme meteorological events.

If the projected scenarios occur, there may be an increase in phenomena in which people's safety and property are at stake. Therefore, it is urgent to adopt new approaches to strengthen the interconnection of the measures to be implemented in the scope of disaster risk reduction and climate change adaptation. Two main areas of action should guide adaptation measures to climate change:

a) In emergency planning: focused on the assessment of risks and vulnerabilities for the dissemination and training of the various agents and the population on climate change and its effects; the integration of the component of climate change adaptation in civil protection emergency plans and territorial planning instruments, based on risk mapping, to reduce vulnerability to climate risk; identification of good practices.
b) In emergency response: with the redimensioning of structures with the necessary adaptation of means and resources to cope with the impacts of climate change; training for intervention teams; identification of good practices.

h) Transport and Communication (GT TRANS)

The Working Group Transport and Communication (WG TRANS) aims to meet the need to study, monitor, and propose measures to preserve transport and communication infrastructures and services, whose vulnerability to the impacts of climate change should be a concern within the ENAAC. In this perspective, the WG TRANS in its work program will accommodate explicitly the aspects related to the protection of road, rail, port, airport, and telecommunication infrastructures.

The possibility of an increasingly frequent occurrence of very severe meteorological phenomena which could strike major transport infrastructures continuously or suddenly, sometimes with real

catastrophic effects, constitutes a significant risk to the safety of people and property and the functioning of the economy and society in general.

It is therefore essential to minimise the effects of such impacts using preventive measures that must be identified, prioritised, planned and put into practice, and also using careful planning of emergency actions to enable people and goods transport services and telecommunications, essential for the development of rescue and protection operations, to continue operating in situations of extreme weather events.

i) Sea and Coastal Areas (GT MAR)

On the coast of mainland Portugal, the most important consequences of climate change are the rise in mean sea level and the modification of the regime of sea disturbance, meteorological upheaval, temperature, and precipitation. These changes have an impact on the sediment balance of the coast. They may be translated into the establishment or variation of the intensity of erosion and the modification of the frequency and intensity of coastal flooding, and changes in the water quality of estuaries, lagoons, and coastal aquifers.

The areas of greatest vulnerability in the coastal zone identified with erosion trends or confirmed erosion and a record of coastal overtopping and flooding are those where the impacts of climate change will be most evident. They are therefore of additional concern in places with a high density of human occupation, protected or not by coastal protection/defence structures, with particular relevance to coastal areas whose morphological content is associated with the soft or mobile and low rocky substrate (beaches, dunes, barrier islands, sand barriers, wetlands).

Rising sea levels will favour coastal flooding and will be particularly important where the morphology is low. In the case of riverine wetlands, the influence of flooding will depend on the magnitude of the eustatic forcing and the rate of sediment accumulation and its distribution, which is very variable in time and space, with a site-specific reaction pattern. The future modification of the sea wave regime (5º to 15º offshore rotation) resulting from the forecasts on the climate change scenario (SIAM I) has the potential to increase solid coastal transport at the expense of the variation on the annual distribution of wave heights and direction, with an expected increase on the intensity of erosive processes on specific coastal stretches.

2.4 Coordination and Implementation

A Strategy of this type requires a simple and effective implementation structure to achieve its objectives.

The implementation of the ENAAC 2020 is under the responsibility of:

a) **A Coordination Group (CG)**.
b) **A Scientific Panel (SC).**
c) **APA, who chairs the Coordination Group**

The Interministerial Commission for Air and Climate Change (CIAAC) ensures the political monitoring of the sectoral departments and the regional governments of the Azores and Madeira.

Figure 2 presents the organisational chart and the relations between the different elements of this structure and their relationship with the Groups and Thematic Areas. The competencies of each component are specified below.

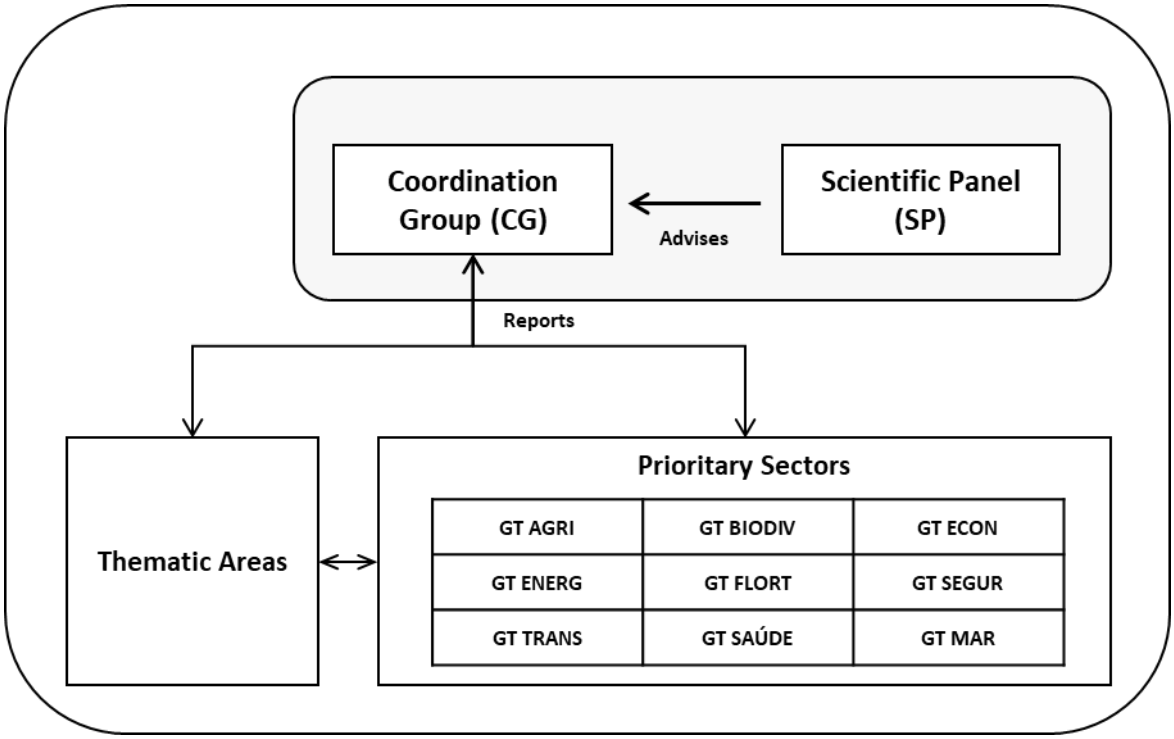

FIGURE 2: ORGANISATION CHART OF ENAAC 2020

2.4.1. Coordination Group (CG)

The ENAAC 2020 Coordination Group is made up of:

a) APA, which chairs;
b) Coordinators of the Thematic Areas;
c) Coordinators of the Sectoral Working Groups;
d) Representatives of the Autonomous Regions of the Azores and Madeira;

e) Representatives of ANMP – National Association of Portuguese Municipalities.

The Coordination Group meets when convened by its Chair whenever deemed necessary to achieve the Strategy's objectives or at the proposal of one or more of its members.

The Coordination Group competencies are:

a) Draw up a general biannual implementation plan based on input from the different Thematic Areas and Sectoral Working Groups, the first of which should be completed two months after the submission of the respective thematic plans.
b) To coordinate the process of monitoring, evaluating and reporting on the work and the degree of success of the Strategy about its objectives.
c) To promote articulation between sectors through discussion and definition of guidelines for the activities of the Thematic Areas and Sectoral Working Groups.
d) Streamline the activities necessary to pursue the Strategy.
e) Prepare proposals for the review of the Strategy.
f) Approve the reports.
g) Propose the constitution of the ENAAC Scientific Panel within a maximum period of six months from the date of designation of the coordinators.

2.4.2. Scientific Panel (SP)

The Scientific Panel supporting the ENAAC 2020 has a minimum composition of 5 elements, appointed for three years, under the proposal of the Coordination Group and designated by order of the member of the Government responsible for the environment. The members of the Scientific Panel shall be scientists with recognised experience in different areas related, among others, to climate change, environment, risk management or public policies. The Scientific Panel shall elect a chairperson from among its members at its first meeting or after changes of more than three members in its composition.

The Scientific Panel will provide opinions that any member may request of the ENAAC Steering Group. The Chairman of the Scientific Panel may attend AG meetings upon invitation by the AG.

The Scientific Panel aims to:

a) Advise and provide scientific support to the work of the different actors involved in the Strategy.
b) Support and give recommendations to the Coordination Group concerning the objectives of the Strategy.

c) Monitor the degree of progress in the implementation of the Strategy, suggesting improvements considered pertinent.

2.4.3. Portuguese Environment Agency (APA)

Within the scope of the ENAAC 2020, APA ensures the general coordination functions of the ENAAC, having as competencies:

a) Coordinate the work of the Strategy, as Chair of the Coordination Group and in coordination with it.
b) Co-coordinate the six Thematic Areas.
c) Secretarial support for the Scientific Panel.
d) Contribute with technical advice and analytical support necessary for the continuation of the ENAAC.
e) Monitor, evaluate and report on the work, according to the commitments made by Portugal and the degree of success of the ENAAC 2020 concerning its objectives.
f) Promote the review of the ENAAC 2020.

2.4.4. Reporting

The Coordination Group is responsible for ensuring the elements for adequate reporting on climate change adaptation to comply with international obligations, namely to the following entities and in the following scopes:

a) United Nations Framework Convention on Climate Change, in the context of National Communications and other reports on international cooperation.
b) European Commission, within the scope of the implementation of the EU Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 (MMR).
c) European Commission, in the framework of the implementation of the EU Strategy for Climate Change Adaptation, and in particular its *Scoreboard*.
d) In the framework of the MMR, European Commission regarding methodologies for climate change support in the various EU funds.

Reporting will be developed through the contributions produced by the various Thematic Areas and Sectoral Working Groups, particularly the Thematic Area dedicated to funding, implementation, and reporting, to meet the various international commitments within the established deadlines.

2.5. Timetable and expected results

Without prejudice to other timelines agreed explicitly by the Strategy framework, Figure 3 presents the overall timeline of the ENAAC 2020, including key deadlines and expected reports.

The reports should contain, among other things:

a) Progress towards each of the objectives of the ENAAC 2020, with a detailed description by thematic area and priority sector, in particular concerning the degree of integration of adaptation into the various public and sectoral policies and the implementation of adaptation measures.

b) Recommendations to remedy difficulties or gaps, and proposal for improvements, given the state of the overall implementation of the ENAAC 2020, based on progress towards the objectives described in the previous paragraph.

The ENAAC 2020 will have three moments for assessing progress and planning the implementation of the strategy at the end of each of the years indicated:

a) **2016**: Progress Report #1.

b) **2018**: Interim Report #2.

c) **2020**: Final and Evaluation Report.

Additionally, and in line with the vision and objectives of the Strategy, the National Adaptation Platform should be operational in the third year after the formal approval of this Strategy, and the formal Review of the ENAAC 2020 should be promoted.

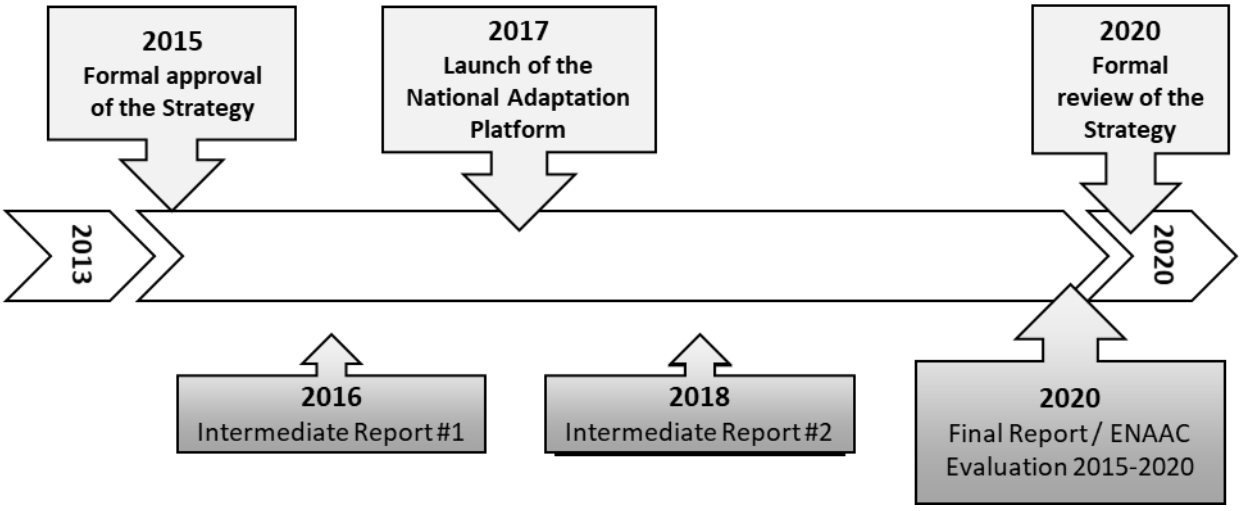

FIGURE 3: OVERALL TIMELINE OF ENAAC 2020 WITH INDICATION OF DEADLINES FOR KEY DELIVERABLES AND PROGRESS REPORTS

PART B. CONCLUSIONS AND PROPOSALS OF THE ENAAC PROGRESS REPORT (RCM NO. 24/2010, 18th OF MARCH)

(Extracted from the report released in September 2013)

2. Review of Phase 1 of the ENAAC

The field of influence and the success of the ENAAC should be evaluated in light of the original ambition and objectives, expressed in the Resolution of the Council of Ministers establishing the ENAAC, that requires, to the various entities involved, adequate exploitation of the existing critical mass, the development of specific skills in this area in different agents of society and promotion and sharing of scientific knowledge on the subjects included therein.

Phase 1 of the ENAAC was marked by its strategic character, i.e., rather than seeking immediate results in terms of long lists of possible adaptation measures, the intention was to introduce this theme in the concerns and analysis matrixes of the various sectors of Portuguese society. The option to return the competence to develop sectoral analysis on adaptation to the various coordinating entities (compared to an alternative scenario where, for example, a long-range scientific study on this matter would be contracted) originated from this concern.

For the same reasons, this model also had some limitations. The fact that scientific support for the development of the work at the coordination level and sometimes also at the sectoral level was less than desirable ended up limiting the depth of analysis that could be carried out in some sectors,

with the quality of the final product being determined by the existing competencies in each sectoral group. Despite this factor (which could be considered *a priori* as limiting), it should be noted that many sectors managed to make remarkable progress in the in-depth identification of impacts and vulnerabilities, knowledge gaps and first lists of adaptation measures. This work base will be fundamental for Phase 2 of the ENAAC.

The result achieved by each sector is summarised in the sector reports (Section II), but attention is drawn to the more detailed technical reports that some sectors have produced, and which are disclosed as annexes to this progress report (see Table 1).

Table 1: List of available detailed sectoral reports

Sectoral Group	Sectoral Reports
Agriculture, Forestry and Fisheries	Strategy for the Adaptation of Agriculture and Forestry to Climate Change Forest Adaptation to Climate Change
Biodiversity	National Strategy for Climate Change Adaptation - Biodiversity Sector
Energy and Industry	ENAAC Energy Sector Adaptation Measures
Spatial Planning and Cities	Analysis of International Climate Change Strategies
Human Health	Climate Change and Human Health - State of the Art
Safety of People and Goods	Climate Change - Ministry of Internal Affairs - Sectoral Group Safety of People and Goods
Water resources	Sectoral Strategy for Climate Change Adaptation - Water Resources
Coastal Zones	

The sector-based model followed (also marked by quite different working methodologies between sectors) suited a "variable geometry" of *stakeholders* and working methods relevant to each case but makes the communication between the work developed across sectors and its comparability a challenge that needs to be better addressed in the future. This model may remain broadly valid in the future but can be improved if some standard benchmarks (e.g., climate scenarios) and analysis and reporting tools are developed.

An aspect to be considered in the future organisation of the work refers to the sharing of information by the various sectoral groups. The use of a document sharing platform may be a solution for the identification and deepening of synergies. The promotion of intersectoral initiatives should also materialise in the next phase.

A summary of the various strengths and weaknesses on which lessons need to be learned and reflected upon before moving on to a second phase is shown in Table 2.

Table 2: Strengths and weaknesses in the implementation of the ENAAC

ENAAC General	
Strengths	Weaknesses
The work carried out was essentially technical and brought together the most relevant knowledge and actors	Weak visibility of the work developed, creating the erroneous perception that the ENAAC is "stalled
Broad set-up of the coordination group, which allows for the confrontation of different perspectives on the same subject	The number of participants and frequency of meetings has not allowed for a detailed discussion Insufficient knowledge and reporting of the activities of each sectoral group to enable potential conflicts between sectors to be identified and resolved Poor representation of the scientific community
The strategy was designed to have the Climate Change Commission ministerial coordination, ensuring follow-up and political support for the initiatives and proposals.	With the approval of the organic law of MAMAOT, the Commission for Climate Change was extinguished, losing this component of coordination and interministerial policy monitoring.
ENAAC Coordination APA	
Strengths	Weaknesses
With the integration of CECAC in APA, an Adaptation and Monitoring Division was created, which allows for a more consistent focus on this policy area	Activities of exclusive competence of the coordination are poorly defined Lack of instruments to support and encourage the development of work at the sectoral level Insufficient human resources allocated to the theme of adaptation
Sectoral Groups	
Strengths	Weaknesses
The primary approach of the ENAAC by activity sector, which allows the identification of the most relevant adaptation measures for each group	Deficient integration between sectors and difficulty in identifying measures that may conflict with each other or that may be leveraged simultaneously for various sectors
Accountability of the entity responsible for the policy area	Varying interest and capacity of each agency to deal with

of each sector by identifying their vulnerabilities	the theme of adaptation, the development of sectoral work is very uneven between sectors Allocation of human resources is generally insufficient for the size of the task. Budgetary difficulties in the various entities do not allow internal deficiencies to be overcome through external contracting
Flexibility in the formation of sector groups, which allows each sector to identify the most relevant stakeholders for its case Broad constitution of most sectoral groups that allows for integration in the analysis of vulnerabilities and the identification of adaptation measures by public and private sector actors and entities operating at the national, regional and local scale	Little openness to the participation of other stakeholders Little visibility of the work developed at the sectoral level (to date)
Sector coverage defined around sectoral competencies of central government agencies allows good adherence between ENAAC sector and responsible entity	High sensitivity to central government restructuring Absence of a group with specific skills in the area of public works and infrastructures Some overlap between more horizontal groups (e.g. water resources or planning) with other more vertical (e.g. agriculture, energy, tourism) Weak representation of local government (municipalities)

3. The Future of the ENAAC: Proposals for Phase 2

The ENAAC should now evolve to promote and help the various sectors, the central, regional, and local administration and policy makers find the means and tools for the transposition from the theoretical to the real plan. Phase 2 will necessarily have to focus on this desideratum.

Therefore, the next phase of the ENAAC will have to build on the strengths and try to address some of the weaknesses identified in the previous section. Thus, the Coordination Group suggests that the review of the ENAAC be done along the following lines:

1. Maintenance of the priority approach by sectoral groups, but with a reassessment of the number and structure of the sectoral groups, namely because of the entities involved,

duplication of competencies between groups, reinforcement of areas currently not or poorly covered (e.g. municipalities, infrastructures), the evolution of the structure of the central administration, alignment with the sectors considered in the European strategy and identification of thematic priorities for the development of the ENAAC.

2. Reinforcement of the interaction between sectors and evolution of a strategy based on vulnerability assessment for more concrete planning of adaptation measures, assessing the possibilities of evolving into a National Plan for Climate Change Adaptation containing consensual and prioritised measures among all sectors.
3. Strengthening the governance structure of the ENAAC, covering in particular:
    a) Greater direct involvement of the Ministries and/or Secretariats of State, to reinforce the support given to the development of ENAAC's work;
    b) Development of some basic tools for all of ENAAC's work, namely:
        i. Systematisation and dissemination of technical and scientific information on climate change, including:
        ii. Monitoring of climate evolution, based on observations; iii. National and regional climate scenarios and the development of national climate change narratives,
        iii. Compilation of national and complementary studies and information sources from platforms such as Climate-Adapt and Infobase.
        iv. Methodological harmonisation for developing models and criteria for classifying and describing adaptation measures.
        v. Use of a sharing platform reserved for members of the coordination group.
    c) Definition of a formal system for collecting and systematising national activities with relevance to climate change adaptation that supports:
        i. The development of national priorities.
        ii. Community and international reporting on this matter (MMR, National Communications, and specific monitoring to be adopted under the Strategy
        European)
        iii. The reporting of the adaptation component of the support given under the National Strategic Framework (2020).
    d) Definition of a financial support system, giving priority to the integration of adaptation objectives in the Partnership Agreement for the 2020 programming cycle of community funds, developing and materialising the provisions of Decree-Law no. 38/2013, of March 15 and Decree-Law 93/2010, of July 27, namely:
        i. to the implementation of adaptation measures on the national territory.
        ii. to research and development projects that seek to fill information gaps on adaptation.
        iii. to international cooperation projects on adaptation.
    e) Strengthening participation and articulation with the Autonomous Regions of the Azores and Madeira:

i. Introduction of legal obligations, including in land management instruments, on adaptation and development of technical guidelines for such duties in areas to be identified in the coordination group.
ii. Extension of the planning horizon of Phase 2 of the ENAAC and its alignment with the fundamental of climate policy for the period 2013-2020.

4. Introduction of legal obligations, including in land management instruments, on adaptation and development of technical guidelines for such duties in areas to be identified in the coordination group.

5. Extension of the planning horizon of Phase 2 of the ENAAC and its alignment with the fundamental of climate policy for the period 2013-2020.

The implementation of a review with the depth described above requires superior approval and, if accepted, a new legal framework, so it is proposed to give the ENAAC Coordination Group a mandate for the preparation of a proposal to be submitted to the respective guardianships by December 31, 2013.

ANNEX I. BODIES COORDINATING THE WORK

Subject area	Coordination
Research and innovation	FCT; APA
Spatial planning	DGT; ANMP; APA
Water resources	APA
Financing, implementation and reporting	APA
International cooperation	Camões; APA
Communication and dissemination	IPMA; APA

Sectoral Group	Coordination
Agriculture	GPP; DGADR
Biodiversity	ICNF
Economy	DGAE
Energy	DGEG
Forests	ICNF
Health	DGS
Safety of People and Goods	ANPC
Transport and Communication	IMT; ANACOM
Sea and Coastal Areas	APA; DGPM

Annex 2

Adaptation to Climate Change Action Programme

Approved by the Resolution of the Council of Ministers nº. 130/2019, of 2nd of August

P-3AC

Programa de Ação para a Adaptação às Alterações Climáticas

Adaptation to Climate Change Action Programme

Approved by the Resolution of the Council of Ministers Nº. 130/2019, of 2nd of August

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P-3AC

Programa de Ação para a Adaptação às Alterações Climáticas

Adaptation to Climate Change Action Programme

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PREFACE

The urgency of climate action has been signalled by society due to scientific evidence confirming that climate change is a present phenomenon caused by greenhouse gas emissions (GHG) resulting from human activity. This trend is likely to worsen if there is no immediate and effective climate action.

The Paris Agreement reached in 2015, established long-term objectives to limit the increase in the global average temperature to a maximum of 2ºC above pre-industrial levels, with a commitment by the international community to continue all efforts so that this increase does not exceed 1.5ºC, values that science defines as maximum to ensure the continuation of life on the planet without too disruptive changes.

The global average temperature has been increasing, with the years 2015 to 2018 recording the highest temperatures ever and reaching circa 1°C above pre-industrial levels. In turn, carbon dioxide concentrations in the atmosphere continue to rise.

In 2018, the Intergovernmental Panel on Climate Change (IPCC) Special Report "Global Warming of 1.5°C" concluded that an increase in the global average temperature of more than 1.5°C will have more severe consequences and sooner than initially expected, calling for urgent reductions in GHG emissions to the atmosphere. In 2019, climate change was identified as the third cause of biodiversity decline and ecosystem collapse.

In the current panorama of escalating challenges associated with climate change, it is urgent to promote the adoption of additional mitigation measures, which combat the causes, and adaptation measures, which minimise the impacts, with a view to a carbon-neutral and climate-resilient society, adapted to its consequences, reducing vulnerability and achieving sustainable development.

The urgency of action is further underlined by several studies indicating that, in the European context, the Southern countries and the Iberian Peninsula present the most significant vulnerabilities and fewest opportunities with climate change. Consequently, the costs of inaction in the face of the impacts of climate change are substantial for Portugal.

Adaptation has been gaining prominence in Portugal due to the development of initiatives in various sectoral areas and territorial scales. Portugal was, in 2010, one of the pioneers at the European level in the adoption of the National Adaptation Strategy, approved by the Resolution of the Council of Ministers no. 24/2010, of April 1, supported by the first studies on this subject in Portugal (SIAM I and SIAM II projects). This strategy was later revised by the Resolution of the Council of Ministers No. 56/2015, of July 30, which approved the National Adaptation Strategy 2020 (ENAAC 2020), which is guided by three main objectives: improve the level of knowledge on climate change; implement adaptation measures and promote the integration of adaptation in sectoral policies.

The AdaPT Programme, supported by the European Economic Area Financial Mechanism, was the pilot programme for adaptation in Portugal and originated structuring projects in the adaptation process, such as ClimAdaPT.Local, which resulted in the elaboration of 27 municipal adaptation strategies, and the Climate Portal. This Program was a driver of good action in climate change adaptation and a significant contribution to raise awareness and increase the ability to assess vulnerabilities and promote awareness and education on this issue.

The current support framework – Portugal 2020, particularly the Operational Programme for Sustainability and Efficient Use of Resources (POSEUR) –, includes several funding opportunities for climate change adaptation, has allowed the continuation of the path initiated by the AdaPT Programme, through support to municipal and inter-municipal adaptation planning, and the implementation of adaptation measures, particularly in the areas of coastal adaptation, water resources, and nature conservation.

The path taken in terms of climate change adaptation allowed to start a cycle more focused on action. From the work carried out, it was possible to identify the principal vulnerabilities and impacts of climate

change in the territory, establish priority adaptation measures to be adopted by the different sectoral areas, and identify the available funding sources.

In this framework, the Environmental Fund supported the implementation of adaptation projects aimed in particular at reducing vulnerabilities to fires and preventing the effects of temperature increases and the formation of urban heat islands, flagship projects for climate change adaptation in the interface between cities and water resources, as well as projects focused on reducing the effects of climate change on the coastline and flood risk prevention.

The Action Programme on Climate Change Adaptation (P-3AC), object of this resolution, aims to achieve the second objective of the ENAAC 2020 – to implement adaptation measures –, essentially identifying the physical interventions with direct impact on the territory. To this end, it establishes the lines of action and priority adaptation measures, identifying the entities involved, the monitoring indicators and potential funding sources.

The nine lines of action established aim to reduce the significant impacts and vulnerabilities of the territory, namely:

a) increased frequency and intensity of rural fires.
b) increased frequency and intensity of heat waves.
c) increased frequency and intensity of periods of drought and water scarcity.
d) increased susceptibility to desertification.
e) increased maximum temperature.
f) increased frequency and intensity of extreme precipitation events.
g) sea-level rise.
h) increased frequency and intensity of extreme phenomena causing coastal overtopping and erosion.

In the implementation horizon of the P-3AC, with short and medium-term objectives for 2020 and 2030, respectively, the intention is to mobilise existing funding instruments and support the definition of transversal and sectorial policies, of future policy and/or funding instruments, to guide the implementation of actions of a more structural nature that contribute to reducing the vulnerability of the territory and the economy to the impacts of climate change, minimising those impacts.

The proposal for the Multiannual Financial Framework for the period 2021-2027, presented by the European Commission, contemplates the increase of the level of ambition regarding the financing of the fight against climate change, having been proposed that at least 25% of the European Union budget should contribute to the achievement of objectives regarding climate action. The P-3AC will necessarily guide the integration of climate change adaptation in sectoral plans and the design of funding programmes, supporting the valorisation of the territory and the construction of a society more adapted to climate change.

The preparation of the P-3AC resulted from an overall process of stakeholder involvement, with comprehensive sectoral coverage and different levels of territorial organization, both public and private. Thus, the intervention priorities included in the P-3AC resulted from the combination of several sources of information produced within the scope of ENAAC 2020, of strategic and programmatic instruments, and municipal and inter-municipal plans and strategies. The P-3AC was also prepared based on the contributions collected under the work of the ENAAC 2020 Coordination Group, having been subject to the opinion of the Scientific Panel supporting ENAAC 2020 and, subsequently, subject to revision after a public consultation that took place from 16 October to 28 November 2018, on the Participa.pt portal.

Thus:

Under the terms of paragraph *g) of* Article 199 of the Constitution, the Council of Ministers resolves:

1. To approve the Action Programme on Climate Change Adaptation (P-3AC), annexed to this resolution and which forms an integral part thereof.
2. To establish that the lines of action and measures to reduce vulnerabilities to climate change contained in the P-3AC constitute the benchmark for national action on climate change adaptation, without

prejudice to the guidelines contained in the National Adaptation Strategy 2020 (ENAAC 2020), and should integrate, among others, the sectoral planning and preparation of funding instruments to be developed under the Multiannual Financial Framework 2021 -2027.

3. To determine that it is the responsibility of the Portuguese Environment Agency (APA, I. P.), in conjunction with the entities that make up the ENAAC 2020 Coordination Group:
   a) To promote the integration of lines of action and measures for climate change adaptation provided for in the P-3AC in sectoral policies and planning.
   b) To contribute to the establishment of a favourable framework for the pursuit of the lines of action and measures foreseen in the P-3AC, promoting their integration in funding instruments, namely those to be developed within the Multiannual Financial Framework 2021-2027, without prejudice to other tools of national, European or international scope and, within this scope, to collaborate in the preparation of calls for applications, whenever requested.
   c) To support the entities that make up the ENAAC 2020 Coordination Group and promote their articulation to ensure the implementation, follow-up and monitoring of the P-3AC.
   d) To prepare an annual monitoring report of the P-3AC, in articulation with reports of monitoring of the ENAAC 2020, when relevant, based on the established indicators and targets, supported by information to be made available annually by the entities responsible for its implementation or funding, establishing, when necessary, the adequate articulation mechanisms.
   e) To prepare proposals to revise the P-3AC, namely in light of the evolution of knowledge, the development of national and European adaptation policies, including the multiannual financial framework, or the evaluation of the progress achieved in the implementation of the P-3AC.
4. Determine that it is the responsibility of the entities that make up the ENAAC 2020 Coordination Group, in conjunction with APA, I. P.:
   a) To promote the integration of the lines of action and measures for climate change adaptation foreseen in the P-3AC in the sectorial policies and planning within the scope of the respective action area, involving the entities identified in the P-3AC.
   b) Contribute to the establishment of a favourable framework for the pursuit of the lines of action and measures foreseen in the P-3AC, identifying sectoral priorities for adaptation, and promoting their integration in funding instruments, namely within the 2021-2027 Multiannual Financial Framework, without prejudice to other instruments of European or international scope, and collaborate in the preparation of calls for applications, whenever requested.
   c) To promote the use of European and national funding instruments to implement the measures foreseen in the P-3AC, encouraging their dissemination among sectorial agents and the public.
   d) Contribute to the preparation of monitoring reports and review proposals of actions, indicators and targets, collaborating in the annual monitoring of the P-3AC, providing relevant sectorial information for indicators and targets, and preparing proposals for articulation mechanisms to be established with third-party entities.
5. Determine that the entities responsible for the financial instruments that provide funding for the measures identified in the P-3AC make information regarding their implementation available to APA, I. P., on an annual basis and by the appropriate indicators, during the 1st quarter of the year following their implementation.
6. To determine that this resolution takes effect on the day following its publication.

Presidency of the Council of Ministers, 6th of June 2019 – The Prime Minister, *António Luís Santos da Costa*

Adaptation to Climate Change Action Programme (P-3AC)

ANNEX referred to in paragraph 1

1. Introduction - why do we need to adapt to the effects of climate change?

The Paris Agreement has changed the paradigm in implementing the United Nations Framework Convention on Climate Change (UNFCCC), with the explicit recognition that only with everyone's contribution can the challenge of climate change be met. The Agreement aims to achieve the decarbonisation of the world's economies. It sets the objective of limiting the global average temperature increase to below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C, recognising that this will significantly reduce the risks and impacts of climate change.

It is essential to note in this regard that the recent special report of the Intergovernmental Panel on Climate Change[18] (IPCC) confirms unequivocally that we already see the negative impacts of climate change, concluding that limiting global warming to 1.5°C requires the unprecedented transformation of societies and urgent and deep emission reductions across all sectors of activity, as well as changes in human behaviour. It also concludes that additional mitigation and adaptation measures are needed to achieve climate-resilient development pathways that can limit climate change while adapting to its consequences, reducing vulnerability and achieving sustainable development. It further notes that implementation of the current commitments of the Parties to the Convention would lead to emissions twice as high as those in line with global warming of 1.5°C and would lead to a warming of about 3°C compared to the pre-industrial level in 2100. Considerable additional efforts by the largest emitters are needed to achieve change. Limiting warming to 1.5°C is possible, but it implies immediate and expanded action across all sectors, with emissions halved by 2030 compared to 2010, reaching zero net CO emissions globally by mid-century.

Even if all global GHG reduction commitments are met, due to the climate inertia mechanism, the consequences of high carbon concentrations in the atmosphere will persist for decades, so the effects of climate change are inevitable, with only the degree to which they are felt varying.

Portugal will contribute internationally to the objectives of the Paris Agreement by committing to reduce greenhouse gas emissions (GHG) so that the balance between these emissions and the removal or capture of GHG from the atmosphere (for example, through forest or agricultural carbon sequestration) is zero in 2050. The primary purpose of the Carbon Neutrality Roadmap 2050, an exercise in progress that proposes to materialise that commitment, is to set targets to achieve carbon neutrality of the Portuguese economy in 2050 and is achieved through alternative trajectories, technically feasible, economically viable and socially accepted, allowing a zero balance between emissions and removals.

In the Paris Agreement, adaptation gains another prominence in the context of the Convention, which considers increasing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change as explicit objectives. To this end, Parties must participate in an adaptation planning process, ensure implementation of actions, and be encouraged to report on their adaptation efforts and/or needs. The Paris Agreement also identifies as an objective to make financial flows consistent with a climate-resilient low-carbon trajectory.

As a result, it is necessary to characterise the exposure of the national territory to climate change and consequently identify its current and future vulnerabilities. This analysis should underpin the definition

[18] Global Warming of 1.5°C - an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

and subsequent implementation of adaptation strategies to minimise and prevent climate impacts and the social, economic and environmental resilience of natural and human systems.

It should also be noted that the identification of impacts and vulnerabilities and the ways to attenuate or mitigate them through adequate policies and instruments are crucial to increase the resilience of communities, as well as of the relevant sectors for the objectives of carbon neutrality, in particular for agriculture and forestry, industry, residential and services, and renewable energies.

Following the precautionary principle, the approach followed for the analysis of impacts and vulnerabilities and the identification and prioritisation of adaptation measures is to consider the probability of not achieving the objectives of the Paris Agreement, and therefore, to assume the most severe scenarios of climate change.

2. Climate scenarios, impacts and vulnerabilities in Portugal

In several studies, Southern Europe and the Iberian Peninsula are highlighted as among the regions in Europe potentially most affected by climate change[19], facing a variety of potential impacts such as increases in the frequency and intensity of droughts, floods, flash floods, heat waves, rural fires, erosion and coastal overtopping.

According to the IPCC, the most severe climate scenarios for Portugal (RCP8.5, IPCC AR5)[20] predict that the temperature increase may reach +5°C in 2100 (applicable to a minimum, average and maximum temperatures), particularly during summer and in the Portuguese interior (see Figure 1). The higher temperatures are reflected in an increase of very hot days (Tmax 35°C), especially in the southern interior, an increase in the number of tropical nights (Tmin 20°C) and longer and more frequent heat waves, especially in the north-eastern interior. Recent emission records are, however, close to the least severe RCP4.5 scenario implying a radiative forcing in 2100 of 4.5 Wm -2 to which will be associated an average temperature increase between 1.1 and 2.6°C (1.8°C on average), meaning that there is a probability of not exceeding 2°C, but without meeting the objective of not exceeding the most ambitious goal assumed in Paris. However, the average temperature increases in this scenario could vary between 2°C and 3°C in Portugal.

[19] EEA, 2017, Climate change, impacts and vulnerability in Europe 2016: European Environment Agency's indicator-based report.

Forzieri, G., Bianchi, A., Marin Herrera, M. A., Batista e Silva, F., Feyen, L., Lavalle, C., European Commission, Joint Research Centre and Institute for the Protection and the Security of the Citizen, 2015, Resilience of large investments and critical infrastructures in Europe to climate change, Publications Office, Luxembourg;

Climate Impacts in Europe. The JRC PESETA II Project. JRC Scientific and Policy Reports, EUR 26586EN; Ciscar JC, Feyen L, Soria A, Lavalle C, Raes F, Perry M, Nemry F, Demirel H, Rozsai M, Dosio A, Donatelli M, Srivastava A, Fumagalli D, Niemeyer S, Shrestha S, Ciaian P, Himics M, Van Doorslaer B, Barrios S, Ibáñez N, Forzieri G, Rojas R, Bianchi A, Dowling P, Camia A, Libertà G, San Miguel J, de Rigo D, Caudullo G, Barredo JI, Paci D, Pycroft J, Saveyn B, Van Regemorter D, Revesz T, Vandyck T, Vrontisi Z, Baranzelli C, Vandecasteele I, Batista e Silva F, Ibarreta D (2014).

Final report of the JRC PESETA III project, EUR 29427 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978 -92-79-97218-8, doi:10.2760/93257, JRC112769: J.C. Ciscar, D. Ibarreta, A. Soria, A. Dosio, A. Toreti,

A. Ceglar, D. Fumagalli, F. Dentener, R. Lecerf, A. Zucchini, L. Panarello, S. Niemeyer, I. Pérez- Domínguez, T. Fellmann, A. Kitous, J. Després, A. Christodoulou, H. Demirel, L. Alfieri, F. Dottori, M. I. Vousdoukas, L. Mentaschi, E. Voukouvalas, C. Cammalleri, P. Barbosa, F. Micale, J. V. Vogt, J. I. Barredo, G. Caudullo, A. Mauri, D. de Rigo, G. Libertà, T. Houston Durrant, T. Artés Vivancos, J. San- Miguel-Ayanz, S.N. Gosling, J. Zaherpour, A. De Roo, B. Bisselink, J. Bernhard, L., Bianchi, M. Rozsai, W. Szewczyk, I. Mongelli and L. Feyen, Climate impacts in Europe:.

[20] *Representative Concentration Pathways* (RCP) or representative concentration trajectories are consistent with a wide range of possible changes in future anthropogenic (i.e. human-caused) greenhouse gas (GHG) emissions and aim to represent their atmospheric concentrations. RCP 2.6 assumes that global GHG emissions (measured in CO2 equivalents) peak between 2010 -2020 and emissions decline substantially after that, implying a radiative forcing in 2100 of 2.6 Wm-2 correspondings to about a 1°C increase in the planet's mean temperature in 2100. Emissions in RCP 4.5 peak around 2040, then decline. In RCP 8.5, emissions continue to increase throughout the 21st century, reaching a radiative forcing of 8.5 Wm-2 and potentially reaching 4°C of average temperature increase in 2100 (*IPCC, 5th Assessment Report*).

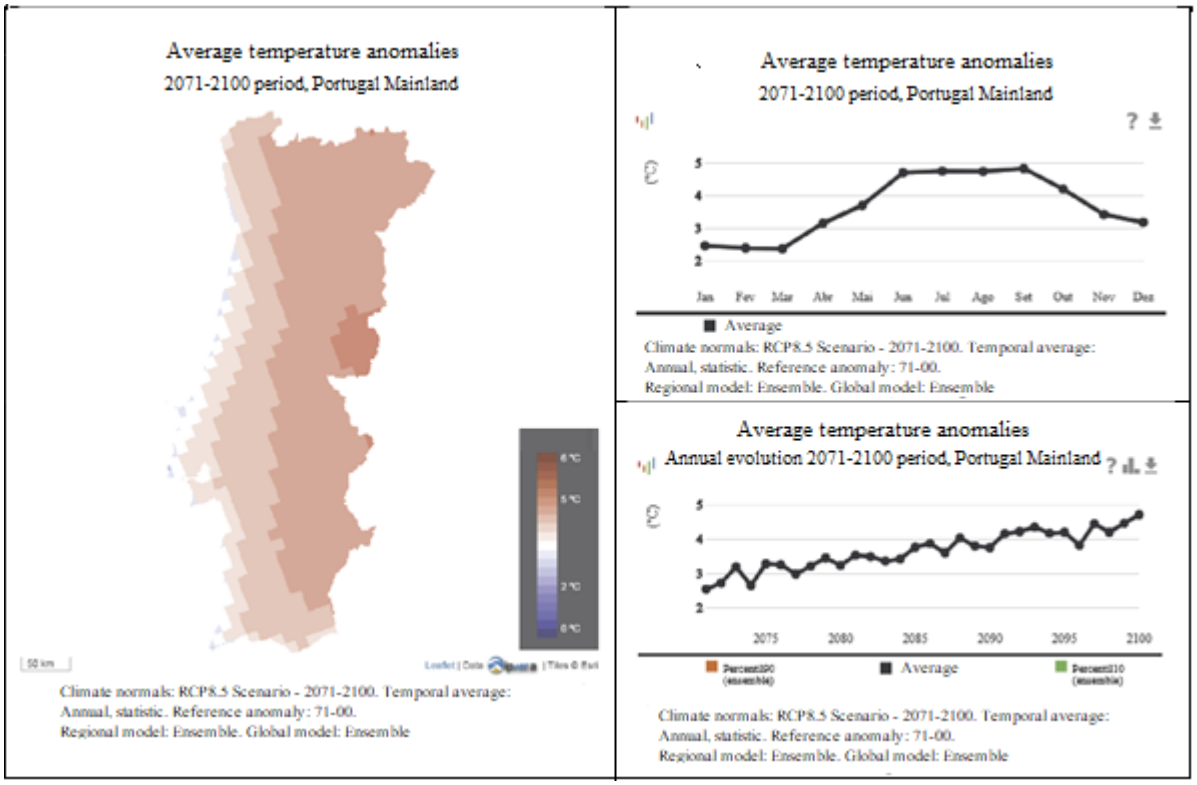

Figure 3 - Average temperature anomalies (reference 1971 -2000) for 2071 -2100, RCP8.5 and the regional and global model ensembles.

Source: http://portaldoclima.pt/http://portaldoclima.pt/http://portaldoclima.pt/.

Although precipitation scenarios are more uncertain, precipitation patterns are also expected to change, with significant reductions in annual values across the territory (Figure 2), with losses of between -10% and -50% by the end of the century in spring, summer and autumn consistent across most climate models for the RCP8.5 scenario (Soares *et al*. 2017[21]). In addition, an increase in the number of extreme precipitation events is projected at the expense of a reduction in days with low to medium/high precipitation (Soares *et al*., 2017[4]). Equivalent conclusions of lower magnitude are obtained for the RCP4.5 scenario (Soares *et al*., 2017[4]). Thus, an increase in the seasonal variability of precipitation and the extension of the dry season from summer to spring and autumn can be expected. Despite the increased probability of prolonged droughts, there will continue to be a high inter-annual variability, an aspect that justifies the possibility of years with more precipitation than 1971-2000 climate normal.

[21] Soares PMM, Cardoso RM, Lima DCA, Miranda PMA (2017) *Future precipitation in Portugal: high-resolution projections using WRF model and EURO-CORDEX multi-model ensembles.* Clim Dyn 49: 2503 -2530. doi: 10.1007/s00382-016-3455-2.

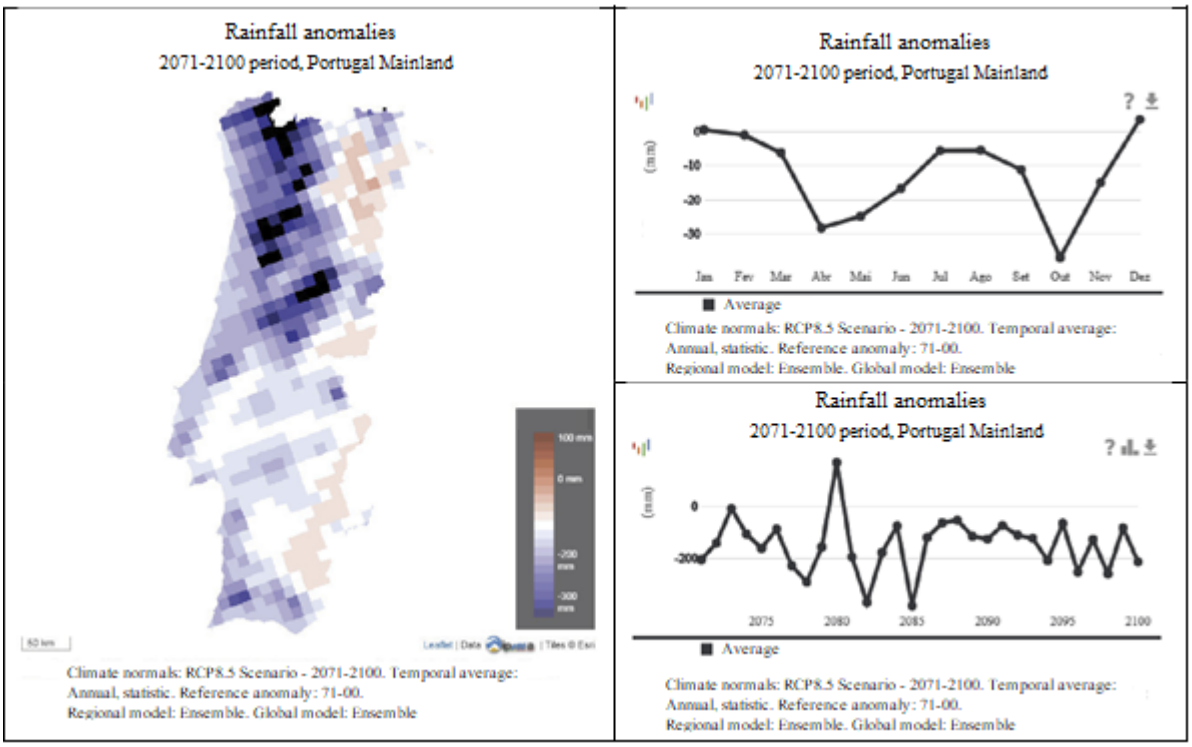

Figure 4 - Rainfall anomalies (reference 1971 -2000) for 2071-2100, RCP8.5 and the regional and global model ensembles.

Source: http://portaldoclima.pt/.

It is essential to highlight that climate change is not a phenomenon with potential future manifestation, as the current climate already presents differences compared to the recent past. The average temperatures recorded since the beginning of the XXI century were always close to or higher than the average 1971-2000 values (State of the Environment Report, 2017). Concerning annual precipitation in continental Portugal, it appears that from the 1980s onward, the magnitude of the negative anomalies about the average precipitation values enormously exceeded the anomalies recorded in the wettest years (Figure 3), indicating a trend of reduction in precipitation predicted by climate models.

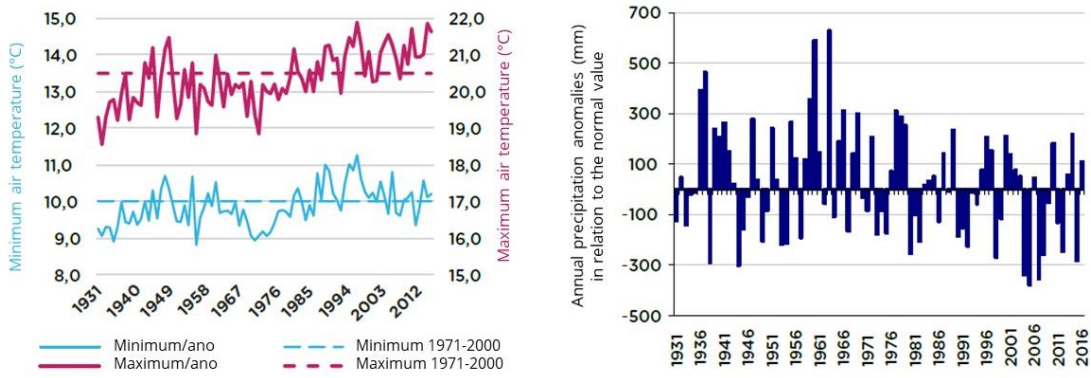

Figure 5 - Anomalies (reference 1971 -2000) of annual minimum and maximum air temperatures (left) and the average amount of yearly precipitation (right) in continental Portugal

Source: IPMA, in State of the Environment Report 2017.

The reduction in annual precipitation, the increase in its variability and the consequent change in the flow regime will reduce river flows, affect the recharge of aquifers, and may even dry out the sources of important rivers in the Iberian Peninsula for longer or shorter periods. These changes may be accompanied by water quality problems, intensification of drought events and increased pressure for desertification, promoting biodiversity loss associated with altered ecosystem structure and dynamics. This reduction in precipitation will also affect the recharge of aquifers, leading to the degradation of the quality of surface and underground water resources. It is noteworthy that these trends have already been observed in recent years, with five drought periods occurring in this century (2004/05; 2008/09; 2011/12; 2014/15; 2016/17), some of which comparable to the most severe that occurred in the twentieth century, the drought of 1944/45 (Figure 4). It should be noted that in 2018, on 31 January, the national territory still showed a moderate lack in 39.9% and severe drought in 55.6% of the total (IPMA, 2018), contributing to the storage status recorded in reservoirs on that date (Figure 5).

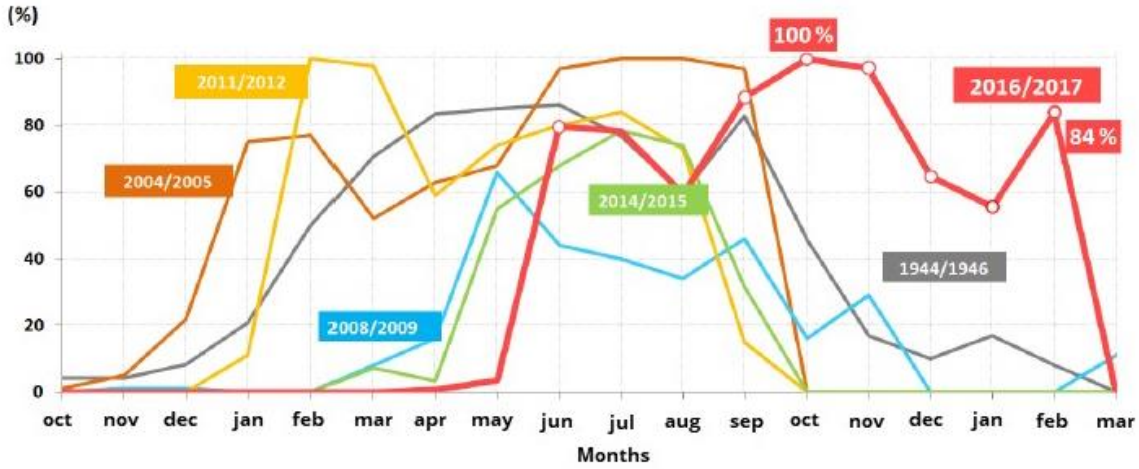

Figure 6 - Monthly evolution of the percentage of the territory in severe and extreme drought, according to the PDSI index classification, for various drought situations (historical: 1944/45; after 2000: 2004/05, 2008/09, 2011/12, 2014/15 and 2016/17)

Source: IPMA, in Report of the Technical Advisory Working Group to the Permanent Commission for the Prevention, Monitoring and Follow-up of the Effects of Drought, December 2017.

Even so, the territory will remain vulnerable to flooding, given the trend towards a more significant contribution to annual precipitation from days of heavy rainfall. In mainland Portugal, significant floods occur in the hydrographic basins of the large and medium rivers (Tagus, Douro and Sado), as other hydrographic basins are more regularised through reservoirs with the capacity to segment or accommodate flood volumes. Additionally, several flash flood episodes have occurred in urban areas due to very concentrated periods of intense rainfall, leading to greater exposure of buildings and infrastructures, a breakdown of social and economic functions, potential human losses, and a higher number of displaced/evacuated people.

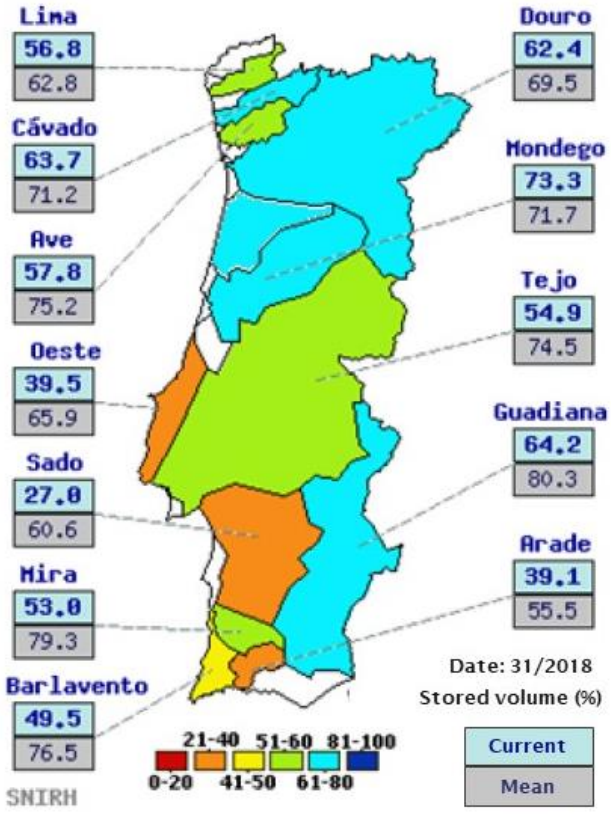

Figure 7 - Storage in reservoirs in mainland Portugal in January 2018

Source: SNIRH.

The new temperature and precipitation regimes associated with climate change bring with them an increase in the number of heat waves, their duration and intensity; an intensification in the number and intensity of major rural fires and extreme, unpredictable, intense, and localized meteorological phenomena, such as torrential rain, hail, cyclones and tornadoes, among others. In addition to the tendency for heat waves to be more intense and frequent or spatially extensive, it is also predicted that there will be a change in their seasonal distribution. Typically, heat waves occur in spring and summer, as shown in the Climate Portal (http://portaldoclima.pt/) for the reference period (1971 -2000); however, this phenomenon is expected to gain equal expressiveness in autumn. The heat wave that occurred in 2003 lasted in some areas of the country for over 2 weeks and was associated with excess mortality of 1,953 deaths, with a particular incidence in individuals aged 75 years or more (DGS, INSA). In 2010, 4 climatological heat waves occurred between 17 May and 11 August, estimating that the excess mortality for periods of intense heat totalled 2 167 deaths (Final Evaluation Report - PCOC 2010). In 2011 five heat waves were registered: one in April, which affected almost the entire mainland, reaching a longer duration in the regions of Mirandela, Montalegre and Nelas. For the period between 23 June and 14 July 2013 (a period that included the two primary heat waves of that year), excess mortality of 1 684 deaths was determined by INSA. In 2017, during a specific period, the Douro River lost almost all its flow in Spanish territory. Along the Tagus River, the flow was reduced to values incompatible with the ecological sustainability of this structuring water line of the national territory. Another consequence of public health of the change in temperature and precipitation regimes is the spread of new vector-borne diseases. This issue has already had evidence with the outbreak of dengue fever that occurred in 2012 in Madeira. Still, it is expected that other episodes of diseases may occur, affecting the population but also animals, through the migration of vectors from lower latitudes.

On the other hand, the risk of pests and plant diseases, or their vectors, may also increase by adapting the climate to their establishment. As a result, there may be an increased risk of pests and diseases in agricultural and forestry systems and aquaculture and the spread of exotic species in marine environments with negative impacts on ecosystems. Thus, it is essential to establish epidemiological surveillance and monitoring activities of disease vectors and agricultural and forestry pests, particularly at the level of their geographical distribution, so that prevention, control and mitigation measures can be implemented and/or strengthened.

The rise in temperature and the prolonged periods of drought are also likely to be responsible for the increase in the number of rural fires, especially the number of Large Forest Fires (GIF) (>= 10 000 ha), which spread by a canopy and may be practically uncontrollable under certain atmospheric conditions. The risk associated with these occurrences has increased dramatically, imposing very high social and economic costs on the country. The year 2017 was notable for recording the largest burnt area since 1995 (Figure 6) and becoming the most tragic year ever, with more than 100 human lives lost.

Drought may also accentuate periods of water stress in plants, particularly in forest stands, increasing secondary pests and diseases in these ecosystems. The meteorological conditions of the summer season and the climatic conditions of the preceding winter and spring explain more than 2/3 of the inter-annual variability of burnt areas in Portugal. In this context, it is essential to note that climate change scenarios predict a significant increase in meteorological conditions conducive to large, burned areas across the Iberian Peninsula, including the entire territory of Portugal (Sousa *et al.,* 2015[22]).

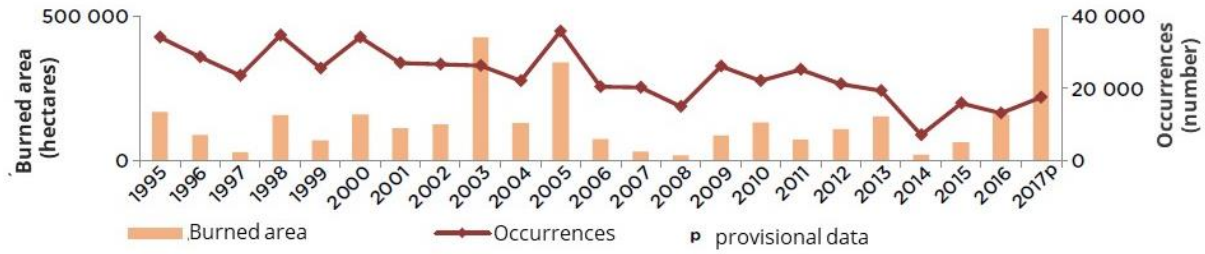

Figure 8 - Rural fires in mainland Portugal: occurrences and burnt area

Source: ICNF, in State of the Environment Report 2017.

Part of the national territory is already threatened by desertification (Figure 7), with soil degradation due to the influence of several factors, including climate variations and human activities. In the climate scenarios of the Climate Portal, the areas susceptible to desertification and erosion increase concerning the present in the west and north inland region.

[22] Sousa P, Trigo RM, Pereira M, Bedia J, Gutierrez JM (2015) *Different approaches to the model future burnt area in the Iberian Peninsula. Agricultural and Forest Meteorology* 202: 11 -25. Doi: 10.1016/j.agrformet.2014.11.018

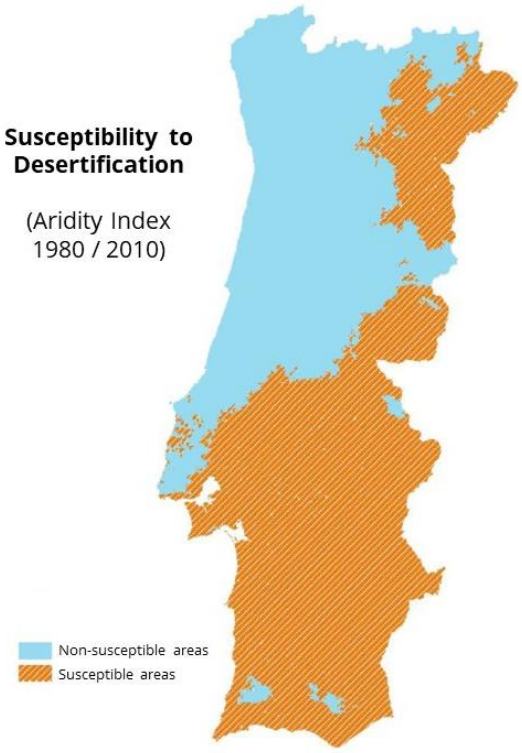

Figure 9 - Susceptibility to Desertification - Aridity Index 1980/2010

Source: ICNF -PANCD 2014 -2020.

The coastline is particularly vulnerable to coastal erosion and coastal overtopping, with very significant and severe effects. This is due to sea-level rise, hourly rotation of the mean wave direction on the west coast and changes in storm surge regime (despite uncertainty about the future evolution on this last point). These factors exacerbate coastal swelling and flooding by allowing waves to break closer to the coast and transfer more energy to the beach (Report of the Coastal Working Group, 2014[23]), in addition to the deficit in river sediment inputs available for coastal drift. The effects of coastal erosion and overtopping are further enhanced by the characteristics of the anthropogenic occupation of the coastal strip of the territory, which substantially increase the risk of socioeconomic costs of climate phenomena. Despite the uncertainty, sea-level rise by the end of the XXI century is expected to be 0.5 m higher, possibly reaching values in the order of 1 m above the 1990 level (Report of the Coastal Working Group, 2014[6]). The winter of 2013/2014 was particularly demonstrative of what may result from this trend. It counted with many storms in the North Atlantic, leading to relevant coastal overtopping throughout the Portuguese coast. Rising sea levels also increase the risk of saline contamination of coastal aquifers, estuaries and final sections of rivers, an aspect that even impacts some water supply systems.

In this way, the main impacts and vulnerabilities of our territory to climate change are listed (some inter-related), which due to their current expression and future worsening trends, are considered to be subject to priority action to reduce or minimize them through adaptation measures:

- Increased frequency and intensity of rural fires.
- Increased frequency and intensity of heat waves.
- Increasing frequency and power of periods of drought and water scarcity.

[23] Available at: http://www.apambiente.pt/_zdata/DESTAQUES/2015/GTL_Relatorio%20Final_20150416.pdf.

- Increased susceptibility to desertification.
- Increase in maximum temperature.
- Increased frequency and intensity of extreme precipitation events.
- Rising sea levels.
- Increased frequency and intensity of extreme events causing coastal swelling and erosion.

3. Progress in the design and implementation of adaptation policies in Portugal

The climate scenarios foresee various pressures on natural and human systems that should be known and studied to prepare and plan effective responses of climate change adaptation. The use of the most severe scenarios allows clear evidence of the vulnerabilities of the country, being confident that in the implementation of adaptation measures, preference should be given to those designated as *no-regrets* (appropriate to the present situation) or *win-win* (present co-benefits and advantages for other policy objectives) adjusted to each case. This concern goes back to work carried out under the National Adaptation Strategy (ENAAC) published by the Resolution of the Council of Ministers No. 24/2010 of 1 April. In this first phase of the ENAAC, the various sectoral working groups identified the respective sectors' principal vulnerabilities and adaptation measures. The results of this work were published in sectoral reports and summarized in the Progress Report published in 2013, available at: http://www.apambiente.pt/index.php?ref=16&subref=81&sub2ref=118&sub3ref=391.

It also resulted from the ENAAC the conceptualization of a funding programme that marked the beginning of the implementation of adaptation actions under the European Economic Area Financial Mechanism (EEA Grants), complemented by the former Portuguese Carbon Fund, currently integrated into the Environmental Fund, to support action on "Climate Change Adaptation" in Portugal, called AdaPT Programme. The programme focused on two main areas of activity:

a) Increase capacity to assess vulnerability to climate change, specifically through the ClimAdaPT.Local project, which was a key initiative to build the ability of municipalities to adapt, developing 27 local adaptation strategies and guidelines to integrate adaptation into municipal planning for use by other municipalities in the country, as well as 5 sectoral pilot projects on water resources, forestry, tourism and biodiversity.
b) Raising awareness and education on climate change, which integrated a project with 30 schools throughout the country, with the general objective of communicating, training and raising the awareness of the school community on how to prevent the effects of climate change and implement adaptation measures, as well as the availability of the Climate Portal, which is a general access platform with functions for the dissemination of climate indicators for specific sectors in Portugal, in historical series and climate scenarios at the regional level.

These projects were completed in 2016/2017.

The ClimAdaPT.Local project has assumed a crucial role in empowering local communities to cope with climate impacts and left a legacy of 27 Municipal Climate Change Adaptation Strategies (EMAAC – Estratégia Municipal de Adaptação às Alterações Climáticas), which identified local vulnerabilities and adaptation options considered appropriate to the territories, several guides, and manuals for the elaboration of EMAAC and guidelines for the integration of adaptation in municipal planning. During the preparation process of the municipal adaptation strategies, many events and activities took place that allowed more than 2000 participants that shared, learned, and debated vital issues to make municipalities more resilient to climate change. It should be noted that municipal action on climate change adaptation was considered a key factor from the beginning of the work of the ENAAC, since many of the vulnerabilities have a high and differentiated territorial expression, therefore the municipalities have an essential role in the practical implementation of vulnerability reduction actions. Additionally, the promotion of inter-municipal climate change adaptation planning enhances resources and allows the articulation of strategies.

The experience gained with the AdaPT Programme served as a reference for the financing of Municipal, Intermunicipal and Regional Plans and Strategies by the Operational Programme for Sustainability and Efficient Use of Resources (POSEUR), in the framework of Portugal 2020, which allowed to expand the territorial coverage with adaptation planning instruments.

In parallel, the experience gained during the first phase of the ENAAC led to its review and the current configuration of the national adaptation policy approved by the Resolution of the Council of Ministers No. 56/2015 of 30 July. This review focused essentially on improving the articulation between areas, particularly those of cross-cutting nature, integration in sectoral policies, and the implementation of adaptation measures. Three main objectives guide the current strategy:

1. **Improving the level of knowledge on climate change** – The basis for the development of the work, focusing on the needs of research, information gathering, consolidation and appropriate communication to the target audience.
2. **Implementing adaptation measures** – It integrates the prioritisation of measures, in harmony with the concerns of science, policy and civil society spheres, through comparative and participatory assessment mechanisms. In addition, the implementation of adaptation measures is supported by the identification of financing mechanisms.
3. **Promote the integration of adaptation into sectoral policies** – Progress on adaptation is geared towards integrating it into sectoral policies, establishing more effective response frameworks. This approach should also rely on appropriate monitoring mechanisms to centralise progress on adaptation policies.

The sectoral working groups and the thematic areas plan and develop their activities at these three levels. In the Biannual Implementation Plans, the Thematic Areas define their priorities for the respective Strategy implementation period, while the sectoral working groups build their competencies, among them the listing of vulnerabilities and adaptation measures of the sector, which in some cases integrate sectoral adaptation plans, giving continuity and updating the work resulting from the first phase of the ENAAC. The monitoring of ENAAC 2020 is mirrored in the Sectoral Progress Reports and Interim Reports, where the progress achieved in each of the objectives is demonstrated.

As a result, other sectoral exercises and policies have been gradually integrating issues associated with climate change impacts and adaptation measures, namely in the following instruments:

- **National Programme for Spatial Planning Policy** *(Programa Nacional da Política de Ordenamento do Território – PNPOT)* (review approved by the Council of Ministers on 14 July 2018), recognizing the fundamental role of spatial planning in minimizing exposure to risk and in the development of a territorial matrix that ensures greater resilience to phenomena arising from climate change, the revised PNPOT identifies climate change as a critical change. It is essential to prospect changes and their impacts and anticipate and mitigate foreseeable effects. Since spatial planning should contribute to increasing adaptive capacity, the Action Programme of the PNPOT identifies as measures the promotion of knowledge on the territorial incidence of natural and anthropic risks and risk management taking into account climate change adaptation.
- **Litoral XXI Action Plan**[24] (*Plano de Ação Litoral XXI*), which is the reference instrument for active management of the coastal zone for a horizon beyond 2020, reflecting the major policy lines and strategic options for the coast, prioritizes the interventions of each stretch of the coast taking into account the global processes arising from climate change. Additionally, the Coastal Zone[25] Programmes (*Programas de Orla Costeira*), as territorial management instruments, establish safeguard regimes of the values to be preserved and, taking into account the risk arising from climate scenarios, identify a set of interventions with territorial incidence to minimise the impacts.
- **National Plan for Integrated Management of Rural Fires** (*Plano Nacional de Gestão Integrada de Fogos Rurais*), which establishes the relationship between climate variability and rural fires, becoming a strategic document in bringing together prevention and firefighting, instituting a cyclical value chain, from planning to continuous improvement, in which one of the main aims is to reduce ignitions and, as a corollary, result in lower emissions of pollutants into the atmosphere, promoting, instead, plant fuel management

[24] https://sniambgeoviewer.apambiente.pt/GeoDocs/geoportaldocs/Litoral/Plano_Acao_Litoral_XXI_2017.pdf.

[25] https://www.apambiente.pt/index.php?ref=16&subref=7&sub2ref=10&sub3ref=1193.

practices that are more compatible with national commitments to GHG emissions. This Plan also aims to harmonise sectoral public policies.

- **National Forestry Strategy**[26] (*Estratégia Nacional para as Florestas*) and **Regional Forestry Management Plans** (*Planos Regionais de Ordenamento Florestal - PROF*), which integrate the critical challenges that climate change raises for the forestry sector, highlighting as critical impacts the worsening of risks associated with harmful biotic agents and forest fires, also contributing to the conditioning of the productivity of stands, and identifying the general lines for increasing the resilience of the sector to these impacts.
- **National Strategy for Nature Conservation and Biodiversity 2030**[27] (*Estratégia Nacional de Conservação da Natureza e Biodiversidade 2030*), which considers the impacts of climate change as one of the main factors of pressure on ecosystems and, in this sense, a threat to biodiversity, both because of what it may represent in terms of loss of habitat and by creating conditions for non-native species to find in the country conditions for their development, creating imbalances in natural systems and, for these reasons, establishes its own targets for action.
- **National Strategy for a Preventive Civil Protection**[28] (*Estratégia Nacional para uma Proteção Civil Preventiva*), highlights the importance of promoting the integration of climate change adaptation in the mechanisms and strategies aimed at the safety of people and property and integrates climate risks in all strategic objectives.
- **National Strategy for the Sea 2013 -2020** (*Estratégia Nacional para o Mar* 2013 -2020 – ENM) highlights the role of climate regulator that the ocean plays on a global scale, where the importance of climate change in the evolution of the marine environment is highlighted, with direct implications for coastal communities and the blue bioeconomy.

It must also be referred the work and respective reports developed within the scope of the Permanent Commission for the Prevention, Monitoring and Accompaniment of the Effects of Drought[29] (*Comissão Permanente de Prevenção, Monitorização e Acompanhamento dos Efeitos da Seca*) whose competencies include the definition of political guidelines within the scope of the adverse climatic phenomenon of drought, as well as the approval and monitoring of the implementation of the plan associated with this issue.

Reference should also be made to the climate change adaptation measures framed within the National Irrigation Programme (*Programa Nacional de Regadios*) to promote irrigation from a perspective of sustainability and efficiency of water resources and combat desertification[30]. This programme provides for interventions in hydro-agricultural facilities aimed at the rehabilitation and modernisation of existing irrigation schemes, contributing to water consumption efficiency in the agricultural sector, thus constituting an adaptation measure.

Also worthy of mention was the approval in October 2017 of a preliminary report concerning the communications sector, with a diagnosis of the situation observed in multiple visits to locations affected by forest fires and with several recommendations based, for the most part, on best practices in other countries and international studies. As a result, it was decided to create a Working Group, coordinated by the National Communications Authority (*ANACOM - Autoridade Nacional de Comunicações*) and with a broad range of public and private entities, with the mandate of carrying out a more in-depth study of the situation and identifying the measures required to improve the protection and resilience of electronic

[26] Resolution of the Council of Ministers No. 6 -B/2015, of 4 February. http://pnpot.dgterritorio.pt/.

[27] Resolution of the Council of Ministers No. 55/2018, of 7 May.

[28] Resolution of Council of Ministers No. 160/2017, of 30 October.

[29] Resolution of the Council of Ministers No. 80/2017, of 7 June.

[30] Resolution of the Council of Ministers no. 133/2018, of 12 October.

communications infrastructures. The Report[31] prepared by the Working Group, which was publicly presented in May 2018, offers a set of 27 measures.

From all the information produced within the scope of the ENAAC and the strategic and programmatic instruments referred to, as well as from work developed within the scope of the EMAAC and the Municipal and Intermunicipal Plans and Strategies concluded or in preparation, the national adaptation action priorities considered in this programme stand out.

[31] https://www.anacom.pt/render.jsp?contentId=1436120.

4. Financial support for Adaptation in the period 2014-2020

The costs of inaction in the face of the impacts of climate change in our country are very high. As a reference of values associated with climatic events, some estimates point to 60-140 million euros of annual costs associated with rural fires (not counting the recent tragic fires of 2017). The 2005 drought had estimated costs of around 290 million euros, and the 2012 drought caused losses mainly in terms of agricultural production losses, with estimated costs of over 200 million euros[32]. To these are added expenses related to the intense storms that have been experienced in recent years, as was the case of the storm Hercules that struck the country in 2014 and produced damage throughout the coastline. According to preliminary estimates made by APA, the costs associated with the effects of storm Hercules could amount to around €17 million and the expenses related to the March 2018 storms on the Portuguese coast are estimated at approximately €1.4 million.

According to several studies, the southern European countries are the ones that present the most significant vulnerabilities and least opportunities with climate change when compared to the other sub-regions of the European continent. The PESETA II project, which aims to increase knowledge on regional and sectoral patterns of climate change in Europe until the end of the century, coordinated by the Joint Research Centre (2014)[33], effectively concludes that the economic losses associated with climate change impacts present a very asymmetric geographical distribution, with a clear bias towards the southern regions of Europe. As an example, in a scenario where the average temperature rises by 2°C by the end of the century (i.e. in line with meeting the Paris goals), the study concludes that welfare losses in terms of GDP range from 0.2% in the Northern European region to 3% for Southern Europe for the last third of this century.

Specifically for Portugal, the latest European Environment Agency report on impacts, vulnerability, and adaptation in Europe[34] indicates for Portugal a value of 6.7 billion euros of accumulated economic losses in the period 1980-2013 resulting from extreme climate events, according to the survey carried out by reinsurer Munich RE (NatCat Service).

Consequently, to avoid these costs and losses where possible, it is necessary to implement the adaptation measures identified in the various sectoral and territorial exercises and ensure adequate funding as a priority for actions of an infrastructural nature.

Funding for the implementation of adaptation measures in Portugal in the integrated and identified form for this purpose had its beginning marked by the AdaPT Programme (2013-2017), described in the previous chapter.

Currently, the leading financial instruments available for the implementation of adaptation measures are part of the EU support framework Portugal 2020 and are particularly relevant:

- **Operational Programme for Sustainability and Efficient Use of Resources** (*Programa Operacional Sustentabilidade e Eficiência no Uso de Recursos – POSEUR*), with an intervention axis dedicated to promoting climate change adaptation and risk prevention and management, which includes:
    a) Investment support for climate change adaptation, including ecosystem-based approaches through the adoption and articulation of cross-cutting, sectoral, and territorial measures.
    b) The protection of the coast and its populations against risks, especially coastal erosion.
    c) Strengthening risk management from a resilience perspective, including preventive and fire-fighting measures.

[32] Information based on the Commission's work for the Prevention, Monitoring and Follow-up of the Effects of Drought and Climate Change, created under RCM No. 37/2012.

[33] Available at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=7181.

[34] Available at: https://www.eea.europa.eu/publications/climate -change-impacts-and-vulnerability-2016.

It is complemented with actions contributing to climate monitoring and extreme weather events, supporting adaptation actions integrated into another axis dedicated to the environment and resource efficiency regarding the water and biodiversity and ecosystems sectors.

- **Rural Development Programme 2020** (*Programa de Desenvolvimento Rural* - PDR 2020), which includes an area dedicated to the environment, efficiency in the use of resources and climate, and provides support for actions devoted to soil conservation, efficient use of water, modernisation of irrigation, as well as protection and rehabilitation of forest stands.
- **Regional Operational Programmes**, which although they have not included adaptation as a priority area because the programmatic option of Portugal 2020 was to concentrate this field in the POSEUR, finance actions that contribute to reducing climate vulnerabilities and increasing resilience, as is, for example, the case of the use of green infrastructure and drainage actions and minimization of floods and flood risks.

There are other specific funding instruments managed at the Community level, which provide concrete support for adaptation:

- **LIFE Programme (2014 -2020)**, which includes a sub-programme dedicated to climate action that foresees climate change adaptation as one of the three priority areas, and is further complemented by specific financial instruments such as the *Natural Capital Financing Facility* (NCFF) - financing the investment and initial running costs of revenue-generating or cost-reducing pilot projects promoting the conservation, restoration, management and enhancement of natural capital and climate change adaptation.
- **INTERREG Programme**, a European mechanism of territorial cooperation that integrates as thematic objectives the fight against climate change and the environment and the efficient use of resources, framing the possibilities for financing adaptation projects in the various sub-programmes with application in Portugal (Mediterranean; POCTEP - Spain - Portugal; SUDOE; Atlantic; MAC 2014 -2020 - Madeira/Azores/Canarias; Europe).
- **Horizon 2020** - the European Framework Programme for Research and Technological Development (RTD), which covers the period 2014 -2020 and centralises research support at the European level for various areas, integrating climate action, the environment and resource and raw resources material efficiency into one societal challenge.
- **URBACT III Programme (2014 -2020)**, a European programme for territorial cooperation, collective learning and exchange of experience around the promotion of sustainable and integrated urban development, and which includes climate change adaptation as one of the topics for exchange of good practices between municipalities in the Member States.

Additionally, there are also crucial national funding sources that support adaptation and complement the EU instruments, with emphasis on:

- **Environmental Fund**[35] (*Fundo Ambiental*) aims to support environmental policies to pursue sustainable development objectives, contributing to the achievement of national and international goals and commitments, including those relating to climate change.
- **Permanent Forest Fund**[36] (*Fundo Florestal Permanente*) is intended to support sustainable forest management in its various aspects and is a relevant financial instrument for the achievement of the objectives of the National Forestry Strategy and other sectoral policy measures, including actions to prevent forest fires and the establishment of stands of interest in combating desertification and adapting to climate change.

[35] Created by Decree-Law no. 42 -A/2016, of 12 August.

[36] Created by Decree-Law no. 63/2004, of 22 March.

The following table systematises, in a non-exhaustive way, the main components of public support that has been directly or indirectly provided to actions contributing to climate change adaptation so far in the current programming framework[37]:

Table 1 – Public earmarked expenditure, as of the end of September 2018, including EU funding and national component

Financial Instrument	Typology of Actions related to Climate Change Adaptation	Amount (M€)
AdaPT Programme (EEA Grants)	Capacity building, awareness raising and demonstration	3,5
Rural Development Programme 2020 (PDR 2020)[38]	Actions to prevent rural fires	98,68
	Measures to support the conservation and improvement of soil fertility	150,17
	Implementation of good water management practices in agriculture	111,27
	Nature Conservation Actions	117,24
	Actions to prevent agricultural and forestry diseases and pests	46,65
	Measures to reduce or minimise the risks associated with floods and flooding in agricultural areas	16,18
Sustainability and Resource Efficiency Operational Programme (POSEUR)	Nature Conservation Actions	6,53
	Actions to Combat Coastal Erosion	104,18
	Flood Prevention and Risk Management	77,73
	Innovative actions for risk prevention and management	3,05
	Planning actions and tools to support Climate Change Adaptation	15,65
	Planning, monitoring, and reporting tools	1,20
Environmental Fund	Territorial Climate Change Adaptation - municipal and inter-municipal projects: heat waves and rural fires	1,70
	Territorial Climate Change Adaptation - municipal and inter-municipal projects: water resources	3,36
	Support to minimize the effects of drought 2016/17	0,80
	Protection of Water Resources	4,40
TOTAL		762,29

[37] It does not include amounts spent by the Permanent Forest Fund, as they mostly concern support to immaterial actions and are difficult to reconcile with concrete adaptation objectives.

[38] As there is insufficient detailed information to identify the components related to adaptation in each type of operation, a weighting methodology of the eligibility criteria present in the respective notices was used.

It should be noted that work is underway to prepare the future multiannual financial framework of the European Union, both at the European and national levels.

In this sense, the P-3AC can contribute to the identification of financial programming needs regarding adaptation, which should be detailed and deepen within the scope of the inter-institutional articulation with a view to integration in the various funding programmes for the post-2020 period.

5. Operationalization of the Adaptation to Climate Change Action Programme (P-3AC)

5.1 Objectives and structure

The policy of climate change adaptation in Portugal is in a state of maturity that allows identifying priorities regarding the key instruments of decision support and the implementation of direct intervention actions in the territory and infrastructures. It is essential to provide resources for these responses to be implemented, thus contributing to implementing the various adaptation plans and strategies.

The P-3AC aims to achieve the 2nd ENAAC objective - Implement adaptation measures - particularly at the level of physical interventions with direct impact on the territory.

In this context, the actions identified are those of priority implementation, in light of current knowledge and the status of the various sectorial exercises, to reduce the main vulnerabilities of the national territory, increasing its resilience and contributing to the well-being of the population, particularly of the most vulnerable groups.

By identifying the principal vulnerabilities and corresponding priority areas of intervention, this Programme aims to be a guiding guide to:

- In the short term (up to 2020), mobilise funding instruments, notably those referred to in the previous chapter.
- In the medium term (up to 2030), support policy definition exercises, policy and/or funding instruments, to guide the implementation of actions of a more structural nature that contribute to reducing the vulnerability of the territory and the economy to the impacts of climate change, minimising these impacts.

Actions of transversal nature are also contemplated, namely those identified under the work of the ENAAC Thematic Areas, which indirectly contribute to the reduction of territorial vulnerabilities to climate change and promote the resilience of sectors and populations. Although these do not assume a territorial intervention character, they have a structuring and supporting role to the remaining actions, requiring appropriate funding.

Each Line of Action is duly described in an individual sheet (Annex I) with the detailed elements for its implementation, the executing or beneficiary entities, the possible funding instruments in the current framework and the respective monitoring indicators and goals.

5.2 Courses of action and measures to address impacts and vulnerabilities

This Programme complements and systematizes the work carried out in the context of the ENAAC 2020 with a view to the second objective - to implement adaptation measures, grouped into 8 concrete lines of action of direct intervention in the territory and infrastructures, complemented by a transversal line of action) which aim to respond to the significant impacts and vulnerabilities identified for Portugal (Table 3):

1. Prevention of rural fires - structuring interventions in agricultural and forestry areas.
2. Implementation of soil conservation and fertility improvement techniques.
3. Implementation of good water management practices in agriculture, industry, and the urban sector to prevent impacts from drought and scarcity phenomena.
4. Increasing the resilience of ecosystems, species, and habitats to the effects of climate change.
5. Reducing the vulnerability of urban areas to heat waves and rising maximum temperatures.
6. Preventing the establishment and spread of invasive alien species, vector-borne diseases and agricultural and forestry diseases and pests.
7. Reduction or minimisation of risks associated with flooding phenomena.
8. Increasing resilience and coastal protection in areas at high risk from coastal erosion, overtopping and flooding.
9. Development of decision support tools, capacity building and awareness-raising actions.

In each line of action, the actions/measures and possible funding lines are identified. These lines of action result from the various planning exercises on climate change adaptation developed at different territorial and sectoral scales.

5.3 Financing

As of September 30, 2018, the available budget in the various current financial instruments were systematized for this Program, which can be mobilized for the identified actions, through the opening of specific calls for applications for this purpose or that not contributing to the same objectives. In this context, it was found to be possible to mobilize about 372 M€ for the implementation of adaptation measures.

In the case of the Community instruments, of a multiannual nature, the appropriations correspond to what was entered in the financial reprogramming of Portugal 2020 and communicated as such to the European Commission.

The following table identifies the funding instruments of national scope and the budgeted amounts allocated to the lines of action for climate change adaptation in 2020. Additionally, in the medium term, this Programme will benefit from the funding lines that may be defined in the future multi-annual financial framework, which is currently under negotiation at the European Union level.

Table 2 – Public expenditure available for allocation to adaptation actions, for the 2020[39] horizon, including EU funding and national component (M€), as of 30 September 2018

	Line of action	POSEUR *	PDR 2020	EEA Grants	Environmental Fund	TOTAL
1	Prevention of rural fires - structuring interventions in agricultural and forestry areas	6,7	121,7		0,1	128,5
2	Implementation of soil conservation and fertility improvement techniques		1,4			1,4
3	Implementation of good water management practices in agriculture, industry, and the urban sector to prevent the impacts of droughts and shortages	100,0	21,4		3,0	124,4
4	Increasing the resilience of ecosystems, species, and habitats to the effects of climate change	4,7	24,3		1,0	30,0
5	Reducing the vulnerability of urban areas to heat waves and rising maximum temperatures	1,9			2,5	4,4
6	Preventing the establishment and spread of invasive alien species, vector-borne diseases and agricultural and forestry diseases and pests	0,6	20,5			21,1
7	Reduction or minimisation of risks associated with flooding phenomena		2,0	2,6	5,2	9,8
8	Increasing resilience and coastal protection in areas at high risk from coastal erosion, overtopping and flooding	46,7				46,7
9	Development of decision support tools, capacity building and awareness raising actions			3,1	2,2	5,4
TOTAL		160,6	191,3	5,8	14,0	371,7

It should be noted that due to the reprogramming of POSEUR and the tenders that have since been completed, in addition to the fact that the closing date of the programmes is approaching, the amount currently available to support new projects in POSEUR is less than estimated at the time. There is a high implementation rate, with the axis "Promoting climate change adaptation and risk prevention and management" standing out, with an implementation rate of 85%.

[39] As of the end of September 2018.

Table 3 – Lines of action that integrate this Program and its respective focus in terms of impacts and vulnerabilities

	LINES OF ACTION	IMPACTS AND VULNERABILITIES							
		Increase in the frequency and intensity of rural fires.	Increased frequency and intensity of heat waves.	Increased frequency and intensity of periods of drought and water scarcity	Increased susceptibility to desertification	Increase in the maximum temperature	Increased frequency and intensity of extreme precipitation events.	Rising sea levels	Increased frequency and intensity of extreme events causing coastal erosion and coastal overtopping.
1	Prevention of rural fires - structuring interventions in agricultural and forestry areas	■	■	■	■	■			
2	Implementation of soil conservation and fertility improvement techniques	■		■	■		■		
3	Implementation of good water management practices in agriculture, industry, and the urban sector to prevent the impacts of drought and scarcity phenomena		■	■	■	■			
4	Increasing the resilience of ecosystems, species and habitats to the effects of climate change	■	■	■	■	■			
5	Reducing the vulnerability of urban areas to heat waves and rising maximum temperatures		■	■		■			
6	Prevention of the establishment and spread of invasive alien species of vector-borne diseases and agricultural and forestry diseases and pests		■	■		■			
7	Reduction or minimisation of risks associated with flooding phenomena						■		
8	Increasing resilience and coastal protection in areas at high risk from erosion, saltwater surge and flooding						■	■	■
9	Development of decision support tools, capacity building and awareness-raising actions	■	■	■	■	■	■	■	■

5.4 Implementation, follow-up and monitoring of the P-3AC

The implementation and monitoring of the P-3AC is the responsibility of APA, as the coordinating entity of the ENAAC 2020 and of the other entities that make up the ENAAC 2020 Coordination Group.

The monitoring indicators of the proposed actions (achievement indicators) are intended to measure their implementation. They derive from the monitoring framework of the financial instruments and their respective targets, which frame the support to the Lines of Action identified herein. For 2020 the targets were defined based on the current availability of each financial instrument. For 2030 the targets are indicative and were set based on the variation compared to 2020, serving as a reference for the funding framework applicable after 2020 and referring to overall amounts for each line of action and not applicable to each financial instrument in particular.

The results indicators associated with the identified materialise objectives of the adaptation process primarily derive from current sectoral planning instruments and intend to measure the programme's contribution, directly or indirectly, within the different areas of intervention (Annex II). The targets for 2020 are those existing in the various exercises, and for 2030 were established based on developments with an appropriate degree of ambition or by reference to existing planning instruments.

In this framework, it is APA's responsibility, in conjunction with the entities that make up the ENAAC Coordination Group:

a) To promote the integration of lines of action and measures for climate change adaptation provided for in the P-3AC in sectoral policies and planning.

b) To contribute to establishing a favourable framework for the pursuit of the lines of action and measures foreseen in the P-3AC, promoting their integration in funding instruments, namely those to be developed within the 2021-2027 multi-annual financial framework, without prejudice to others of national, European or international scope and, within this scope, to collaborate in the preparation of calls for applications, whenever requested.

c) To support the entities that make up the ENAAC 2020 Coordination Group and promote their articulation to ensure the implementation, follow-up and monitoring of the P-3AC.

d) To prepare an annual monitoring report on the P-3AC, in articulation with Monitoring Report of the ENAAC 2020, when relevant, based on the established indicators and targets, supported by information to be made available annually by the entities responsible for its implementation or funding, establishing, when necessary, the adequate articulation mechanisms.

e) To prepare proposals to revise the P-3AC, namely in light of the evolution of knowledge, of the evolution of the national and European adaptation policy, including the multiannual financial framework, or of the result of the evaluation of the progress achieved in the implementation of the P-3AC.

It is the responsibility of the entities that make up the ENAAC 2020 Coordination Group, in coordination with the APA:

a) Promote the integration of lines of action and measures for climate change adaptation.

b) In this context, it is essential to take into account the policies and sectorial planning foreseen in the P-3AC in the scope of the respective area of action, involving the entities identified in the P-3AC.

c) Contribute to establishing a favourable framework for the pursuit of the lines of action and measures foreseen in the P-3AC, identifying sectoral priorities for adaptation and promoting their integration in funding instruments, namely within the 2021-2027 multi-annual financial framework, without prejudice to others of European or international scope, and collaborate in the preparation of calls for applications, whenever requested.

d) To promote the use of European and national funding instruments to implement the measures foreseen in the P-3AC, encouraging their dissemination among sectorial agents and the public.

e) To contribute to the monitoring reports and the proposals for revision of actions, indicators and targets, and to collaborate in the annual monitoring of the P-3AC, providing relevant sectorial information for indicators and targets and in the elaboration of proposals for articulation mechanisms be established with third-party entities.

It is also the responsibility of the entities responsible for the financial instruments that frame the financing of the measures identified in the P-3AC, namely the national authorities responsible for the management of the financial instruments, to make information available to the APA on the implementation of those measures on an annual basis, by the appropriate indicators, during the first quarter of the year following their implementation.

Final note: At the end of the document (Annex III), a glossary is presented with definitions from the IPCC reports supporting the various references made throughout the text.

Annex I – Lines of action and measures

Line of Action #1 - Rural fire prevention - structural interventions in agricultural and forestry areas

Main objectives:

- Reducing biomass fuel
- Reducing the speed at which fires spread
- Increasing the forest's resilience to fire
- Ensuring the safety of people and property

Sectors covered (ENAAC 2020):

- Agriculture
- Energy and energy security
- Forests
- Safety of people and goods
- Transport and communications

Measures/concretization:

- Introduction of discontinuity bands or patches by:
  - (re)afforestation with other forest species resistant to the risk of fire
  - control of excessive densities of natural regeneration after fire
  - introduction of agricultural mosaic
  - creation of areas for grazing and use of goats to control spontaneous vegetation
- Clearance operations in areas adjacent to road/rail structures and buildings
- Economic valorisation of biomass through the installation of Intermunicipal Systems for the collection and interim storage of biomass left over from forestry and agricultural activities in rural areas
- Conversion and reconfiguration of linear electricity transmission and distribution structures that cross-forest areas (e.g. burying cables; changing routes)
- Reconversion and reconfiguration of telecommunications networks in forest areas[40]
- Installation and reconfiguration of warning, cut-off and traffic diversion systems
- Installation of communication/information systems, including surveillance and warning systems for local populations and appropriate signage

Executing/beneficiary entities:

- Local government bodies and their associations[41]
- Entities of the Central and Regional Public Administration
- Transport infrastructure managing entities
- Management entities of wastelands, of ZIF, EGF and FMU
- Producers' associations
- Individual owners/entrepreneurs
- Entities holding infrastructures[42]

  Electronic communications companies
- Energy transmission and distribution companies
- Scientific and academic institutions

Output indicators:

- Intervention area (by category)
- km of network intervened

Associated impacts and vulnerabilities:

- Increase in the frequency and intensity of rural fires
- Increased frequency and intensity of heat waves
- Increased frequency and intensity of periods of drought and water scarcity
- Increased susceptibility to desertification
- Increase in maximum temperature

[40] See Report of the Forest Fires Working Group created at ANACOM's initiative, available at https://www.anacom.pt/render.jsp?contentId=1436120. 24

[41] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b*) Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[42] See Decree-Law No 123/2009, 21 May 2009, available at https://www.anacom.pt/render.jsp?contentId=952960.

• Amounts paid/share (€) Goals: • 2020: make an additional EUR 129 million of public investment (PDR 2020: EUR 122 million; POSEUR: EUR 7 million; other funds: EUR 0.1 million) • 2030: The amounts to be allocated to this area will be reinforced in line with the guidance arising from the framework of the priorities already defined for the Policy Objective of A greener and low-carbon Europe, including climate change adaptation.	Funding instruments[43]: • Environmental Fund • PDR 2020 • Permanent Forest Fund • POSEUR

[43] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to foresee future use for Portugal in terms of adaptation.

Line of Action #2 - Implementation of soil conservation and fertility improvement techniques

Main objectives:

- Minimising soil erosion
- Increase the levels of organic matter in the soil
- Improve the soil's water retention capacity
- Reduce runoff from extreme rainfall events
- Increasing biodiversity in soils
- To decrease the vulnerability of ecosystems, species, and habitats to the effects of climate change
- Increase the resilience of ecosystems in susceptible areas: i) in the headwaters of hydrographic basins; ii) on slopes that are steeper and more prone to erosion, and iii) around torrential water courses and water lines
- Recovering areas of degraded soils and vegetation, with priority in the areas most susceptible to desertification, namely: i) areas affected by rural fires, including forest fires; ii) eroded, salted, and other degraded areas; iii) areas affected by invasive exotic woody species; iv) areas with soils degraded by over-exploitation, namely by unadjusted or unregulated stocking; and v) areas of inert extraction

Measures/concretization:

- Afforestation with soil-improving species - long revolutions
- Incorporation of manures and compost, rotations with legumes, cover crops and with agricultural or forestry by-products (from clearing or deforestation operations)
- Direct seeding or in-line tillage; crop rotation with different types of root systems
- Intercropping in permanent crops
- Setting up overgrazing and biodiverse pastures
- Consolidation and recovery of slopes and riverbanks using natural engineering techniques
- Intervention with structures/natural barriers for erosion control in burnt areas
- Reposition/rehabilitation of the riparian gallery (planting and/or sowing of indigenous species)
- Use of vegetation cover on soils in the wettest period and between rows, use of livestock effluents, composts, and by-products of agro-industries as fertilising materials
- Creation of infiltration gardens and other aquifer recharge solutions (e. g., trenches and infiltration channels)

Sectors covered (ENAAC 2020):

- Agriculture
- Biodiversity
- Forests
- Water resources
- Transport and communications

Executing/beneficiary entities:

- Local government entities and their associations[44]
- Central and Regional Public Administration Bodies
- Management entities of wastelands, of ZIF, EGF and FMU
- Producers' associations
- Farmers and forestry producers
- Entities with infrastructures[45]
- Scientific and academic institutions

Associated impacts and vulnerabilities:

- Increase in the frequency and intensity of rural fires
- Increasing frequency and intensity of droughts and water scarcity periods
- Increased susceptibility to desertification
- Increased frequency and intensity of extreme precipitation events

Funding instruments[46]:

- Environmental Fund
- PDR 2020
- Permanent Forest Fund

[44] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[45] See Decree-Law No 123/2009, 21 May 2009, available at https://www.anacom.pt/render.jsp?contentId=952960.

[46] Only national management instruments are identified; for instruments of centralised Community management, it is not possible to envisage future use for Portugal in adaptation.

Output indicators: • Intervention area (by category and Administrative Unit) • No farms/installations covered • Amounts paid/share (€) Goals: • 2020: make an additional €1.4 million in public investment (PDR 2020: €1.4 million) • 2030: The amounts to be allocated to this area will be reinforced in line with the guidance arising from the framework of the priorities already defined for the Policy Objective of A greener and low-carbon Europe, including climate change adaptation.	

Line of Action #3 - Implementation of good water management practices in agriculture, aquaculture, industry and the urban sector to prevent impacts resulting from drought and scarcity phenomena

Main objectives:

- Reduce water consumption in the various sectors
- Increasing water efficiency in the various sectors
- Improving the resilience and productivity of species and varieties
- Increasing the resilience of water supply infrastructure (agricultural, industrial, tourism, domestic)

Sectors covered (ENAAC 2020):

- Agriculture
- Economy (industry, tourism, and services)
- Forests
- Spatial Planning
- Water resources

Measures/concretization:

- Adoption of good water management practices in agriculture to reduce consumption:
  - Irrigation practices that promote the more efficient and sustainable use of water resources [installation of sprinkler irrigation systems, localised (micro-sprinklers, drop-by-drop) and installation of meters at the water catchments] and energy resources
  - Improved systems for monitoring the actual water needs of crops throughout the growth cycles
  - Remodelling of irrigation infrastructures to reduce losses, optimise water storage and irrigation capacity, rehabilitation, and modernisation of existing infrastructures (allowing for the reduction of evaporation losses and providing more favourable conditions for the management and implementation of more efficient irrigation methods and systems)
  - Use of rainwater and re-use of treated wastewater in agriculture
  - Installation of species and varieties better adapted to changes in climate and extreme events:
  - - Reconversion of crops to less water-demanding species, varieties, and cultivars (adapting crops and varieties to water availability, favouring the installation of species with high water productivity and resistance to water stress)
- Adoption of good water management practices in the industry to reduce consumption:
  - Wastewater reuse in industry
  - Installation of rainwater harvesting systems
- Remodelling of aquaculture infrastructures to optimise water consumption and reduce losses.
- Adoption of good water management practices in the urban sector to reduce consumption:
  - Rehabilitation of water distribution systems and installation of leakage monitoring systems
  - Implementation of differentiated supply systems for the reinforcement and diversification of water sources
  - Installation of new equipment and replacement of old equipment in public and private infrastructures and spaces
  - Intelligent sprinkler, micro-sprinkler and drip irrigation systems in gardens, vegetable gardens and other public green spaces

Executing/beneficiary entities:

- Local government entities and their associations[47]
- Entities of the Central and Regional Public Administration
- Entities of the business sector of the State
- Management entities of wastelands, of ZIF, EGF and FMU
- Producers' associations
- Farmers and forestry producers
- Managing entities of water supply systems
- Entities managing drainage systems and wastewater treatment systems
- Industries
- Hotels and similar establishments
- Scientific and academic institutions

Associated impacts and vulnerabilities:

- Increased frequency and intensity of heatwaves
- Increased frequency and intensity of periods of drought and water scarcity
- Increased susceptibility to desertification
- Increase in maximum temperature

Funding instruments[48]:

- Environmental Fund
- PDR 2020
- POSEUR

[47] Including municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b*) Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[48] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to envisage future use for Portugal for adaptation.

- Requalification of green spaces with native species adapted to local soil and climate conditions
- Use of treated rainwater or wastewater for urban cleaning, irrigation of green spaces and aquaponics/hydroponics production facilities

Output indicators:

- Intervention area (by category and Administrative Unit)
- Equipment installed
- Refurbished/rehabilitated infrastructures
- No of farms/installations covered
- Amounts paid per share (€)

Goals:

- 2020: 124 million of public investment (PDR 2020: €21 million; OP SEUR: EUR 100 million; other funds: EUR 3
- 2030: The amounts to be allocated to this area will be reinforced in line with the guidelines resulting from the framework of priorities already defined for the Policy Objective of a greener and low-carbon Europe, including climate change adaptation; at least EUR 350 million in the AUC

Line of Action #4 - Increasing the resilience of ecosystems, species, and habitats to the effects of climate change

Main objectives:

- Maintain or restore riparian galleries
- Minimise barrier effects and reduce obstacles in the hydrographic network
- Implementing environmental flow regimes
- Conserving and managing temporary pond systems
- Encourage the creation of refuges and ecological corridors for vulnerable fauna species:
- Install ex-situ breeding systems for vulnerable freshwater fish and migratory fish
- Securing groundwater levels in aquifers in areas where groundwater-dependent ecosystems exist
- Monitor and manage estuarine, lagoon and marine ecosystems to ensure sustainable fishing and aquaculture activities and their proper functioning

Measures/concretization:

- Intervention in riparian galleries as a priority in i) areas of distribution of populations of freshwater bivalves or the Red Seabream (*Anaecypris hispanica*); ii) small intermittent coastal basins in the centre and south that are home to threatened endemic freshwater fish species; and iii) essential areas for the conservation of vulnerable freshwater amphibian and reptile populations.
- Conservation and rehabilitation of watercourses to maintain environmental flows and the river continuity in the distribution areas of endemic species (in particular the Saramugo - *Anaecypris hispanica*)
- Regulating the volumes of water abstracted for irrigation from catchments that serve as summer refuges for vulnerable freshwater and migratory fish species.
- Installation or adaptation of transposition devices on weirs for vulnerable freshwater and migratory fish.
- Installation or adaptation of wildlife passages/crossings on the highway/railway. Conservation of temporary pond systems: i) sites with important populations of the striped terrapin (*Emys orbicularis*) and the Mediterranean terrapin (*Mauremys leprosa*); and ii) preferably oriented N -> S in open areas, away from roads and maintaining 10-70% forest cover, suitable for the various vulnerable amphibian species
- Creation of refuges and ecological corridors for vulnerable fauna species: i) in small intermittent coastal basins in the centre and south, in sectors upstream of the main anthropogenic pressure factors, to safeguard native ichthyofauna; ii) from low to high altitude in forest areas important for mountain amphibian and reptile species; and iii) in agricultural and forest ecosystems important for amphibians and reptiles, creating small areas of microhabitats with native species in areas currently occupied by monocultures
- Adaptation of the existing ex situ spawning conditions of aquaculture facilities
- Implementation of the measures in the ex-situ reproduction plan for the Mediterraneanaramugo (*Anaecypris hispanica*)
- Promote, conserve and value animal, plant and forest genetic heritage to increase resilience to climate change (resistance to drought, diseases and pests)
- Adapt fishing practices by promoting non-waste and minimising by-catches of more vulnerable species in the new climate framework; Redirect aquaculture activity towards native species with greater climate resilience

Sectors covered (ENAAC 2020):

- Agriculture
- Biodiversity
- Forests
- Water resources
- Transport and communications
- Coastal areas and the sea

Executing/beneficiary entities:

- Local government bodies and their associations[49]
- Entities of the Central and Regional Public Administration
- Entities of the business sector of the State
- Management entities of wastelands, of ZIF, EGF and FMU
- Producers' associations
- Farmers and forestry producers
- Scientific and academic institutions
- Transport infrastructure managing entities

Associated impacts and vulnerabilities:

- Increase in the frequency and intensity of rural fires
- Increased frequency and intensity of heatwaves
- Increased frequency and intensity of periods of drought and water scarcity
- Increased susceptibility to desertification

[49] Including municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a,*) Associations and Foundations; *b*) Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

	• Increase in maximum temperature
Output indicators: • Intervention area (by category and Administrative Unit) • Length of water lines covered (Km) • Classified area covered (ha) • Area of distribution of vulnerable species populations covered (ha) • Amounts paid per share (€) Goals: • 2020: make an additional €30 million of public investment (PDR 2020: €24 million; POSEUR OP: €5 million; other funds: €1 million) • 2030: The amounts to be allocated to this area will be reinforced in line with the guidance arising from the framework of the priorities already defined for the Policy Objective of A greener and low-carbon Europe, including climate change adaptation.	Funding instruments[50]: • Environmental Fund • POSEUR • Regional OPs • PDR 2020

[50] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to envisage future use for Portugal for adaptation.

Line of Action #5 - Reducing the vulnerability of urban areas to heatwaves and increasing maximum temperatures

Main objectives:

- Regulating temperature in urban spaces
- Minimising the adverse effects of intense heat on the health of populations in general and risk groups in particular

Measures/concretization

- Measures that counter the heat island effect, particularly during heatwave events:
- Implementation of green infrastructure (including urban gardens with smart irrigation systems), including the use of natural materials as building material (e.g. green roofs and facades) and renaturalisation and restoration of pavement permeability
- Implementation of water retention basins
- Creation of shaded areas (including tree planting and the installation of canopies between buildings)
- Creating ventilation corridors
- Thermoregulation of air by misting and installation of public drinking fountains
- Awareness-raising actions for the general population and the most vulnerable groups to deal with heatwaves
- Creating green areas with drought-resistant vegetation cover
- Installation or retrofit of shading/cooling equipment in:
  - Urban transport infrastructure and rolling stock (vehicles, stops, stations, car parks)
  - Public buildings (primarily schools, hospitals and health centres)
  - IPSS supporting children and the elderly
- Alert systems to provide warnings for the general population and users of urban transport systems

Output indicators:

- Infrastructures installed or reconverted
- Municipalities covered
- Population covered
- Amounts paid per share (€)

Goals:

- 2020: 4.4 million of public investment (SEUR OP: 1.9 million; other funds: EUR 2.5 million)
- 2030: The amounts to be allocated to this area will be reinforced in line with the guidelines resulting from the framework of priorities already defined for the Policy Objective of a greener and low-carbon Europe, including climate change adaptation.

Sectors covered (ENAAC 2020):

- Economy (industry, tourism, and services)
- Spatial Planning
- Health
- Transport and communications

Executing/beneficiary entities:

- Local government bodies and their associations[51]
- Entities of the Central and Regional Administration
- Entities in the business sector of the State
- Enterprises (trade and services sectors, including tourism)
- Social Solidarity Institutions
- Transport infrastructure managing entities
- Public transport service operators
- Scientific and academic institutions

Impacts and associated vulnerabilities:

- Increased frequency and intensity of heatwaves
- Increased frequency and intensity of periods of drought and water scarcity
- Increase in maximum temperature

Funding instruments[52]:

- POSEUR
- Environmental Fund
- Regional OPs

[51] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[52] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to envisage future use for Portugal for adaptation.

Line of Action #6 - Preventing the establishment and spread of invasive alien species, vector-borne diseases, and agricultural and forestry diseases and pests

Main objectives:

- Monitor the vectors that potentially transmit diseases with an impact on public health to implement contingency plans
- Control and eradicate invasive alien species
- Controlling emerging pests and diseases in agricultural and forestry systems
- Recover species and habitats affected by invasive alien species

Sectors covered (ENAAC 2020):

- Agriculture
- Biodiversity
- Forests
- Water resources
- Coastal areas and the sea
- Health

Measures/concretization:

- Strengthening entomological surveillance at the national level, particularly as regards the geographical and seasonal distribution of vectors that can carry disease agents from other latitudes, through the expansion of the National Programme for Surveillance of Culicidal Vectors (REVIVE)
- Identification of risk areas through mapping and geo-referencing and making the information available on an electronic platform
- Prevention, control and eradication of emerging vector-borne diseases of agricultural and forest ecosystems enhanced by climate change
- Setting up a centralised warning system for agriculture and forestry (biotic and abiotic agents)
- Development of platforms for information, early warning and pathways of introduction of alien species
- Control of invasive alien species, and, where possible, eradication in priority sites for the most vulnerable species, such as amphibians and reptiles, and the distribution areas of Saramugo (*Anaecypris hispanica*).
- Valorisation of the genetic material of agricultural and forestry varieties and species to reduce susceptibility to emerging diseases and pests

Executing/beneficiary entities:

- Local government bodies and their associations[53]
- Entities of the Central and Regional Administration
- Entities of the business sector of the State
- Management entities of wastelands, of ZIF, EGF and FMU
- Producers' associations
- Farmers and forestry producers
- Scientific and academic institutions

Associated impacts and vulnerabilities:

- Increased frequency and intensity of heatwaves
- Increased frequency and intensity of periods of drought and water scarcity
- Increase in maximum temperature

Output indicators:

- No. of actions carried out
- Target population covered
- Vectors and pathways identified
- No. of sites monitored
- Intervention area (exotic/invasive species)
- No. of invasive species controlled
- Amounts paid per share (€)

Goals:

- 2020: 21 million of public investment (PDR 2020: 20 M€; SEUR OP: 1 M€)
- 2030: The amounts to be allocated to this area will be reinforced in line with the guidelines resulting from the framework of priorities already defined for the

Funding instruments[54]:

- POSEUR
- PDR 2020

[53] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[54] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to envisage future use for Portugal in terms of adaptation.

Policy Objective of a greener and low-carbon Europe, including climate change adaptation.

Line of Action #7 - Reducing or minimising the risks associated with flooding phenomena

Main objectives:

- Reduce the risk of river and urban flooding
- Increasing the resilience of infrastructure
- Implementing Flood Risk Management Plans

Measures/concretization:

- Creating infiltration areas through:
  - Construction and/or rehabilitation of retention basins (excavation and dyke)
  - Reconversion of impermeable surface areas (e. g. renaturalisation of riverside ecosystems, installation of drainage paving)
  - Building retention ditches parallel to the ground level on slopes to retain precipitation
- Protecting water lines and restoring the natural profiles of river sections and floodplains:
  - Cleaning and regularisation of water lines
  - Ecological restoration and maintenance of riparian vegetation
  - Clearance of flood plains
  - Removal of sediments and other material in the beds
  - Restoration of the flow section of hydraulic crossings and pontoons
  - Removal of obsolete structures with no current function
  - Rehabilitation of existing weirs for the purpose of stormwater correction
  - Construction of small flood-correction works
- Construction of protective infrastructure
- Maintenance/installation of hydrometric stations and updating of flow curves in the context of flood risk prevention
- Implementation of hydrological and hydraulic modelling as a decision support system for the management of hydraulic infrastructures in extreme weather situations and flood risk warning
- Implementation of forecasting and warning systems for the population and responsible entities
- Remodelling of urban stormwater drainage networks to hydraulically adjust to flows in heavy rainfall events, particularly in critical areas such as bridges, aqueducts and other bottlenecks
- Identification and delimitation of areas of preferential flooding and creation of conditions for run-off accordingly in drainage basins
- Implementation of sustainable urban drainage techniques:
  - Use of permeable pavements and roughness by appropriate drainage conditions
  - Rainwater runoff retention systems in relevant locations
  - Creation of preferential rainwater runoff paths

Sectors covered (ENAAC 2020):

- Agriculture
- Economy (industry, tourism and services)
- Energy and energy security
- Forests
- Spatial Planning
- Water resources
- Safety of people and goods
- Transport and communications

Executing/beneficiary entities:

- Local government bodies and their associations[55]
- Entities of the Central and Regional Administration
- Entities in the business sector of the State
- Farmers and forestry producers
- Managing entities of water supply systems
- Entities managing drainage systems and wastewater treatment systems
- Transport infrastructure managing entities
- Entities with infrastructures[56]
- Trade, services, and industrial companies
- Electronic communications companies
- Scientific and academic institutions

Associated impacts and vulnerabilities:

- Increase in frequency and intensity of extreme precipitation events

[55] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[56] Decree-Law No. 123/2009, of 21 May 2009.

– Delimitation/creation of infiltration areas – - Construction of wells or infiltration trenches • Infrastructure (e. g. transport, energy, communications, sanitation): – Raising roads/infrastructure – Side protections – Interventions in drainage systems - transversal and longitudinal (and including the possibility of creating retention basins) – Work on embankments (including plant cover) - Relocation of infrastructure – Interventions at the level of infrastructure stability (including engineering structures - e. g. bridges, viaducts, etc.)	
Output indicators: • Intervention area/risk area • Water lines covered • Infrastructures Intervened • Amounts paid per share (€) Goals: • 2020: make an additional €10 million of public investment (PDR 2020: €2 million; other funds: €5 million; EEA Grants: €3 million) • 2030: The amounts to be allocated to this area will be reinforced in line with the guidelines stemming from the framework of the priorities already defined for the Policy Objective of a greener and low-carbon Europe, including climate change adaptation /at least €390 M in flood and drought prevention	Funding instruments[57]: • POSEUR • Environmental Fund • Regional OPs • PDR 2020 • EEA Grants 2014- 2021

[57] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to foresee future use for Portugal in terms of adaptation.

Line of Action #8 - Increasing resilience and coastal protection in areas at high risk from coastal erosion, overtopping and flooding

Main objectives:

- Reducing the risk of coastal flooding
- To guarantee a coastline more resilient to erosion, overtopping and coastal flooding, particularly in built-up areas or urban centres
- To guarantee sediment re-establishment, including large-scale artificial feeding operations and the operationalisation of processes promoting the natural re-establishment of sediment transport from river basins
- Maintain or restore natural transition zones between coastal and terrestrial ecosystems

Measures/concretization:

- Operations promoting the natural re-establishment of sediment traffic from river basins, including in particular,
- Dredging of lagoons to replenish beaches, to safeguard the conservation of priority species and habitats
- Interventions in dune systems (including renaturalisation with native species and maintenance and restoration of secondary dunes important for vulnerable amphibian and reptile species
- Interventions to replenish sediment in coastal systems
- Protection and rehabilitation of coastal systems
- Cliff work
- Interventions in coastal defence structures (including raising of grades and riprap)
- Artificial feeding operations, including high magnitude (shots)
- Planned retreat with the removal of structures or buildings in high-risk areas (including renaturalisation) and reconstruction in non-existent or low-risk areas
- Land acquisition/expropriation operations for risk mitigation
- Interventions in transport and communication infrastructures located in coastal areas (strengthening, relocation)
- Installation and reinforcement of appropriate signage

Output indicators:

- Intervention along the coastline
- Interventions carried out
- Municipalities covered
- Amounts paid per share (€)

Goals:

- 2020: make an additional €47 million of public investment (POSEUR: €47 million)
- 2030: make €560 million of public investment in coastal protection

Sectors covered (ENAAC 2020):

- Biodiversity
- Economy (industry, tourism and services)
- Spatial Planning
- Transport and communications
- Coastal areas and the sea

Executing/beneficiary entities:

- Local government entities and their associations[58]
- Entities of the Central and Regional Administration
- Port Administrations and other entities with competence in the maritime space
- Managing entities of transport and communications infrastructures
- Scientific and academic institutions

Impacts and associated vulnerabilities:

- Increase in frequency and intensity of extreme precipitation events
- Rising sea levels
- Increased frequency and intensity of extreme events leading to coastal erosion and stranding

Funding instruments[59]:

- POSEUR
- Environmental Fund
- Regional OPs

[58] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[59] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to foresee future use for Portugal in terms of adaptation.

Line of Action #9 - Development of decision support tools, capacity building and awareness-raising actions

Main objectives:

- Improving the level of knowledge on climate change
- Systematising information and facilitating access to it
- To sensitise, mobilise and raise awareness among citizens, communities, policymakers, administration technicians (central, regional, and local) and stakeholders
- Build capacity of key public and private stakeholders for adaptive management - Demonstrate and monitor impacts of climate change

Measures/concretization:

- Communication, dissemination, education and awareness-raising actions on climate change risks and adaptation measures
- Development of decision support tools and dissemination of good practices, including information systems, modelling and scenarisation, reporting and developing a National Adaptation Platform.
- Capacity building actions for technicians and decision-makers in climate change vulnerability assessment and adaptive management
- Production of information and knowledge, in particular through the implementation of systems for monitoring the impacts of climate change and the drawing up of climate risk mapping
- Development of Climate Change Adaptation Plans
- Setting up forecasting, warning and response systems, including climate prediction models for extreme phenomena and population warning mechanisms
- Creation of a system to identify risk areas, using mapping and geo-referencing and making the information available on an electronic platform, with access to the entities with responsibility in the corresponding decision areas
- Implementation of communication circuits for the transmission of information to health authorities, following forecasting and warning systems
- Setting up monitoring and evaluation arrangements at the national, regional, inter-municipal and municipal level
- Promotion of research and development in support of the Lines of Action

Output indicators:

- No. of actions carried out
- Target population covered
- No. of systems implemented
- No. of tools developed
- No. CA Adaptation Plans
- Amounts paid per share (€)

Goals:

- 2020: 5 million of public investment (other funds: ¤2 million; EEA

Sectors covered (ENAAC 2020):

- All

Executing/beneficiary entities:

- Central and Regional Administration Bodies
- Environmental NGOs
- Civil Protection Voluntary Organisations
- Local government bodies and their associations[60]
- Scientific and academic institutions
- Managing entities of water supply systems
- Entities managing drainage systems and wastewater treatment systems
- Transport Infrastructure Management Entities
- Public transport service operators

Impacts and associated vulnerabilities:

- All impacts and vulnerabilities

Funding instruments[61]:

- POSEUR
- Environmental Fund
- PDR 2020
- Regional OPs
- EEA Grants 2014- 2021

[60] Including parish councils, municipal companies and consortia led by municipalities and associations of municipalities with partners such as *a*) Associations and Foundations; *b)* Companies, regardless of their legal form; and *c*) Non-Governmental Organisations.

[61] Only national management instruments are identified; for the instruments of centralised Community management, it is not possible to foresee future use for Portugal in adaptation matters.

- 2030: The amounts to be allocated to this area will be reinforced in line with Policy Objective of a greener and low-carbon Europe, including climate change adaptation.

Annex II – Result indicators and targets

Result indicator	Target 2020 [62][63]	Target 2030
Municipalities covered by adaptation plans (municipal, inter-municipal or regional)	60%	100%
Municipalities with forest fire defence plans that integrate future climate vulnerability assessments and adaptation measures	2%	100%
Water efficiency in urban consumption	80%	85%
Water efficiency in industrial consumption	85%	90%
Water use efficiency in agriculture	65%	80%
Target population of awareness or dissemination campaigns related to climate change impacts and adaptation measures	5%	25%
Transport infrastructure managing entities that have adaptation plans or contingency plans for extreme events	10%	50%
Energy production, transmission and distribution companies that have adaptation plans or contingency plans for extreme events	25%	100%
Water supply and wastewater treatment companies that have adaptation plans or contingency plans for extreme events	50%	100%
Telecommunications companies that have adaptation plans or contingency plans for extreme events	25%	100%
Continental coastline in a critical state of erosion	16,5%	10%
Irrigated infrastructure area with precision technologies that promote efficient water use	10%	50%
Reduction in the number of people affected by floods in risk areas identified in the Flood Risk Management Plans (compared with the previous cycle of the PGRI)	-	25%
Reduction in the geographical distribution area of invasive alien species (compared to the reference year)	-	10%
Reduction in the number of cases of human vector-borne diseases associated with climate change (decadal average)	-	10%

[62] The reduction targets are set against the reference value indicated in the respective existing sectoral planning instruments.

[63] Where indicators arise from current EU funding programmes, the target refers to the closure year of those programmes.

Annex III – Glossary

Adaptation

The process of adaptation to the actual or expected climate and its effects. In human systems, adaptation aims to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention can facilitate adaptation to the expected climate and its effects.

Climate change

Climate change refers to a change in the state of the climate that can be identified (e.g. by statistical tests) through changes in the mean and/or the variability of its properties, and that persists over a long period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, such as modulations of solar cycles, volcanic eruptions and persistent anthropogenic changes in atmospheric composition or land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: "a change in climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and is, in addition to the natural variability of the climate, observed over comparable periods." Thus, the UNFCCC distinguishes between climate change attributable to human activities that alter atmospheric composition and climate variability attributable to natural causes.

Scenario

A plausible description of how the future might develop based on a coherent and internally consistent set of assumptions about fundamental driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither prognoses nor forecasts but are useful in providing insight into the implications of developments and actions. See also Climate scenario, Representative concentration thresholds.

Climate scenario

A plausible and often simplified representation of future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to affecting models. Climate projections often serve as raw material for constructing climate scenarios, but climate scenarios typically require additional information, such as the actual observed climate. A climate change scenario is a difference between a climate change scenario and the current climate.

Climate

In a narrow sense, the climate is generally defined as the average weather, or more rigorously, as the statistical description of average and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period for an average of such variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate, in a broader sense, is the state, including a statistical description, of the climate system.

Desertification

Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Land degradation in arid, semi-arid and dry sub-humid areas is the reduction or loss of biological or economic productivity and complexity of rainfed cropland, irrigated or grazed land,

forest and woodland resulting from land uses or from process or combination of processes, including processes arising from human activities and habitation patterns, such as (1) soil erosion caused by wind and/or water; (2) deterioration of physical, chemical, biological or economic properties of soil; and (3) long-term loss of natural vegetation.

Greenhouse effect

The infrared radiative effect of all infrared absorbing constituents in the atmosphere. Greenhouse gases, clouds and (to a lesser extent) aerosols absorb terrestrial radiation emitted from the Earth's surface and elsewhere in the atmosphere. These substances emit infrared radiation in all directions but, all else being equal, the net amount emitted into space is usually less than would be emitted in the absence of these absorbers due to the temperature decline with altitude in the troposphere and the consequent weakening of the emission. An increase in greenhouse gas concentration increases the magnitude of this effect; the difference is sometimes called the enhanced greenhouse effect. The change in a greenhouse gas concentration due to anthropogenic emissions contributes to an instantaneous radiative forcing.

The surface and troposphere heat up in response to this forcing, gradually restoring the radiative balance at the top of the atmosphere.

Ensemble

A collection of model simulations that characterize a climate prediction or projection. Differences in initial conditions and model formulation result in different evolutions of the modelled system and can provide information on the uncertainty associated with model error and errors in initial conditions in the case of climate predictions and uncertainty associated with model error and internally generated climate variability in the case of climate projections.

Extreme climate event

See Extreme weather event.

Extreme weather event

An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but typically a severe weather event would be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of extreme weather can vary from place to place in an absolute sense. When a pattern of extreme weather conditions persists for some time, such as a season, it can be classified as an extreme climate event, especially if it produces an average or total that is extreme (e.g., drought or heavy rain in a season).

Exposure

The presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure or economic, social or cultural assets in places and settings could be adversely affected.

Radiative Forcing

Radiative forcing is the change in net radiative flux (expressed as W m-2), downward minus upward, in the tropopause or upper atmosphere due to an external driver of climate change, such as a change in carbon dioxide concentration or solar radiation. Sometimes internal drivers are still treated as forcing even though they result from climate change, for example, changes in aerosols or greenhouse gases in palaeoclimates. The traditional radiative forcing is calculated with all tropospheric properties fixed at their undisturbed values and

allowing stratospheric temperatures, if disturbed, to readjust to the dynamic radiative equilibrium. The radiative forcing is called instantaneous if no change in stratospheric temperature is accounted for. After accounting for rapid adaptations, the radiative forcing is called effective radiative forcing. For this report, the radiative forcing is further defined as the change for 1750 and, unless otherwise specified, is an annual global mean value. The radiative forcing should not be confused with the cloud radiative forcing, which describes an unrelated measure of the impact of clouds on the radiative flux in the upper atmosphere.

Greenhouse gas (GHG)

Greenhouse gases are the gaseous constituents of the atmosphere, natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and clouds.

This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. In addition, there are a number of entirely man-made greenhouse gases from the atmosphere, such as halocarbons and other substances containing chlorine and bromine, treated under the Montreal Protocol. In addition to CO_2, N_2O and CH_4, the Kyoto Protocol deals with sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) of greenhouse gases.

Urban heat island

The relative warmth of a city compared to surrounding rural areas, associated with changes in runoff, effects on heat retention and changes in surface albedo.

Impacts

Effects on natural and human systems. In this report, the term impact is used primarily to refer to the impact of extreme weather and climate events and climate change on natural and human systems. Generally, impacts refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate change or hazardous weather events occurring within a specific period and the vulnerability of a community or exposed systems. Impacts are also referred to as consequences and outcomes. Impacts of climate change on geophysical systems, including floods, droughts and sea-level rise, are a subset of impacts referred to as physical impacts.

Uncertainty

A state of incomplete knowledge may result from a lack of information or disagreement about what is known or knowable. It can have many sources, from imprecision in data to ambiguously defined concepts or terminology or uncertain projections of human behaviour. Therefore, uncertainty can be represented by quantitative measures (e.g. a probability density function) or by qualitative statements (e.g. reflecting the decisions of a team of experts).

Climate inertia

The climate system's response to the forcing of greenhouse gases and aerosols is characterised by inertia, driven mainly by the ocean. The ocean has a vast capacity to absorb heat and a slow mixing between the surface and deep sea. This means that it will take several centuries for the entire ocean to warm up and reach equilibrium with altered radiative forcing. The surface ocean (and therefore the continents) will continue to warm until it reaches a surface temperature in balance with this new radiative forcing.

Mitigation

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Representative Concentration Pathways (RCPs)

Scenarios include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover (Moss *et al.*, 2008). The word "representative" means that each RCP provides only one of many possible scenarios that would lead to specific radiative forcing characteristics. The term plateau emphasizes that the long-term concentration levels are of interest and the trajectory taken over time to achieve that outcome (Moss *et al.*, 2010). Typically, RCPs refer to the portion of the concentration plateaus extending to 2100, for which the Integrated Assessment Models produce corresponding emissions scenarios. Four RCPs were selected from the literature and are used in the current IPCC assessment as the basis for the climate predictions and projections presented in Chapters 11 to 14: RCP2.6 - A plateau where the radiative forcing reaches approximately 3 W m-2 before 2100 and then declines (the corresponding ECP assumes constant emissions after 2100). RCP4.5 and RCP6.0 - Two intermediate stabilization plateaus where the radiative forcing is stabilized at approximately 4.5 W m-2 and 6.0 W m-2 after 2100 (the corresponding ECP assumes constant emissions after 2150). RCP8.5 - A high plateau for each radiative forcing is above 8.5 W m-2 in 2100 and continues to increase for some time (the corresponding ECP assumes constant emissions after 2250).

Danger

The potential occurrence of a physical event or the effect of a natural or human-induced trend or physical impacts may cause loss of life, injury, or other health impacts, and loss of and damage to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term hazard usually refers to physical events or the effect of climate-related trends or their physical impacts.

Resilience

The capacity of social, economic and environmental systems to cope with hazardous events or trends or disturbances by responding or reorganising themselves to maintain their essential function, identity and structure, while also maintaining the capacity to adapt, learn and transform.

Risk

The probability of consequences occurring where something of value is at stake and uncertain outcome, recognizing the diversity of values. Risk is often presented as the probability of hazardous events or trends occurring multiplied by the impacts of these events occur or these trends exist. Risk results from the interaction of vulnerability, exposure and hazards. In this report, the term risk is used primarily to refer to the risks of climate change-related impacts.

Vulnerability

The propensity or predisposition to be negatively affected. Vulnerability covers various concepts and elements, including sensitivity or susceptibility to harm or lack of capacity to cope or adapt.

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