REPUBLIC OF CROATIA

MINISTRY OF ECONOMY AND SUSTAINABLE DEVELOPMENT

CLIMATE CHANGE ADAPTATION STRATEGY IN THE REPUBLIC OF CROATIA FOR THE PERIOD UNTIL 2040 WITH A VIEW TO 2070

April 2020

LIST OF USED ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
DHS	District heating system
MUP	Ministry of the Interior (*Ministarstvo unutarnjih poslova*)
DHMZ	Croatian Meteorological and Hydrological Service (*Državni hidrometeorološki zavod*)
SB	State Budget
EEA	European Environment Agency
EES	Power system (*Elektro energetski sustav*)
ERDF	European Regional Development Fund
ESF	European Social Fund
ESIF	European Structural and Investment Funds
EU	European Union
FLAG	Fisheries Local Action Group
EPEEF	Environmental Protection and Energy Efficiency Fund
HAPIH	Croatian Agency for Agriculture and Food (*Hrvatska agencija za poljoprivredu i hranu*)
HEP	Croatian Electric Power Company (*Hrvatska elektroprivreda*)
HEP ODS	HEP Distribution System Operator (*HEP Operator distribucijskog sustava*)
HERA	Croatian Energy Regulatory Agency (*Hrvatska energetska regulatorna agencija*)
HGI	Croatian Geological Survey (*Hrvatski geološki institut*)
HGK	Croatian Chamber of Economy (*Hrvatska gospodarska komora*)
HHI	Croatian Hydrographic Institute (*Hrvatski hidrografski institut*)
HKIŠDT	Croatian Chamber of Forestry and Wood Technology Engineers (*Hrvatska komora inženjera šumarstva i drvne tehnologije*)
HOK	Croatian Chamber of Trades and Crafts (*Hrvatska obrtnička komora*)
HOPS	Croatian Transmission System Operator Ltd. (*Hrvatski operator prijenosnog sustava*)
HROTE	Croatian Energy Market Operator Ltd. (*Hrvatski operator tržišta energije*)
HŠ	Croatian Forests Ltd. (*Hrvatske šume*)
HŠI	Croatian Forest Research Institute (*Hrvatski šumarski institut*)

Abbreviation	Meaning
HTZ	Croatian National Tourist Board (*Hrvatska turistička zajednica*)
HV	Croatian Waters Ltd. (*Hrvatske vode*)
HVZ	Croatian Firefighting Association (*Hrvatska vatrogasna zajednica*)
HZJZ	Croatian Institute of Public Health (*Hrvatski zavod za javno zdravstvo*)
MCPP	Ministry of Construction and Physical Planning
HZZO	Croatian Health Insurance Fund (*Hrvatski zavod za zdravstveno osiguranje*)
HŽ	Croatian Railways Ltd. (*Hrvatske željeznice*)
IPCC	Intergovernmental Panel on Climate Change
IPCC AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2013)
LRSGU	Local and regional self-government unit
LSGUs	Local self-government units
PPP	Public-Private Partnership
JUZP	Public Institution for the Management of Protected Areas (National Parks and Nature Parks) (*Javna ustanova za upravljanje zaštićenim područjima (Nacionalnim parkovima i Parkovima prirode)*)
MEPE	Ministry of Environmental Protection and Energy
MSTI	Ministry of the Sea, Transport and Infrastructure
NbS	Nature-based solutions
RES	Renewable energy sources
PG	Farms (*poljoprivredna gospodarstva*)
SEA	Strategic Environmental Assessment
TDU	State administration bodies (*tijela državne uprave*)

GLOSSARY OF TERMS

Term	Meaning
Climate	Climate is a set of average weather conditions of the atmosphere, i.e. a set of meteorological elements and phenomena over a longer period of time. According to the recommendation of the World Meteorological Organisation, a 30-year climate reference period is used (e.g. 1931 –1960, 1961 –1990).
Climate change	IPCC defines climate change as "...any change of climate over time whether due to natural cause or as a result of human activity". The definition of climate change according to the United Nations Framework Convention on Climate Change (UNFCCC) relies particularly on human activity as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods."
Climate change adaptation	The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". Adaptation can also be thought of as learning how to live with the consequences of climate change. Climate change adaptation can also be viewed as adaptation to natural variability/changeability, i.e. occurrence of extremes regardless of whether their frequency, duration or spatial extent increases.
Adaptive capacity	The ability of a system (natural and human) to adjust to climate change (including climate variability and extremes), to adjust to potential damages, to take advantage of opportunities, and to cope with the consequences.
Maladaptation	An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits, but lead to exacerbated vulnerability in the medium to long-term.
Aggregate impacts	Individual impacts of actions when past and future actions within a reasonably foreseeable period of time are aggregated. Cumulative effects may be the result of individually minor, but jointly more significant actions that take place over a certain period of time.
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g. a change in crop yield in response to a change in temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to rising sea levels).

Term	Meaning
Vulnerability	The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.
Resilience	The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.
Risk	The relationship between the consequence of an event and the probability of its occurrence.
No regrets measures	No regrets measures are those that provide benefits even without climate change. The implementation of these measures is a very effective first step of a long-term adaptation strategy. For example, the control of leakage in water pipes or maintenance of drainage channels is almost always considered a good investment from the perspective of cost-benefit analysis, even in the absence of climate change. Improving building thermal insulation standards and investing in climate change adaptation of buildings are also typical examples of no regrets measures, as they increase climate resilience, and any additional cost will be recovered within a few years.
Hazard	Hazard means an occurrence, phenomenon or human activity that may cause loss of life or injury, or other health impacts or property damage.
Climate change mitigation	The term used to describe the process of reducing greenhouse gas emissions that contribute to climate change. It includes strategies to reduce greenhouse gas emissions (low carbon development) and enhance carbon sinks.
Carbon sinks	Binding and absorption of carbon (usually in the form of CO_2). Natural carbon sinks are forests and other ecosystems that bind carbon, thus removing it from the atmosphere and neutralising CO_2. emissions.
Greenhouse gases	All atmospheric gases (of natural or anthropogenic origin) that absorb thermal radiation emitted from the Earth's surface. In doing so, they trap heat in the atmosphere, which results in unbalanced warming and climate change.
Ecosystem services	Ecosystem services can be defined as the benefits people derive from ecosystems. The UN defined four categories of ecosystem services that contribute to human well-being: • provisioning services, e.g. wild food products, crops, fresh water and herbal medicines;

Term	Meaning
	• regulating services, e.g. filtration of harmful substances in marshes, regulation of climate through carbon storage, circulation of water, pollination and protection against disasters; • cultural services, e.g. recreation, spiritual and aesthetic values, education; • supporting services, e.g. soil formation, photosynthesis and circulation of nutrients.
Green infrastructure	Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services, and includes green (or blue, in the case of aquatic ecosystems) spaces and other physical elements in areas on land (including coastal areas) and marine areas. Green infrastructure does not refer only to green spaces such as parks and open spaces, but also to blue infrastructure that includes urban drainage systems, drainage trenches, marshes, rivers, streams, ponds, oxbow lakes, canals and their banks, as well as other watercourses. Protected areas and ecological network areas (Natura 2000) are a part of green infrastructure.
RCP	Representative Concentration Pathways
Evapotranspiration	The process of transferring water to the atmosphere by evaporation from the soil or by transpiration from plants. Transpiration is the process of losing water in the form of water vapour.
Extreme weather and climate events	For the purposes of this Strategy, extreme weather and climate events shall mean extremely adverse weather and climate conditions that interrupt the ordinary course of life, cause casualties, damage and/or loss of property, as well as damage to public infrastructure and/or the environment.

1. INTRODUCTION

1.1. Importance of climate change adaptation for the Republic of Croatia

Climate change represents a growing threat in the 21st century and poses a challenge for all humanity as it affects all environmental and social aspects and jeopardises the sustainable development of society. Climate change affects the frequency and intensity of extreme weather (extreme precipitation, floods and torrents, erosion, storms, drought, heat waves, fires) and gradual climate change (increase in air, land and water surface temperature, rise in sea levels, sea acidification, expansion of arid areas). There is an indisputable scientific and political consensus that climate change is already occurring to a significant extent, which has been confirmed by the adoption of a number of international resolutions and agreements. The Paris Agreement on climate change requires the countries of the world to act in two directions: (i) take urgent action to reduce greenhouse gas emissions in order to limit the temperature rise to 1.5 °C, that is, 2 °C compared to the pre-industrial period, and (ii) implement climate change adaptation measures to reduce climate change damage (in force since 4 November 2016, ratified by the EU on 5 November 2016, and by the Republic of Croatia on 17 March 2017). The 2019 Report of the Intergovernmental Panel on Climate Change (IPCC) states that the global trend of rising temperature is already at +1.1 °C and that, if greenhouse gas concentrations continue to increase at the current rate, global warming is likely to reach 1.5°C between 2030 and 2052 .

Climate change effects depend on a range of parameters and the intensity of those effects will vary depending on the geographical location, development level and vulnerability. According to the international climate modelling results (IPCC, EEA), the Mediterranean region is designated as a climate "hot spot" where an average rise of 1.5°C has already been reached, with particularly pronounced climate change effects (extreme weather, expansion of arid areas, rise in sea levels).

There is growing evidence that the Republic of Croatia is affected by climate change effects and that, given that it largely belongs to the Mediterranean region, they will intensify, while the vulnerability to climate change is assessed as high. Climate change strongly affects the environment and exacerbates the existing environmental issues, such as declining biodiversity and weakening of ecosystem services. The vulnerability of certain sectors of the economy is almost acute, especially of agriculture, forestry, fisheries, energy and tourism, because the success of all these sectors largely depends on climate factors.

According to a report by the European Environment Agency (EEA), the Republic of Croatia belongs to the group of three European countries with the highest cumulative share of damage from extreme weather and climate events in relation to the gross national product (GNP). It is estimated that these losses in the period from 1980 to 2013, i.e. over 33 years amounted to approximately EUR 2.25 billion, or approximately EUR 68 million per year on average. The total damage reported in the period from 2013 to 2018, i.e. over 6 years, amounted to approximately EUR 1.8 billion, or approximately EUR 295 million a year. Exceptional losses increased significantly during 2014 and 2015 (EUR 2.83 billion). Some economic sectors were significantly affected in that period. According to certain estimates, between 2000 and 2007 extreme weather conditions caused damage to the agricultural sector in the amount of EUR 173 million, while the drought in 2003 caused damage between EUR 63 million and EUR 96 million to the energy sector. It is also estimated that in August 2003 the mortality rate was 4 % higher due to heat stroke. This analysis does not include the loss of human life, cultural heritage

and ecosystem services, while an appropriate methodology for the integrated assessment of climate change effects is only just being developed.

Croatia's degree of vulnerability can already be assessed in light of the fact that the share of agriculture and tourism in the total GDP in 2018 amounted to about one quarter of the total GDP. Consequently, extreme vulnerability of the economy to the effects of climate change can negatively reflect on the overall social development, especially on vulnerable social groups. Therefore, societies that do not begin to implement climate change adaptation measures in time can face catastrophic consequences for the environment and the economy, thus jeopardising their sustainable development. The cost of investing in climate change adaptation today will reduce the cost of repairing potential damage in the future. In that context, particular importance should be given to innovative measures that contribute to strengthening climate resilience and reducing greenhouse gas emissions (adaptation-mitigation co-benefits).

Therefore, it is essential to initiate the social process of adopting the concept of climate change adaptation, determine the effect of climate change on the Republic of Croatia, identify the degree of vulnerability and set priority measures. In other words, it is necessary to adopt a strategic approach to the process of climate change adaptation and use the opportunities it presents through the development and implementation of innovative sustainable development solutions. The European Green Deal (2019) establishes a strategic approach to addressing the issue of climate change impacts through the adoption of a new EU Strategy on Adaptation to Climate Change. In doing so, it is important to ensure that climate change adaptation measures also contribute to the reduction of greenhouse gas emissions.

Climate change is also recognised as a "security threat, risk and challenge for the Republic of Croatia" under the National Security Strategy of the Republic of Croatia (Official Gazette 73/17), which provides for action aimed at strengthening climate resilience and reducing risks. Security threats led to the issue of human migration, and the term climate migrants was introduced globally, describing those people who are forced to relocate within their country or migrate to other countries due to the adverse effects of climate change and extreme weather events. This consequence also shows how climate change, due to its negative effects on natural ecosystems, indirectly affects society as a whole, and destabilises it. It should be noted that climate change is only one of the reasons for permanent migration. It is also the result of poor local infrastructure, lack of adaptation to natural climate variability and impaired functioning of society due to socio-economic reasons.

For the purposes of the Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with the view to 2070 (hereinafter: the Adaptation Strategy), climate change adaptation is defined as a process that "... implies an assessment of adverse impacts of climate change and taking appropriate measures to prevent or reduce the potential damage they may cause". This definition is also a cornerstone for the development of the Adaptation Strategy. Accordingly, climate change adaptation implies undertaking a set of activities aimed at reducing the vulnerability of natural and social systems to climate change, increase their ability to recover from the effects of climate change, as well as exploit the potential positive effects that may also be a consequence of climate change.

Due to its size and economic power, the Republic of Croatia can only make a small contribution to a global reduction of greenhouse gas emissions, while it is primarily up to the larger countries, strong emitters of greenhouse gases, to take action on mitigating climate change. Concurrently with climate change mitigation measures, it is up to each country, including

Croatia, to define priority climate change adaptation measures that will ensure the reduction of vulnerability and the strengthening of resilience to climate change.

Climate change adaptation is a new concept and a lengthy process that needs to be carried out continually and in a planned manner. The development of the Adaptation Strategy with the aim of achieving long-term goals is a fundamental prerequisite and an appropriate framework for coordinated action.

The Adaptation Strategy provides the **vision**: **Republic of Croatia resilient to climate change.** For this purpose, the following **goals** were set: **(a) reduce the vulnerability of natural and social systems to the adverse effects of climate change, (b) increase their ability to recover from the effects of climate change, and (c) exploit the potential positive effects that may also be a consequence of climate change.** The Adaptation Strategy sets out priority measures and coordinated action through short-term action plans and monitoring of the implementation of measures.

Climate change adaptation is regulated by the Climate Change and Ozone Layer Protection Act (Official Gazette 127/19). In the process of developing the Adaptation Strategy, the sectors that are expectedly most exposed to climate change were identified: water resources, agriculture, forestry, fisheries and aquaculture, biodiversity, energy, tourism, and health. In addition, two cross-sectoral topics that are key for the implementation of a comprehensive and effective climate change adaptation were addressed: spatial planning and disaster risk management.

This is the first national Adaptation Strategy and it covers sectors that are, according to current knowledge, most exposed and vulnerable to climate change. Further monitoring of climate change impacts on Croatia will show whether measures should also be taken in some other sectors, and the Adaptation Strategy will be updated as required. Concurrently, the issue of climate change adaptation is increasingly included in the legislation of the European Union as well as in international (ISO) and European (EN) standards, of which particularly those related to the construction sector are being updated. This is one of the ways how infrastructure may be enhanced in the context of mitigating climate change risks. Measures to strengthen the resilience of large investments and critical infrastructure to climate change are implemented through the EU's common policy. This applies to both physical assets and systems of vital significance for ensuring health, well-being and safety. Therefore, all major infrastructure projects financed from EU funds have to prove that they have taken into account climate change adaptation measures to reduce risks, and have to demonstrate how the project contributes to reducing greenhouse gas emissions (so-called climate proofing). This approach to integrating climate change adaptation and mitigation will become increasingly present in all EU's common policies in which Croatia also participates.

Climate change adaptation requires the attention and participation of all stakeholders, the economy and decision-makers at a national, regional and local level. Measures need to be adjusted to the assessed needs, implementation options and available capacities. Adapting to climate change represents a significant cost, but it can ultimately result in general positive financial effects or significant reduction of negative effects, particularly if the implementation of adaptation measures begins sufficiently early. For this reason, the defined priorities of the Adaptation Strategy, which will be translated into action plans, should reflect the gradual approach and concern for the rational use of human and financial capacities.

The Adaptation Strategy is not an isolated document, but has been developed in synergy with the Sustainable Development Strategy of the Republic of Croatia and with relevant sectoral strategies. These strategies address, to a lesser or greater extent, climate change issues, and some of them propose appropriate measures (e.g. the Maritime Development and Integrated Maritime Policy Strategy of the Republic of Croatia for the 2014–2020 period, the Transport Development Strategy of the Republic of Croatia for the 2017–2030 period, the Spatial Development Strategy of the Republic of Croatia, and the draft Marine Environment and Coastal Area Management Strategy of the Republic of Croatia). This Adaptation Strategy avoids the repetition of measures already mentioned in other strategies that contribute to adaptation (for example, it does not propose measures for the marine environment and its ecosystem, as this is already covered by the draft Marine Environment and Coastal Area Management Strategy of the Republic of Croatia). However, it is important to emphasise that, in view of its nature, the Adaptation Strategy is part of the so-called horizontal strategies or strategies that have a cross-sectoral character and, therefore, the Climate Change and Ozone Layer Protection Act prescribes the alignment of all development strategies with the Adaptation Strategy.

The value of this Adaptation Strategy is also that it is the first strategic document that gives the assessment of climate change for Croatia by the end of 2040 and 2070, possible impacts and vulnerability assessment, which should be an incentive for further integration of the described risks into sectoral strategic and planning documents at the national and local level. In cooperation with other initiatives, a solid national framework for strengthening climate resilience of the entire socio-economic system of the Republic of Croatia can be achieved.

The drafting of the Adaptation Strategy was preceded by the creation of the so-called Green Book, which was based on technical documents concerning: climate modelling with resulting climate projections for the Republic of Croatia until 2040, i.e. 2070; analysis of climate change effects and vulnerability to projected climate change; defining the initial programme of measures that will be applicable in the process of climate change adaptation; analysis of cost-effectiveness of the measures and assessment of the need to strengthen capacities for climate change adaptation. The purpose of the Green Book was to encourage and initiate a national discussion on all important issues relevant to climate change adaptation. After consultations with key stakeholders, the so-called White Book was developed, which included the conclusions of public discussions. The strategic environmental assessment was carried out to define environmental protection measures that were integrated into the Adaptation Strategy.

1.2. Time frame of the Adaptation Strategy and rise in greenhouse gas concentrations in the future

The development of the Adaptation Strategy starts with the results of climate model projections for two periods, taking into account two scenarios with greater levels of greenhouse gas concentrations in the future: RCP4.5 and RCP8.5 as defined by the IPCC. The RCP4.5 scenario is considered a more moderate scenario, unlike the RCP8.5 scenario that is considered more extreme. Namely, the obligations under the Paris Agreement are being implemented at a slow pace, while the increase in greenhouse gas concentrations is not following the so-called RCP2.6 scenario, under which the objectives of the Paris Agreement are achievable. Furthermore, climate projections were created for two periods: the first ending in 2040 and the second ending in 2070, which ensures that the results of climate modelling performed for the purposes of this

Adaptation Strategy are comparable with similar research published by the international research community.

Based on the results of climate modelling for the entire period until 2070, the impacts of climate change on individual sectors as well as expected changes and vulnerabilities in the observed sectors were estimated. Of course, the results of climate model projections for the first period, i.e. until 2040, are statistically more likely because they are closer to the present, and the scenario of increasing greenhouse gas concentrations RCP4.5 is also considered more probable. Therefore, the proposed adaptation measures are based on the scenario of increasing greenhouse gas concentrations.

The spatial scope of the Adaptation Strategy is the territory of the Republic of Croatia. However, it should be taken into account that global climate change analyses have, in the narrowest sense, a regional and local character, and that cases of climate modelling that applies exclusively to one country are rare; this is especially not the case when it is relatively small in size, as is the Republic of Croatia. In this sense, the projections of climate models developed for the purposes of the Adaptation Strategy also have a wider spatial scope than the Republic of Croatia, but the features of the future climate change related to the Republic of Croatia and its most important regions are outlined from these projections. Similarly to other European countries, the Republic of Croatia is exposed to weather phenomena coming from different areas of Europe, but which can also be generated outside Europe (for example, over the Atlantic Ocean, Siberia, the Mediterranean, etc.). Weather and climate, therefore, do not recognise state borders, so the same weather, climate and climate change can affect areas independently of national territories.

The assessment of climate and the status of sectors in the second observed period 2041 –2070 is less certain (although the change is more pronounced in both RCP scenarios) because this time frame is too distant for greater statistical probability. For this reason, within the Adaptation Strategy, we are talking about the "view" to the time frame up to 2070 and the measures apply to that second period only to a lesser extent. This approach is understandable because it is ineffective to plan more concrete measures for such a long period. However, the scenarios proposed for the first period, despite the uncertainties that are an integral part of climate modelling, are a good basis for assessing the development of climate change in the second period of the Adaptation Strategy.

1.3. Process of developing the Adaptation Strategy and methodological approach

The approach to developing the Adaptation Strategy is a combination of expert work carried out by a group of sectoral and cross-sectoral experts and scientists, and contributions of interested stakeholders (representatives of public authorities such as ministries, counties, cities and municipalities, representatives of various scientific, educational and professional institutions, non-governmental organisations, professional chambers and other interested public). The drafting of documents at all stages was based on the proposals presented at a number of meetings (workshops) of stakeholders organised during the development of the Adaptation Strategy (18 in total) and obtained in direct communication with specific stakeholders, as well as the proposals received in the process of public consultation. The development of the Adaptation Strategy was carried out in several phases.

i. Creating a scientific basis for developing the Adaptation Strategy

- All the research to date carried out in each of the selected sectors was thoroughly analysed, and a large number of professional and scientific publications considered relevant for particular sectors were reviewed, primarily related to climate change impacts and vulnerabilities and climate change adaptation. All those topics and findings considered important for the development of the Adaptation Strategy were outlined. Based on this analysis and direct contacts with representatives of individual institutions, specific topic proposals were given, which would need to be explored in the future in order to create a firmer basis for the more efficient implementation of the adaptation process.

- Comparisons of climate change projections for future time periods 2011 –2040 and 2041 –2070 with the reference climate period 1971 –2000 were made. The results of future climate projections were obtained on the basis of numerical integration by using the Regional Climate Model (RegCM) at two spatial resolutions (50 km and 12.5 km). A total of 20 climatological variables were analysed. The model results served as the basis for sectoral scenarios when defining climate change impacts and vulnerabilities.

- One of the key phases in the development of the Adaptation Strategy is the assessment of climate change impacts on the observed sectors and the assessment of their vulnerability to climate change. The impact and vulnerability assessment was developed for each sector separately, but cross-sectoral impacts for each sector were assessed as well. This step in drafting the Adaptation Strategy is actually the first step in defining the adaptation measures.

ii. Planning climate change adaptation measures

- Based on the results of the climate change impact and vulnerability assessment in individual sectors, an assessment of adaptation measures for vulnerable sectors was carried out. This step represents the first "look ahead" in the process of drafting the Adaptation Strategy. The proposed measures are based on the analytical background presented in the two previous documents, i.e. those dealing with climate modelling and the assessment of climate change impacts and vulnerabilities of individual sectors in relation to these impacts. In a certain way, this step also represents a transitional phase in drafting the Adaptation Strategy since the presented proposals of measures define a wider operational context that forms the basis for defining action plans as operational instruments of the Adaptation Strategy. In this step, the measures are not yet given in the order of importance of their implementation; rather, all assessed measures that are necessary for a specific sector and cross-sectoral topics were simply listed in order to achieve a desirable situation in which the negative impacts of climate change would be minimised within the time frames of the Adaptation Strategy (until 2040 with the view to 2070).

- The cost-effectiveness analysis, using the method of multi-criteria analysis, defined the basic starting point for further development of the Adaptation Strategy as it evaluates the adaptation measures proposed in the previous step and defines the priorities of the Adaptation Strategy affecting the ranking of adaptation measures.

iii. Developing the Adaptation Strategy

- Based on all data collected and previous documents prepared as well as in accordance with the Climate Change and Ozone Layer Protection Act and EU guidelines for developing climate change adaptation strategies and accompanying documents, a working version of the Adaptation Strategy (Green Book) has been drafted.
- Based on public consultation, comments and suggestions received regarding the working version of the Adaptation Strategy, a draft version of the Adaptation Strategy (White Book) has been developed.
- The procedure of strategic environmental assessment was carried out and environmental protection measures were integrated into the Adaptation Strategy.

All background documents are available on the website dedicated to climate change adaptation, which is managed by the ministry responsible for environmental protection: http://prilagodba-klimi.hr/. The climate modelling data described in this Adaptation Strategy is stored at the Digital Academic Archives and Repositories, Dabar) managed by Srce (University Computing Centre in Zagreb). The data is maintained and managed by DHMZ and made available to the academic and scientific community for further use and sectoral modelling (https://dabar.srce.hr/repozitoriji, http://repozitorij.meteo.hr/).

2. GENERAL GOALS OF THE ADAPTATION STRATEGY

The vision of "Republic of Croatia resilient to climate change" has been defined, and it will be realised by achieving the goals (a) to reduce the vulnerability of natural and social systems to the adverse impacts of climate change, and (b) to strengthen their resilience and ability to recover from these impacts. Although the nature itself is endangered, it represents the backbone of climate change adaptation. Preserved ecosystem services support the socio-economic development and strengthen the resilience of society and economy to climate change. The third goal is (c) to exploit potential positive effects of climate change. The implementation of the Adaptation Strategy should make vulnerable systems more resistant than they are today and more useful in the overall adaptation of society to climate change, while damage from natural disasters should be lower, which will contribute to achieving long-term sustainable development of the Republic of Croatia.

The purpose of the Adaptation Strategy is to bring together all relevant institutional, political, economic and social stakeholders in order to create sufficiently strong support for the implementation of joint adaptation measures and activities, which calls for a proactive approach. This means that actions or measures need to be started immediately since any delay will reduce their effectiveness and make them more expensive.

The Adaptation Strategy aims to raise awareness of the importance of climate change impacts on society and the necessity to integrate the climate change adaptation concept into the existing and new policies, strategic and planning documents, programmes and other activities implemented at all levels of governance. In this sense, it should help the adaptation principle to become one of the decisive criteria in planning and making developmental decisions in the future across all government levels. This will contribute to reducing the vulnerability of the

environment, economy and society to climate change and eliminate potential conflicts between sectors in the process of adaptation.

Despite significant advances in scientific knowledge on climate change and its impacts, there are still many unknowns related to climate change impacts and the degree of vulnerability of particular sectors. Therefore, the Adaptation Strategy also aims to promote or steer scientific research to a better understanding of the complexity of climate change impacts and reduce the degree of uncertainty related to the effects of climate change. Investments in research and development are required in order to find innovative climate change adaptation solutions, which will benefit the entire society in terms of strengthening resilience to climate change.

3. INTERNATIONAL CONTEXT AND POLICY OF THE EUROPEAN UNION

Climate change adaptation is very location- and context-specific, and it is up to each country to take measures that it deems a priority. However, the European Green Deal strongly supports the continuation of work on the climate change adaptation policy at all levels and in the international climate negotiations. One of the priorities of the European Green Deal is the adoption of a new EU Strategy on Adaptation to Climate Change as part of the activities related to climate ambition. According to the work plan of the European action plan, in 2020/2021 it is planned to update the current EU Strategy on Adaptation to Climate Change, which has three main (general) goals:

- Promoting the action by Member States by encouraging all Member States to adopt comprehensive adaptation strategies (such as the Adaptation Strategy), providing sufficient financial resources, promoting activities in cities
- Promoting better-informed decision-making by addressing gaps in knowledge about adaptation and further developing the European Climate Change Adaptation Platform (Climate-ADAPT)
- Promoting adaptation in key vulnerable sectors by integrating it into common agricultural, fisheries and cohesion policy, ensuring that Europe's infrastructure is flexible and resilient to climate change, and promoting the use of insurance against natural and man-made disasters.

At the international level, outside the EU, there are several agreements of major importance for the Adaptation Strategy, namely:

- United Nations Framework Convention on Climate Change (UNFCCC), which aims to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system
- The Kyoto Protocol, in conjunction with the UNFCCC, is an addition to the international climate change agreement signed with the aim of reducing carbon emissions and other greenhouse gases
- The Paris Agreement builds upon the UNFCCC and for the first time unites all nations with a common cause of undertaking ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. It aims to accelerate and intensify the actions and investments needed for a sustainable

low carbon future. The goal is to keep a global temperature increase below 2 °C by the end of this century, i.e. to limit its increase to 1.5 °C. The text includes, *inter alia*, the following: "Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal". It entered into force on 23 June 2017.

- Goal 13 of the UN 2030 Agenda for Sustainable Development "to take urgent action to combat climate change and its impacts" is one of the 17 new Sustainable Development Goals (SDGs).

4. SITUATION IN THE REPUBLIC OF CROATIA: PROJECTIONS OF FUTURE CLIMATE AND THE IMPACT AND VULNERABILITY ASSESSMENT

4.1. Climate projection in the Republic of Croatia for 2040 with a view to 2070

The rise in global temperature since the middle of last century is exceptionally strong and predominantly caused by the increase in carbon dioxide concentration, the most important greenhouse gas. According to the 2013 IPCC estimates, the increase in carbon dioxide concentration and the rise in global temperature can be largely attributed to human activity.

In addition to the "historical" climate simulation for the period 1971 –2000, the RegCM regional climate model was used to calculate change (projections) for the future climate in two periods: 2011 –2040 and 2041 –2070, assuming IPCC scenarios of increasing greenhouse gas concentrations RCP4.5 and RCP8.5. The RCP4.5 scenario is characterised by a medium level of greenhouse gas concentrations with relatively ambitious expectations regarding their future reduction, which would peak around 2040. The RCP8.5 scenario is characterised by a continuous increase in greenhouse gas concentrations, which, by the year 2100, would be up to three times higher than today.

RegCM's numerical integrations used the marginal and initial conditions of four different Global Climate Models (GCMs) that were used in experiments in the fifth phase of the Coupled Model Intercomparison Project (CMIP5) for the preparation of the Fifth Climate Change Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) in 2013. The GCM models are as follows: the CNRMCM5 model of the French meteorological service, the model of the European EC-Earth consortium, the MPI-ESM model of the German Max-Planck Institute for Meteorology and the HadGEM2 model of the British Meteorological Office.

For those climate parameters whose spatial variability does not change significantly (e.g. temperature – daily mean, maximum, minimum, followed by pressure, evapotranspiration, insolation, etc.), the 50 km horizontal resolution used in this regional climate model can be sufficient to describe well the state of the reference climate and expected future changes according to the predetermined climate scenario. For those climatological parameters that have a higher spatial variability (precipitation, snow cover, wind, etc.) or depend on the different characteristics of small spatial scales (orography, land-sea contrast), a higher (finer) horizontal resolution would be preferable. However, due to the complex orography and particularly significant differences and contrasts in the coastal belt of the Republic of Croatia, adequate

numerical modelling of climate and climate change is very demanding and materially exceeds the modelling capabilities that were available during the preparation of the Adaptation Strategy.

Concrete numerical assessments outlined in the modelling results should be considered only as an approximation due to all the uncertainties in climate modelling, although they generally agree with similar European studies. The climate modelling results for the most commonly used climatological variables are as follows:

Precipitation. Observed trends. During the period from 1961 to 2010, annual precipitation levels in the Republic of Croatia showed prevalent statistically insignificant trends, which are positive in eastern lowlands (increase) and negative in other areas of Croatia (decrease). Slight trends are noticeable in most seasons, with the exception of summer precipitation that exhibits a clear negative trend across the country (decrease). In autumn, there are slight trends of mixed trajectory, and the increase in inland precipitation is mainly due to the increase in the number of days with large daily precipitation quantities. During the winter, precipitation trends are not significant and are mostly negative in southern and eastern regions. In the rest of the country, precipitation trends are of mixed trajectory. In spring, the results show no significant changes in total precipitation in southern and eastern part of the country, while a negative trend (decrease) is present in the remaining parts.

Future change in precipitation for the RCP4.5 scenario. At an annual level, a very small decrease in the mean annual precipitation is forecast until 2040, which will have no significant impact on the total annual volume. In north-western Croatia, change is moving in the direction of a smaller annual precipitation increase. It is expected that average annual precipitation will continue to decrease (up to about 5 %) until 2070, which will extend to almost the entire country, except its northernmost and westernmost parts. The largest decrease is expected in the southern Lika region up to the Dalmatian hinterland along the border with Bosnia and Herzegovina (about 40 mm) and in the southernmost land areas (about 70 mm).

The projected changes in total precipitation *per season* between 2011 and 2040 have different trajectories. In winter in the entire Croatia, and in spring in most of Croatia, a smaller increase in total precipitation is expected. In summer and autumn, a decrease in total precipitation will prevail throughout the country. The expected increase in winter precipitation is between 5 and 10 % in the northern and central regions, while the increase in total spring precipitation in western regions will be smaller. Considerably lower spring precipitation levels are expected in eastern and southern regions. The largest summer precipitation decrease of 5–10 % is expected in northern Dalmatia and southern Lika, whereas the decrease in other parts should be less than 5 %. In autumn, the largest forecast decrease in total precipitation amount is about 20 mm in Gorski Kotar and in the northern part of Lika, which accounts for about 5 % of the total precipitation in that season, and in the far south the decrease is also about 5 %.

In the 2041 –2070 period, the decrease in precipitation is expected in all seasons, except in winter. The largest decrease (slightly more than 10 %) will occur in spring in southern Dalmatia and in summer (10–15 %) in mountainous areas and northern Dalmatia. The largest increase in total precipitation, 5–10 %, is expected on the islands in autumn and in northern Croatia in winter.

Future change for the RCP8.5 scenario. Until 2040, an increase in the total winter and spring precipitation in relation to the reference climate is expected in most of the country. This increase would be the largest, 8–10 %, in northern and central Croatia in winter. In summer,

the predominant decrease in total precipitation is forecast, mostly in Lika – up to 10 %. In autumn, a slight increase in total precipitation is expected.

In the 2041 –2070 period, an increase in total winter precipitation is forecast for entire Croatia, and mostly, by 8–9 %, in northern and central regions. In summer, total precipitation is expected to decrease throughout the country, mostly in northern Dalmatia, 5–8 %. In spring and autumn, change refers both to an increase and a decrease in precipitation. However, a decrease in total autumn precipitation rate would prevail in most of the country, except in northern Croatia.

Rainy and dry periods. Scenario RCP4.5. Until 2040, the expected number of *rainy periods* (a series of at least 5 days when the total precipitation is greater than 1 mm) would generally decrease, except for winter in central Croatia, when it would slightly increase. These changes are generally small. A further decrease in the number of rainy periods is expected in the mid-21st century (2041 –2070). The greatest decrease would be in mountainous and coastal Croatia in winter and spring, but also in summer in the parts of mountainous Croatia and northern Dalmatia.

In the 2011 –2040 period, the number of *dry periods* could increase in autumn in almost the whole country and in northern areas in spring and summer. The number of dry periods in winter would decrease in central Croatia, as well as in certain locations in the coastal area in spring and summer. An increase in the number of dry periods is expected in practically all seasons by the end of 2070. The most prominent increase would be in spring and summer, and slightly less in winter and autumn.

Scenario RCP8.5. In the spring season that is important for vegetation no significant change in the number of dry periods is expected by 2040, but in the 2041 –2070 period there will be an increase in the number of dry periods that would affect most of Croatia.

Air temperature. Observed change. During the 1961 –2010 period, the trends of mean, mean minimum, and mean maximum air temperatures show warming throughout Croatia. Trends in annual air temperature are positive and statistically significant, and changes are greater in the continental part of the country than on the coast and in the Dalmatian hinterland. The greatest change (increase) was observed in maximum air temperature. The highest contribution to the overall positive air temperature trend was due to the summer trends, and the trends for winter and spring equally contributed to the increase in mean maximum temperatures. The slightest changes were in regard to the autumn air temperature. The observed warming is also reflected in all temperature extreme indices.

Future change for the RCP4.5 scenario. In the 2011 –2040 period, mean *annual* air temperature values are expected to increase almost uniformly (1.0 to 1.2 °C) throughout Croatia. In the 2041 –2070 period, the expected trend of rising temperatures would continue and would amount to between 1.9 and 2°C. Somewhat warmer could only be at the far west of the country, along the western coast of Istria.

In the 2011 –2040 period, a clear signal of increase in average ground air temperature throughout Croatia is expected in all *seasons*. In winter and summer, the highest projected temperature increase would be from 1.1 to 1.3 °C in the coastal regions. In spring, the increase could range from 0.7 °C in the Adriatic to slightly more than 1.0 °C in the north of Croatia, and in autumn the expected increase in temperature could be between 0.9 °C in eastern regions to about 1.2 °C in the Adriatic, exceptionally up to 1.4 °C in western Istria.

In the period from 2041 to 2070, the highest increase in mean air temperature, up to 2.2 °C, is expected in the Adriatic in summer and autumn. In winter and spring, the largest projected temperature increase is somewhat smaller – up to about 2.1 °C or 1.9 °C in continental areas. In winter and spring, the spatial distribution of temperature increase is reverse to that in summer and autumn: the increase is the smallest in the Adriatic and higher towards inland. In spring, the average temperature increase is between 1.4 and 1.6 °C in the Adriatic region, with a gradual increase of 1.9 °C towards northern regions.

The projected change in *maximum* air temperature by 2040 are similar to those for mean (daily) temperature and are expected to increase in all seasons. Generally, the increase would be higher than 1.0 °C (0.7 °C in spring in the Adriatic), but less than 1.5 °C. In the 2041 –2070 period, a further increase in maximum temperature is expected. It could be higher than in the previous period, and in relation to the reference climate it could reach 2.3 °C in summer and autumn on the islands.

The *minimum* temperature is expected to increase in the future climate as well. Until 2040, the highest expected increase in minimum temperature is in winter: up to 1.2 °C in northern Croatia and on the coast and up to 1.4 °C in Gorski Kotar, i.e. in the area where it is usually the coldest. The slightest expected increase, less than 1.0 °C, would occur in spring. In the 2041 –2070 period, the highest increase in minimum temperature is expected in winter – from 2.1 to 2.4 °C in the continental part and from 1.8 to 2 °C in the coastal area. In other seasons, the increase in minimum temperature would be somewhat smaller than in winter.

Future change for the RCP8.5 scenario. According to this scenario, in 2011 –2040 period, the *seasonal* increase in temperature would be on average higher only by about 0.3 °C compared to RCP4.5. This coincidence of results in two different scenarios is also evident in the projections of temperature increase from global climate models, according to which the increase in temperatures in all IPCC scenarios in most of the first half of the 21st century is very similar. However, in the 2041 –2070 period, the forecast increase in temperature for the RCP8.5 scenario is significantly higher than that for RCP4.5 and is between 2.6 and 2.9 °C in summer and from 2.2 to 2.5 °C in other seasons.

For the *maximum* temperature up to 2040, the expected seasonal increase in relation to the reference period is highest in summer (up to 1.7 °C in the coastal areas and on the islands), and lowest in spring (0.9–1.1 °C). In winter and autumn, the expected increase in maximum temperature is between 1.1 and 1.3 °C. In the mid-21st century (2041 –2070), the highest expected increase in mean maximum temperature is up to 3.0 °C in summer on the Adriatic islands and between 2.2 and 2.6 °C in other seasons.

For the *minimum* temperature, the largest forecast increase in the 2011 –2040 period is above 1.5 °C in north-western Croatia, northern part of Gorski Kotar and in the eastern part of Lika in winter and in the coastal regions in summer. In spring and autumn, the expected increase is somewhat lower, from 1.1 to 1.2 °C. By 2070, the minimum temperature would increase from 2.2 to 2.8 °C in winter and from 2.6 to 2.8 °C in summer. In spring and autumn, the increase would be slightly lower – between 2.2 and 2.4 °C.

Extreme temperature conditions were analysed based on frequency of a number of days of occurrences of an (extreme) event in the season, i.e. the change in frequency in the future climate.

Future change for the RCP4.5 scenario. In the 2011 –2040 period, a rise in the number of *hot days* (when the maximum temperature is over 30 °C) is expected in summer, which could also

result in prolonged periods with high air temperature (*heat waves*). An increase in the number of hot days from an average of 15 days up to 25 days in the reference climate period (1971 – 2000) would amount in most of Croatia to between 6 and 8 days, and more than 8 days in eastern Croatia and in some locations in the Adriatic. In mountainous areas, the increase in the number of hot days under future climate conditions would be the same as in the vast majority of the country. The number of hot days would continue to increase in the 2041 –2070 period. It is expected that the number of hot days will increase by slightly more than 12 days across Croatia, which would almost double the number of hot days in mountainous areas compared to the reference period.

Under future climate conditions, an increase in the number of *summer days with warm nights* (when the minimum temperature is higher than or equal to 20 °C) is expected by 2040, and the highest increase is projected for the Adriatic area. A further significant increase in the number of days with warm nights is expected by 2070.

The expected number of winter *ice days* (when the minimum temperature is below –10 °C) would decrease in the 2011 –2040 period compared to the reference climate. For the 2041 – 2070 period, a further decrease in the number of ice days is forecast.

Future change for the RCP8.5 scenario. Under this scenario, a slight increase in the number of *hot days* is expected by 2040, and by 2070 this increase would be approximately 30 % higher compared to RCP4.5. Compared to the RCP4.5 scenario, the forecast number of *days with warm nights* will only slightly increase by 2040, but a significant increase is expected in the 2041 –2070 period, especially in eastern Slavonia and coastal regions. A further decrease in the number of *ice days*, especially in the 2041 –2070 period.

Medium wind speed at 10 m. In the 2011 –2040 period will not change in winter and spring, but forecasts suggest a possible rise during summer and autumn in the Adriatic. The forecast increase in average wind speed is particularly pronounced in autumn in northern Adriatic (up to about 0.5 m/s), representing a change of about 20–25 % compared to the reference period. The slight increase in average wind speed is also forecast in autumn in Dalmatia and mountainous regions. In the 2041 –2070 period, a moderate decrease in average wind speed is expected in winter in parts of northern and eastern Croatia. In summer and autumn, the simulated upward trend in wind speed continues in the Adriatic, similar to the 2011 –2040 period.

Maximum wind speed at 10 m. At an *annual* level, in future climates between 2011 and 2040 and between 2041 and 2070, the expected maximum wind speed would remain virtually unchanged in relation to the reference period, with the highest values of 8 m/s on the southern Dalmatian islands.

Until 2040, a slight reduction in the maximum wind speed for *seasonal* averages is expected in all seasons, except in summer. Winter is expected to show a reduction in the maximum wind speed by about 5 % in the regions where the wind is the strongest under the reference climate – in southern Adriatic and in the hinterland of central and southern Dalmatia. In the 2041 – 2070 period, a reduction in the maximum wind speed is expected in all seasons except in summer. The largest decrease in the maximum wind speed in this period is expected in winter in southern Adriatic. It is worth noting that the 50 km resolution (the resolution used in this climate modelling) is insufficient for a more accurate description of spatial (local) variations in maximum wind speed, which depend on many details of more accurate scales (orography, terrain orientation – ridges and valleys, vegetation, urban barriers, etc.).

Evapotranspiration. In the future climate period, between 2011 and 2040, an increase in evapotranspiration by 5 to 10 % is expected in most of the areas in spring and summer, and a more significant increase is expected only on the outer islands and in western Istria. In most of northern Croatia, no change in the overall summer evapotranspiration is expected. Until 2070, the expected change for most of Croatia is similar to that in the 2011 –2040 period. A somewhat more pronounced increase (10–15 %) is expected in summer in the coastal areas and in the hinterland as well as up to about 20 % on the outer islands.

Air humidity. By 2040, an increase in air humidity is expected throughout the year and mostly in summer in the Adriatic. In the 2041 –2070 period, a uniform increase in air humidity is expected throughout Croatia, somewhat higher in summer in the Adriatic.

Solar irradiance. The forecast changes in the incoming solar energy flux in the period from 2011 to 2040 do not go in the same direction in all seasons. While a decrease in the incoming solar energy flux is projected in winter throughout Croatia and in spring in western regions, an increase in values compared to the reference period is expected in summer and autumn, and in the northern areas in spring. All changes range from 1 to 5 %. In the summer season, when the inflow of solar energy is the highest (in the coastal areas and the hinterland 250–300 W/m^2), the forecast increase is relatively small. In the 2041 –2070 period, the incoming solar energy flux is expected to increase in all seasons except in winter. The highest increase occurs in summer, namely from 8 to 12 W/m^2, in mountainous and central Croatia, whereas the lowest occurs in central Dalmatia.

Snow cover. Until 2040, a decrease in *snow water equivalent*, i.e. the snow cover is forecast in winter. This reduction is the largest in Gorski Kotar and would amount to 7–10 mm, which makes up slightly less than 50 % of snow water equivalent in the reference climate[1]. In the 2041 –2070 period, a further decrease in snow water equivalent is expected throughout Croatia. Hence, a stronger decrease in snow cover in the future climate is expected in those areas that have the highest amounts of snow in the reference climate – in Gorski Kotar and other mountainous regions.

Soil humidity. It is expected that in the period until 2040 soil humidity will decrease in northern Croatia, and by 2070 throughout Croatia as well (in the central part of northern Croatia for more than 50 mm). The highest decrease in soil humidity is expected in the summer and fall months.

Surface runoff. In the 2011 –2040 period, no significant change in surface runoff is expected in most parts of Croatia during the year. However, in mountainous areas and partly in the hinterland of Dalmatia, surface water flow could be reduced by about 10 % in winter, spring and autumn. By 2070, the amount of runoff would decline slightly, mostly in spring, when this reduction could affect the whole of Croatia. This decrease in runoff coincides with a decrease in total spring precipitation in the mid-21st century.

Sea level. The forecasts of the rise in sea level have not been obtained with the RegCM model, but the results have been taken from the IPCC AR5 and prepared with the conclusions based on research of domestic authors and monitoring current fluctuations in mean sea level change in the Adriatic Sea. According to the CMIP5 Global Model (IPCC AR5), the results for the mid-21st century (2046 –2065) show an expected rise in the *global* mean sea level under RCP4.5 of 19–33 cm, and with RCP8.5 of 22–38 cm. In the 2081 –2100 period, this increase

[1]Any changes in the future climate were calculated in relation to the RegCM simulation of the reference (historical) climate from 1971 –2000,

would be 32–63 cm for RCP4.5 and 45–82 cm for RCP8.5. This global rise in sea levels will not be evenly reflected in all areas. The forecasts of change in the Adriatic Sea level by the end of the 21st century (according to IPCC AR5 and domestic sources) provide an indicative increase in the range between 32 and 65 cm, which has also been used when proposing measures related to the change in the mean sea level. However, it should be noted that these estimates are associated with considerable uncertainties, which were encountered already in the calculation of the sea level for the historical climate.

The two climate scenarios that were considered in climate modelling during the development of the Adaptation Strategy are: (1) a future in which mitigation and adaptation measures are implemented (RCP4.5), and (2) a future in which the existing climate change adaptation policy remains the same, i.e. no significant mitigation and adaptation measures are implemented (RCP8.5). The RCP4.5 scenario is the most common scenario used when developing adaptation strategies, and the measures in this Adaptation Strategy were also determined according to it. The summary overview of features of climate change parameters for the Republic of Croatia according to the RCP4.5 scenario is given in Table 4-1.

Table 4-1: Forecasts of climate parameters for the Republic of Croatia according to the scenario RCP4.5 compared to the 1971 –2000 period,

Climate parameter	Future climate projections according to the RCP4.5 scenario compared to the 1971 –2000 period obtained by climate modelling	
	2011 –2040,	**2041 –2070,**
PRECIPITATION	**Average annual quantity**: *slight decrease* (except for a slight increase in north-western Croatia)	**Average annual quantity**: *further decreasing trend* (up to 5 %) in almost all of Croatia, except for north-western parts
	Seasons: different signs; **winter and spring** in most of Croatia *a slight increase* of +5 to 10 %, and **summer and autumn** *decrease* (mostly from –5 to 10 % in southern Lika and northern Dalmatia)	**Seasons**: *decrease* **in all seasons** (up to 10 % in mountainous areas and northern Dalmatia) *except* **in winter** (increase of 5–10 % in northern Croatia)
	Decrease in the number of **rainy periods** (except in central Croatia where it would slightly increase). The number of **dry periods** would *increase*.	The number of **dry periods** would *increase*.

SNOW COVER		*Decrease* (highest in Gorski Kotar, up to 50 %)	*Further decrease* (especially in mountainous areas)
SURFACE RUNOFF		There are no major changes in most regions; however, in mountainous areas and the hinterland of Dalmatia a *decrease* of up to 10 %	*Decrease* in runoff throughout Croatia (especially in spring)
AIR TEMPERATURE		Average: *increase* of **1–1.4 °C** (all seasons, entire Croatia)	Average: *increase* of **1.5–2.2 °C** (all seasons, entire Croatia – especially the continental parts)
		Maximum: *increase* in all seasons **1–1.5 °C**	Maximum: *increase* up to **2.2 °C** in summer (up to 2.3 °C on the islands)
		Minimum: the highest *increase* **in winter, 1.2–1.4 °C**	Minimum: the highest *increase* in the continent **in winter 2.1–2.4 °C**; and **1.8–2 °C** in coastal areas
EXTREME WEATHER CONDITIONS	**Hot days** (number of days with Tmax > +30 °C)	**6 to 8 days** *more* than the reference period (reference period: 15–25 days per year)	Up to **12 days** *more* than the reference period
	Cold days (number of days with Tmin < –10 °C)	*Decrease* in the number of days with Tmin < –10 °C and increase in *T*min values (1.2–1.4 °C)	Further *decrease* in the number of days with Tmin < –10 °C
	Warm nights (number of days with Tmin ≥ +20 °C)	*Increasing*	*Increasing*
WIND	**Average speed** at 10 m	**Winter and spring** *without change*, but an *increase* of 20–25 % **in summer and particularly autumn** in the Adriatic	**Winter and spring** *mostly without change*, but an *increasing trend* **in summer and autumn** in the Adriatic.

	Max. speed at 10 m	Per year: *without change* (highest values on islands in southern Dalmatia) Per season: *decrease* in **winter** in southern Adriatic and hinterland	Per season: *decrease* in all seasons except in summer. *The highest decrease* in **winter** in southern Adriatic
EVAPOTRANSPIRATION		*Increase* in **spring and summer** 5–10 % (outlying islands and western Istria > 10 %)	*Increase* of 10 % for most of Croatia, up to 15 % in coastal areas and hinterland, and up to 20 % on outlying islands.
AIR HUMIDITY		Year-round *increase* (**most in summer** in the Adriatic)	Year-round *increase* (**most in summer** in the Adriatic)
SOIL HUMIDITY		*Decrease* in northern Croatia	*Decrease* throughout Croatia (**most in summer and autumn**)
SOLAR IRRADIANCE (INPUT SOLAR ENERGY FLUX)		*Increase* throughout Croatia in **summer and autumn**, *increase* in northern Croatia, and *decrease* in western Croatia in **spring**; *decrease* throughout Croatia in **winter**	*Increase* in all seasons except in winter (highest in mountainous and central Croatia)
MEAN SEA LEVEL		2046 –2065, **19–33 cm** (IPCC AR5)	2081 –2100, **32–65 cm** (estimation of average mean values for the Adriatic from various sources)

4.2. Assessment of climate change impacts and vulnerability of sectors to climate change

Adapting to climate change is fundamentally a horizontal issue, i.e. an issue that needs to be addressed in an integrated manner with a high degree of coordination between the participants. However, it should be noted that the Adaptation Strategy is based on the analysis of those sectors and cross-sectoral areas that are relevant to the adaptation due to their socio-economic importance for the Republic of Croatia and/or are of importance to nature and the environment. For this purpose, eight key sectors have been selected (water resources; agriculture; forestry; fisheries; biodiversity; energy; tourism and health) and two cross-sectoral thematic areas (spatial planning and risk management). The Adaptation Strategy is the outcome of an integrated approach which, based on analysis of the situation in selected sectors and cross-sectoral thematic areas, results in both an overview of cross-sectoral impacts and vulnerabilities and a set of measures, while taking into account implementation capacities and cross-sectoral effects of implementation of each measure. When planning and implementing the measures,

the vulnerability of the spatial environment from the aspect of biodiversity and ecosystem services that mitigate climate change effects should be taken into account and priority should be given to nature-based solutions (NbS).

The main expected impacts, which can lead to a high vulnerability of **water resources** are: reduction of water quantity in watercourses and in springs; reduction of underground water reserves and lowering of groundwater levels; reduction of water levels in lakes and other lake-type natural or built-up systems; rising sea levels, salinisation of coastal aquifers and aquatic systems; increase in water temperature followed by the reduction of the reception capability of aquatic receivers; increased frequency and intensity of flooding in vulnerable areas; increased frequency and intensity of torrents; increased frequency and intensity of rainwater floods in urban areas; rising sea levels, and thus the risk of flooding at the mouths of watercourses; reduced efficiency of coastal infrastructure and intensified salinisation of river estuaries and coastal aquifers. The increased vulnerability of the marine environment caused by climate change will also be manifested in the risks related to the weakening of thermohaline circulation of the Adriatic Sea, which can significantly affect a variety of abiotic and biotic processes and changes, especially related to ocean ventilation and change in oxygen concentration in deeper layers, increasing the acidity of the sea, as well as a series of related biological processes and impacts on marine biodiversity and fisheries (e.g. reduction in productivity, changes in the dynamics of food chains, reduction in populations of species forming marine biogenic habitats, changes in the distribution of species, higher risk of disease occurrence, etc.). Changes in ocean and sea circulation are a direct result of climate change and cause drastic changes, not only in the marine environment or marine biodiversity, but also in the climate of surrounding areas, which in turn affects all sectors.

The Republic of Croatia is relatively rich in water, but not in water supply because of its geological structure with a large share of the surface with karst structures and large spatial-temporal heterogeneity of runoffs. Namely, the karst areas that occupy about half of the territory of the Republic of Croatia generally have a small possibility of accumulation of water reserves over a long period during critical dry periods. The state of water and marine resources in the territory of the Republic of Croatia is largely dependent on transboundary impacts due to the global impact of climate change on the dynamics of ocean and sea level change as well as the high share of cross-border and transboundary watercourses in relation to Croatia's total water resources. It is expected that the deterioration of hydrological conditions due to climate change will increase the frequency and duration of dry periods on the one hand, and the frequency and intensity of flood situations on the other hand.

The forecast increase in air temperature for the period up to 2070, as well as the stagnation or minor reported trends of minimal change in total precipitation rates, will result in increased evapotranspiration, reduction of surface and underground runoff and, consequently, even more pronounced reduction in water resources. In such conditions, synergistic effects of negative impacts are expected due to an increase in anthropogenic pressures, above all expressed in the increased water demand. Adverse climate change will particularly jeopardise vulnerable coastal karst aquifers and other aquatic phenomena in the coastal area (lakes, watercourses, springs) due to the cumulative effect of possible changes with reduced flows and groundwater levels and more intensive sea penetration into karst coastal aquifers and lakes, as well as spreading of salinised seawater along the watercourse basins deeper into the hinterland. The results of the performed modelling show that the intensity of short-term severe precipitation will increase in the future, of both rare and frequent possibilities of the phenomenon, creating

preconditions for frequent occurrences of floods in flood watercourses, urban areas and river basins.

Negative impacts of climate change are particularly expected at watercourses in the coastal area due to the coinciding and cumulative effect of rising sea levels and the occurrence of extreme flows. With the reduction of the mean annual and minimum annual flows and the increase in maximum annual flows, very pronounced changes in water temperatures are expected, which will have a negatively impact on aquatic ecosystems, their diversity and reception capacity, as well as the possibility of their use for other purposes. In such circumstances it is necessary to achieve the goal of preserving the good status of water in such changed climate conditions as a result of climate change and to ensure a reduction of flood and drought risks. When doing so, it is necessary to use nature-based solutions (NbS) as much as possible because, for example, natural or less modified river systems are generally more resistant to extreme climate events and return to their initial state easier than those modified by various water-technical interventions.

The expected rise in sea levels, but also the impact of future tides, waves and storms will also have an impact on the coastal infrastructure. The most vulnerable places will be urban areas with a low coastline (e.g. places on islands such as Cres, Mali and Veli Lošinj, Krk, Rab, Krapanj, Vela Luka and others, but also in coastal Croatia such as Nin, Trogir, Ston and others). A particularly negative impact of the rise in sea levels is expected to occur at sandy shores, which will be exposed to increased erosion and other morphological changes in terms of altering their geometries, which can even lead to their complete disappearance. However, in areas where this is possible, depending on geomorphological features of the coast, urbanisation of the area and so forth, the emergence of new sandy shores is expected. Negative changes are expected for the artificial parts of the coast, where built beaches will lose their functional optimums, and where structural damage can also occur.

Table 4-2: Overview of the impacts and challenges of climate change adaptation in the area of **water resources**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Reduction of water quantity in watercourses and in springs • Reduction of underground water reserves and lowering of groundwater levels • Reduction of water levels in lakes and other lake-type natural or built-up systems • Rising sea levels and changes in its thermohaline features • Salinisation of coastal aquifers and aquatic systems	• Strengthening professional, research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems • Construction, reconstruction and upgrading of existing systems for protection against the harmful effects of water by applying the “room for the river” approach and use of natural retention areas, water use systems and water protection systems as well as other multi-purpose hydro-technical

• Water temperature rise followed by a reduction of the reception capability of aquatic receivers • Increased frequency and intensity of flooding in vulnerable areas • Increased frequency and intensity of torrents • Increased frequency and intensity of rainwater flooding in urban areas	systems in new (future) climate conditions • Strengthening the resilience of the coastal water and municipal infrastructure against the possible impacts of climate change • Applying an integrated approach to water resources and systems management and intensifying of cross-sectoral observations and activities • Increasing the protection of natural water and maritime systems, particularly of protected areas and ecological network areas, from adverse impacts of climate change and for their adaptation

The main expected impacts of climate change that cause high vulnerability in the sector of **agriculture** are: changes in the vegetative period of arable crops with an emphasis on grains and oilseeds (e.g. corn, sugar beets, soy, etc.); lower yields of all crops and a higher water demand; a longer vegetative period will enable the cultivation of new varieties and hybrids; while more frequent flooding and stagnation of surface water will reduce or completely destroy yields. According to some predictions, agriculture is the sector that will suffer the highest damage from the consequences of climate change. It is expected that, due to climate change, the yield of current agricultural crops in the Republic of Croatia will be reduced by 3–8 % by 2050.

Increasingly longer and more frequent drought periods, storm winds, floods, hail, fires, as well as the increasing threat to agricultural crops from heat stress over the last decades, especially in Dalmatia, are a clear signal, primarily to fruit growers, olive growers and winemakers to start implementing climate change adaptation measures. The drought in the summer months in the period between 1980 and 2014 was the largest single cause of damage to Croatian agriculture resulting from climate variability, while in the period from 2013 to 2016 it caused damage totalling HRK 3 billion, which is equal to 43 % of direct aid paid to agriculture in the same period.

Without increased investments, a satisfactory percentage of areas under irrigation and indoor production cannot be achieved, nor can the level of organic matter in the soil be significantly increased, which will result in a reduction in agricultural production compared to the existing situation.

It has been observed that climate change already affects the phenological phases of fruit and vegetable crops (e.g. apple, grapevine, olive and corn), particularly in some regions of Croatia (Slavonia and Dalmatia), so that the vegetative period begins earlier, lasts less time, and ultimately results in lower yields. The lack of ground water (drought) and higher air temperatures in the upcoming period will be the two key issues in agricultural efforts to cope with climate change. However, climate change will also have certain positive effects on the

agricultural sector, such as enabling the cultivation of new crops and varieties in areas where that has not been possible before.

Table 4-3: Overview of the impacts and challenges of climate change adaptation in the area of **agriculture**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Change in the duration/length of the vegetative period of agricultural crops and lower yields • Higher demand for irrigation water due to frequent droughts • Longer vegetative period will enable the cultivation of new varieties and hybrids • More frequent flooding and stagnation of surface water – which will reduce or completely destroy yields • Reduced growth rate and quality of animal products, reproduction disturbances, new diseases	• Strengthening the capacity to understand and implement climate change adaptation measures • Increasing the absorption capacity of soil for water on agricultural land • Soil conservation tillage and other methods of reduced soil tillage • Selection of animal breeds that are more resistant to climate change • Breeding of varieties, hybrids and breeds more resistant to climate change • Irrigation of agricultural land • Construction of water accumulations • Application of bioengineering anti-erosion measures • Construction and/or reconstruction of drainage systems • Development of the drought warning system

In the **forestry** sector, there are several major expected impacts that cause high vulnerability. This is primarily related to a higher frequency and length of the forest fire season, including fires on the continent. The current trend in the number of forest fires shows that there were significantly more fires in the dry years in the Mediterranean area, while forecasts show that the risk of forest fires in the future will be higher for the whole of the Republic of Croatia. Furthermore, it is expected that phenological phases of tree species will shift toward an earlier start of vegetation and that their vegetation season will be extended depending on species and habitats. Due to the change in habitat conditions, a migration of species and pests, including invasive species, could occur. The productivity of certain forest ecosystems, such as oak-tree forests, could be reduced, although it should be emphasised that it depends not only on atmospheric change, but also on the management practices and other impacts. Due to the increased frequency of forest fires and the occurrence of strong winds, icing events that cause

damage, floods, pest attacks and similar, higher damage to forest ecosystems are expected, such as reduction in value of wood varieties and loss of forest functions of general benefit.

Table 4-4: Overview of the impacts and challenges of climate change adaptation in the area of **forestry**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Increased incidence of forest fires including the occurrence of fires in the continental part of Croatia due to increased temperature and decreased precipitation • Decreased productivity of some forest ecosystems • Migration of harmful organisms • Shift in phenological phases of forest tree species • Increased sensitivity of tree species to changed climate conditions • Increased extinction rate of tree species due to climate change • Damage to forest ecosystems due to the increased intensity and frequency of extreme weather events (natural disasters) • Reduced forest functions of the general benefit, i.e. reduced capacity of the forest ecosystems to provide services	• Intensifying research and increasing management capacities to assess the occurrence of adverse impacts associated with climate change and adaptation of forest ecosystems to climate change • Establishment of cross-sectoral monitoring and reporting on the status of forest ecosystems as a prerequisite for informed planning and implementation of adaptation measures • Research on climate sensitivity of tree species in different climates • Research on the impact of climate on the extinction rate of tree species • Developing tree species growth scenarios and models depending on the climate to identify possible options for climate change adaptive management • Identification of species and provenances of forest trees that are genetically best adapted to climate change impacts and are of economic significance • Developing recommendations for adapting to the adverse impact of harmful organisms under the influence of climate change • Raising awareness in the forestry sector about the impact of climate change on forest ecosystems, vulnerabilities, risks and possible adaptation measures • Establishing green infrastructure in larger urban areas

	• Strengthening the capacities for fire protection

The major expected impacts of climate change in the **fisheries and aquaculture** sector will be additional pressure on the marine ecosystem that is already under the influence of numerous anthropogenic factors, in particular overfishing, habitat destruction and pollution.

The estimated increase in the temperature of the Adriatic Sea between 1.6 and 2.4 °C by 2070 can expectedly result in the migration of marine organisms (especially shrimp and hake) to deeper waters and towards the north, a higher number of invasive alien species and the reduction or disappearance of native fish species and change in the choice of breeding species. As one of the consequences, it is possible to expect a decrease in the primary production, resulting in lower abundance of pelagic fish due to changes in water circulation caused by thermohaline causes. The predicted increase in temperature and reduced fresh water quantities will most likely limit the availability of water for freshwater aquaculture. The positive effects of rising water temperatures will be accelerated growth and shorter breeding cycle of fish. The acidification of seas and oceans will have major consequences for marine ecosystems based on habitat-forming species, and the related ecosystem services, with potentially significant impacts on the well-being of society. The acidity of the Adriatic Sea is estimated to increase by 0.1 to 0.2 degree of pH, which will disrupt shellfish breeding in certain areas. Increased acidity can result in the degradation of biogenic habitats providing a large number of services (e.g. Posidonia beds are crucial for maintaining populations of more than 400 species, among which those of economic importance; coralligenous habitats serve as shelters, feeding grounds and places for the settlement and development of numerous species, including those of economic importance, etc.). Acidification stimulates the homogenisation of communities and the reduction in functional diversity at the landscape level.

Future climate change will impact the economic viability of fishing, especially coastal and demersal fishing. In the cultivation of marine organisms, the impact will be twofold: positive for breeding tuna and sea bream, and negative for breeding sea bass and oysters. The fisheries sector will be particularly vulnerable to global trends in supply and price of fish flour and fish oil as a result of climate change.

Table 4-5: Overview of the impacts and challenges of climate change adaptation in the area of **fisheries and aquaculture**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Migration to the northern Adriatic Sea or to the deeper sea of cold-water species due to rising sea temperatures	• Strengthening capacities for predicting the future status of bioresources

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
• Increase in the number of alien species and influence on domestic species due to rising sea temperatures • Decrease in the primary production, resulting in lower numbers of pelagic fish due to changes in water circulation caused by thermohaline causes • Slower growth rate and higher mortality of shellfish due to increased sea acidity • Impaired habitat capacity to provide ecosystem services essential for maintaining species of economic importance • Impaired socio-economic stability of the fisheries sector	• Development of techniques and tools for exploiting alien species and popularisation of their use • Strengthening research capacities in the field of selective breeding, feeding of fish and breeding in recirculation systems • Development of measures to preserve the most vulnerable habitats that provide services of maintaining populations of economically important species • Increased resilience of aquaculture to the reduced flow of water, changes in physico-chemical parameters of water, and occurrence and spread of diseases • Mitigating the negative impacts of climate change by applying integrated forms of aquaculture • Integration of fishermen into the tourism sector for the purpose of socio-economic sustainability

Biodiversity is currently most threatened by the degradation and loss of habitats, unsustainable exploitation of natural resources and pollution. The most important climate impacts in this sector are: change in average air temperatures; reduced precipitation amount and changes in spatial distribution of precipitation; occurrence of climate extremes, as well as warming, acidification and rising sea levels. The most vulnerable ecosystems are freshwater, underground, high-mountain and semi-natural grassland.

As a consequence, the following is expected at the habitat level: reduction in habitat size, changes in share and disappearance of certain habitats; increase in arid areas; drying out of wetland habitats; submersion of coastal habitats, salinisation of land and freshwater habitats by the sea; fragmentation; changes in structure, processes, functions and services, changes in the composition of species communities.

The main expected climate impacts that cause high vulnerability at the species level are: changes in phenology; termination of flowering of cryophilic and stenothermal plant species with shortening of vegetation and reduction of vigour; changes in abundance and distribution of species; spreading of ranges of thermophilic species (both positive and negative) due to increased average air temperature; drying and extinction of hygrophilic species due to reduced

precipitation quantities and changes in precipitation patterns; spreading of ranges of xerophilic species (both positive and negative) due to lower precipitation quantities and changes in precipitation patterns; reduction in populations of forest species due to frequent fires caused by increased average air temperature and reduced precipitation; loss of species adapted to life in a narrow range of environmental conditions (particularly endemic species with limited distribution); appearance and spreading of invasive alien species and species adapted to life in a wide range of environmental conditions and suppression of native species, thus also altering the structure and function of habitats; changes in inter-species interactions (positive and negative); changes in life cycles, changes in migration periods; decrease in reproduction performance; reduced resistance to disease or predation; reduction and disappearance of freshwater species in the Adriatic basin due to the salinisation of coastal habitats caused by rising sea levels; spreading of marine species to the north and appearance of thermophilic (tropical) invasive alien marine species due to sea temperature rise; potential uncontrolled growth in populations of organisms that cause disease in shellfish, fish, etc. The most vulnerable groups of species include the already endangered group of pollinators, which have a significant role in the ecosystem, as well as all species adapted to life in a narrow range of environmental conditions (particularly endemic species with limited distribution). Soil is exceptionally important for climate change adaptation, with particular emphasis on the importance of preserving soil biodiversity.

The scope of research of ecosystems, habitats and wild species at the national level is still insufficient to valorise their vulnerability to climate change and develop predictive models, so that efficient adaptation measures could be defined.

Sectors of special importance for adapting biodiversity to climate change are water management, agriculture, forestry and spatial planning. This highlights the importance of cross-sectoral measures to strengthen the resilience of biodiversity on the basis of nature-based solutions (NbS) such as careful use of space, restoration, revitalisation, measures related to traditional knowledge and agricultural practices, etc.

Table 4-6: Overview of the impacts and challenges of climate change adaptation in the area of **biodiversity**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Reduction in habitat size, changes in their share and disappearance of some habitats • Habitat fragmentation • Changes in structure, processes, functions and services • Changes in the composition of species communities • Changes in phenology • Termination of flowering of cryophilic and stenothermal plant species with	• Raising awareness of the importance of ecosystems, habitats, wild species, protected areas and ecological network areas, and the importance of preserving ecosystem services and their impact on all aspects of life and economy • Increasing knowledge, and improving and updating existing databases in the nature protection system with elements for vulnerability assessment and for development of predictive models

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
shortening of vegetation and reduction of vigour • Damage, degradation and extinction due to climate extremes (long-lasting droughts, excessive short time precipitation, stormy winds, excessive sunlight, etc.) • Changes in abundance and distribution of species • Loss of species adapted to life in a narrow range of environmental conditions (particularly endemic species with limited distribution) • Appearance and spreading of invasive alien species and species adapted to life in a wide range of environmental conditions and suppression of native species • Changes in inter-species interactions (positive and negative) • Changes in life cycles • Changes in migration periods • Reduction in populations of forest species due to frequent fires caused by increased average air temperature and reduced and unevenly distributed precipitation • Reduction and disappearance of freshwater species in the Adriatic basin due to the salinisation of coastal habitats caused by rising sea levels • Spreading of marine species to the north and appearance of thermophilic (tropical) invasive alien marine species due to sea temperature rise	• Defining habitats and species most vulnerable to climate change consequences • Strengthening the resilience and preserving ecosystems, habitats and species sensitive to climate change through cross-sectoral cooperation, application of traditional knowledge and agricultural practices and adaptive management • Defining the baseline status and establishing monitoring for the most vulnerable ecosystems, habitats and species • Defining measures to reduce the spreading of invasive alien species and to limit their populations • Reducing anthropogenic impacts on (semi-)natural ecosystems, habitats and wild species primarily via sustainable development measures • Implementation of integrated management of land, freshwater, coastal and marine ecosystems • Strengthening the capacity of research institutions and competent authorities for nature preservation • Providing an economically stimulating regulatory environment for the implementation of planned projects (tax benefits, platform for withdrawing funds from structural and other EU Funds, investment aid etc.) for the purpose of adapting and strengthening the resilience of ecosystems, habitats and species, and the nature protection system • Incorporation of climate change adaptation measures into key nature protection documents and into adaptive

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
	management of protected areas and ecological network areas

The main expected impacts that cause vulnerability in the **energy** sector are: reduction of electricity production in hydropower plants due to the change in temporal distribution of annual precipitation (no significant change in the mean annual level has been projected – with a possible smaller reduction, but there are changes in rain and dry periods, while dry seasons trends are increasing); increase in electricity consumption for cooling purposes (cooling degree days increase) due to increased average air temperature; reduction of energy production in thermal power plants due to inadequate cooling of the plants because of reduction in the average annual precipitation; damage to power plants and infrastructure due to extreme weather events such as ice breaks and floods, and the reduction of electricity production in hydropower plants due to droughts.

Climate parameters directly affect the energy sector in the form of increased or reduced energy resource needs at certain time periods. Climate extremes and natural disasters will significantly disrupt safe energy supply. Global temperature rise in all seasons will increase the cooling energy consumption in summer and reduce the energy needed for heating in winter. Extreme climate events will negatively affect the production, transmission and distribution of energy. Decreasing precipitation levels in the summer period will lead to a reduction in the hydroelectric power plant contribution, while increasing the need for electricity in the summer months. Lower precipitation levels will lead to an issue with the thermal power plant cooling flow system, which will also negatively affect the production.

Table 4-7: Overview of the impacts and challenges of climate change adaptation in the **energy** sector

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
• Decrease in the production of electricity in hydropower plants due to reduced precipitation in all seasons except winter, and consequentially lowered flow rate, numerous dry periods and increased evapotranspiration • Increase in the consumption of electricity for cooling purposes (higher number of cooling degree days) due to increased average air temperature • Reduction of thermal energy production in thermal power plants due to increased	• Strengthening the capacity for climate hazards impact assessments, risk prevention, readiness measures and emergency response • Increasing the resilience and flexibility of the existing power system to the impacts of extreme and climate hazards and expected climate change • Increasing the resilience of the transmission and distribution grid to the impacts of extreme and climate hazards and expected climate change

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
average air temperature in winter months • Decrease in the production of electric and thermal energy in thermal power plants due to insufficient cooling of the plants due to flow reduction • Damage to power plants and infrastructure due to extreme weather events – ice breaking and floods	• Increasing the security of electricity supply in the summer period • Ensuring an enabling legal framework for the use of renewable energy sources with the aim of diversifying sources and increasing decentralised electricity and heat production • Improving the capacity for modelling and predicting weather events and extreme weather conditions for the purpose of adapting the energy sector to climate change • Strengthening the model predictive technologies for weather forecasting and extreme weather conditions and for the assessment of resource bases for renewable energy sources

In the **tourism** sector, the main expected impacts of climate change are: reduction of tourism demand in the summer months due to high temperatures, increased UV radiation, higher frequency and severity of extreme weather events; reduction or loss of attractiveness of ecosystems and biodiversity as elements of attraction in tourism; reduction of water availability and damage to different infrastructure systems (wastewater drainage, solid waste disposal, beach infrastructure, accommodation infrastructure, horticulture of hotel complexes, etc.) and/or their reduced functionality.

Changes in climate parameters will have different implications for individual tourist destinations, but they can be both positive and negative. Due to climate change (but also because of the proximity to western and northern European guests), the regions of Europe further north could become attractive enough for vacation during the summer months, and the Mediterranean and the Republic of Croatia could remain attractive (only) in the rest of the year. The tourism sector will be compelled to enrich its offer and to include higher quality products, which can positively affect competitiveness and guest composition. Favourable climate conditions in the coastal part of the Republic of Croatia in post season and pre-season can positively affect the reduction of seasonal influences on the financial efficiency of tourism in the form of extension of the season. The opportunities for tourism development in mountains and continental areas will increase.

Table 4-8: Overview of the impacts and challenges of climate change adaptation in the **tourism** sector

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability

• Misalignment between the tourist offer and projected climate change (high temperatures, increased solar irradiance, frequency of extreme weather events, etc.) • Changing attractiveness of the coastal parts and inland areas of the Republic of Croatia • Damage to and/or reduced functionality of various infrastructure systems (water supply, drainage, beach infrastructure, horticulture, etc.) • Deterioration of ecosystems, biodiversity and cultural heritage important for tourism due to indirect and direct effects of climate change	• Adaptation of the tourism sector to changed operating conditions due to climate change impacts • Harmonisation of tourism activities with forecast climate change • Strengthening the competences of experts directly related to the tourism sector concerning climate change impacts and adaptation • Inclusion of climate change adaptation measures in all segments of sustainable Croatian tourism • Revitalisation of the tourist offer in the entire Republic of Croatia and exploitation of previously insufficiently used or unused potentials • Implementation of priority programmes of cultural heritage rehabilitation by including acceptable measures to reduce the vulnerability to climate change

The main expected impacts that cause high vulnerability in the **health** sector due to increased frequency and duration of extreme weather conditions as well as the impacts of other important climate parameters are: increased mortality; change in the epidemiology of chronic non-infectious diseases; change in the epidemiology of acute infectious diseases and reduction of air quality, water and food health safety and the level of possibly damaging factors in the environment.

Vulnerability in the health sector is most likely to be manifested by an increase in the number of persons with acute and chronic illnesses, i.e. increased mortality due to extended periods with high air temperatures; increased incidence of vector diseases; increase in respiratory diseases due to increased allergenic pollen in the air, etc.

Lower health safety of water for human consumption can be expected due to lower availability and increased utilisation of resources. The impact of climate conditions is important due to indirect impacts on surface waters and waters for recreation, particularly in the case of improperly designed supply or drainage systems (waste and drainage water). The impact of seawater on the health is significant not only because of the rise in sea temperature and, for example, growth of toxic algal blooms, but also because of eutrophication processes due to the large amount of organic matter that comes into the marine ecosystem with human activity.

Climate change will have a significant impact on food security, i.e. availability, distribution and consumption of food. The incidence of acute intestinal infections is expected to increase. A higher share of chronic disorders such as endocrine diseases, digestive diseases such as cancer and chronic diseases such as Crohn's disease, ulcerative colitis, etc. is also expected.

The reduced level of food safety due to microbiological or chemical contamination as a result of changed macro- and microclimate conditions presents a significant vulnerability and future burden on the health system.

Contrary to the negative consequences described above, and due to the expected reduction in the period of low air temperature and snow cover (snow water equivalent), lower mortality is expected, i.e. a lower number of sudden deaths due to the impact of low temperature on health. As the climate model for both future periods predicts a reduction in the amount of snow water equivalent, i.e. the amount of water that would occur in the event of instant snow melting, an impact on reducing the number of injuries and more efficient diagnosis and injury therapy due to the reduction of the occurrence and duration of extreme snow precipitation is possible.

Table 4-9: Overview of the impacts and challenges of climate change adaptation in the **health** sector

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Increased mortality of the population • Change in the epidemiology of chronic non-infectious diseases • Change in the epidemiology of acute infectious diseases • Reduced quality of outdoor and indoor air due to extremely high and low temperatures and precipitation • More frequent and longer periods of unavailability of water safe for human consumption • Increased levels of contaminants and pollutants in the environment • Impact on the epidemiology of diseases related to climate factors	• Strengthening competences of the health system in climate change impacts on health • Strengthening competences of the health system for response during future adaptation • Determination of sectoral priorities of climate change related activities • Extension of the system for monitoring health and environmental indicators associated with climate change and of the risk assessment system

Although most of the above sectors are also exposed to the consequences of climate change occurring in other sectors or their changes affect the situation in other sectors, it has become evident that there are two management (cross-sectoral) thematic areas that have common points with all thematically clearly defined individual sectors. These two areas are spatial planning and risk management. To an extent, they have the task of integrating individual sectors in the management of climate change adaptation.

Spatial planning has an integrative function in the planning of spatial development and use of land and marine areas, and climate change represents a threat to the management of spatial development. **Spatial planning** also has a function in environmental protection and climate change adaptation which, in the context of intensifying climate change, should be further

enhanced. At the same time, spatial planning plays an extremely important role in reducing the impacts of climate change, as changes in land use (for example, from agricultural or forest land into construction land or change of forests into agricultural land) are considered to be among the most important causes of increase in greenhouse gas emissions. This cross-sectoral activity also includes islands, which represent a particular geographic and problem area in terms of climate change.

The vulnerability of the built environment to climate change impacts includes flooding in settlements due to a rise in sea levels and extreme sea levels as a result of extreme weather conditions and a general rise in the mean sea level (high vulnerability); the occurrence of heat islands in settlements due to the influence of extreme temperatures, in particular the increase in hot days and days with temperatures above 35 °C (medium vulnerability) and flooding in settlements as a consequence of the higher incidence and intensity of extreme weather conditions characterised by large amounts of precipitation in the short term (medium vulnerability).

The estimates of average rise in sea levels on the Croatian coast range from 0.32 m to 0.65 m by the year 2100, with recent estimates increasing this value up to 1.1 m. When coupled with the effects of intermittent extreme sea levels ranging from 0.84 m to 1.15 m, intermittent extreme sea levels occurring at the end of the century will be in the range of 1.4 m to 2.2 m. Temperature rise is the most probable aspect of climate change which, among other things, is manifested by an increase in the number of days with temperatures higher than 35 °C. The largest increase, from 3 to 5 days by 2040, is expected in most of northern Croatia, in the part of northern Primorje and in the part of middle Dalmatia, where this increase is locally more than 100 % compared to today's climate. In the 2041 –2070 period, a further increase in the same parameter is expected from 7 to 10 days in the same areas. Such extended periods of extreme temperatures exacerbate the heat island effect in urban environments. The forecast change in total precipitation varies for different regions and different seasons. A slight increase is expected in the number of days with extreme precipitation in autumn and winter in the southern regions, particularly in the central and southern Adriatic. Larger quantities and irregular incidence of heavy precipitation affects the existing and planned infrastructure for collection and drainage of precipitation.

The basis of spatial planning is a multi-sectoral, interdisciplinary approach that considers, aligns and regulates the spatial requirements of all other sectors. Therefore, dealing with sectoral requirements and proposals, as well as analysing cross-sectoral impacts and aligning them, are common tasks of spatial planning. This also applies to the planning of climate change adaptation measures. First of all, integrating these measures into spatial plans divides the responsibility of many professions that spatial planers use in two ways. The first one concerns direct planning solutions that are the primary responsibility of spatial planners, e.g. planning the development of settlements by defining land use or urban planning of settlements themselves (street network, built structures, grey and green infrastructure, etc.). The other way is indirect, that is, in the spatial planning process sectors submit their requests and inputs that planners, after alignment and resolution of possible conflicts, include in spatial planning solutions. Accordingly, each sector is expected, based on their respective analyses and monitoring, sectoral strategic documents, plans and other expert backgrounds, to define and substantiate their interests, requirements and needs and to further participate in the spatial planning process. In order to reduce the number of potential conflicts, it is necessary to follow the guidelines of the Spatial Development Strategy of the Republic of Croatia, and it is good practice for sectors to consult spatial plans and planners in advance while preparing their

sectoral documents and to anticipate possible problems that may arise in the interaction of their needs with the requirements and expectations of other sectors. Furthermore, another important instrument is integrated coastal area management, which introduces a new management concept to reduce pollution and anthropogenic pressures in coastal areas and the marine environment and which should be used in the context of expected climate change impacts and climate change adaptation options.

Table 4-10: Overview of the impacts and challenges of climate change adaptation in the area of **spatial planning**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Heat islands in settlements due to increased average temperatures in the summer months • Sea floods caused by rising sea levels • Floods in settlements due to extreme amounts of precipitation	• Improving the information base as a basis for making rational decisions related to the planning of climate change adaptation measures • Strengthening capacities within the spatial planning system with the aim of integrating adaptation measures into spatial planning • Integrating climate change adaptation considerations into the integrated coastal area management instrument • Integrating adaptation measures into the spatial planning system • Application of spatial planning adaptation measures through rehabilitation programmes and projects for the most vulnerable areas/sites • Raising awareness of the public and decision-makers related to the planning of climate change adaptation measures

Disaster risk management is defined as the implementation of preventive and planning activities aimed at reducing vulnerability and mitigating the adverse effects of disaster risks. Climate change can increase the likelihood of disaster events and exacerbate their intensity. The main expected impacts that cause high or medium vulnerability in this sector are: landslides; floods; open type fires due to extended periods of high solar irradiance and extended periods of high air temperatures; extreme temperatures due to extended periods of high solar irradiance and extended periods of high air temperatures; pandemics due to the impact on diseases transmission pathways or pathogen characteristics resulting from changes in precipitation, humidity and evaporation rates; and complex risks, particularly in urban areas.

The current preparedness of the civil protection system in the area of response was assessed as high, while preparedness in the area of prevention was assessed as low, which is in line with the actual situation given the insufficient scope of investment. A positive example of a professionally directed multidisciplinary preparation of a strategic document adjusted to the direction of future climate change adaptation is the development of the "Disaster Risk Assessment for the Republic of Croatia", a document adopted by the Government of the Republic of Croatia in November 2019. In this national strategic document, the impact of climate change for each individual risk has been assessed. Negative impacts of climate change have been reported for nine out of the eleven identified risks.

In Croatia, the particular vulnerability of the risk management system is insufficient support in the implementation of internationally recognised guidelines, priority actions in risk management and sustainable development with active inclusion and partnership of all stakeholders in accordance with the Sendai Disaster Risk Reduction Framework 2015 –2030. Without monitoring the identified priority indicators, without developing a compatible and internationally comparable database and without sharing experiences and good practice examples, it is difficult to manage disaster risks. Also, without multi-sectoral assessments of critical areas and multi-hazard areas based on climate models, it is currently impossible to quantitatively estimate multi-sectoral impacts of climate change in Croatia.

Table 4-11: Overview of the impacts and challenges of climate change adaptation in the area of **disaster risk management**

Impacts and challenges that cause high vulnerability	**Possible responses to reduce high vulnerability**
• Open-type fires due to extended periods of high solar irradiance and extended periods of high air temperatures • Epidemics and pandemics due to the impact on diseases transmission pathways or pathogen characteristics resulting from changes in precipitation, humidity and evaporation rates • Increased health and socio-economic burden on the community due to food contamination and environmental pollution after events such as flooding or landslides	• Strengthening competences of key participants in managing risks related to climate change • Strengthening management and recovery capacities after major accidents and disasters related to climate change • Establishing multidisciplinary priority guidelines for actions related to climate change • Expanding risk monitoring and risk assessment systems using climate change risk monitoring tools • More effective remediation of damages resulting from major accidents and disasters related to climate change

Impacts and challenges that cause high vulnerability	Possible responses to reduce high vulnerability
	• Modifying the community's burden after exposure to climate change-related threats

5. CLIMATE CHANGE ADAPTATION MEASURES

5.1. Principles for defining climate change adaptation measures

The approach to determining sectoral and cross-sectoral (horizontal) adaptation measures is based on several general principles:

- *Science-based adaptation approach:* By applying this principle, it is possible to reduce the uncertainties and insecurities regarding the possible effects of climate change. When analysing the status and drafting the scenarios of potential effects, the latest scientific knowledge was used in certain sectors.
- *Complementarity of adaptation and mitigation of climate change impacts:* Adapting to and mitigating the effects of climate change are two complementary concepts of policies related to climate change. Efficient and timely mitigation measures positively affect adaptation, or reduce the socio-economic cost of adaptation. However, it is necessary to clearly separate adaptation measures from mitigation measures in order to reduce the duplication of effort.
- *Precautionary principle:* Uncertainty about the future effects of climate change is not a reason for lack of action. Although it should be insisted that the measures are scientifically founded, even in the case of lack of scientific basis for implementation, it is necessary to implement adaptation measures, since inaction can significantly increase the cost. In this Strategy, the precautionary principle has been consistently implemented.
- *Adaptability principle:* The long-term perspective of the Adaptation Strategy requires that the principle of adaptability be applied so that timely action could be taken in the adaptation process, namely in situations where change in climate change scenarios is observed and based on models used for the purposes of this Adaptation Strategy.
- *Sustainability principle:* No proposed measure should jeopardise the interests of future generations or negatively affect the development of other sectors. From the perspective of nature and the environment, the measures must have a positive effect on nature and the environment, while from the economic perspective, the measures must undergo a cost-effectiveness analysis and then be ranked.
- *Involvement of stakeholders in the consultation and decision-making process:* Active involvement of stakeholders is a basic prerequisite for the successful implementation of climate change adaptation.
- *Integration of adaptation into sectoral policies:* The issue of adaptation to climate change and appropriate measures should be integrated into sectoral policies. The

Adaptation Strategy provides a framework and proposes measures, but their implementation largely depends on the degree of integration of climate change adaptation policies into other sectoral policies, strategies and plans.

5.2. Adaptation measures

Based on the general principles for defining the measures, analysing the current situation by sectors and assessing the degree of vulnerability and possible responses to climate change adaptation challenges, a set of measures has been identified in each sector, aimed at effectively defining the climate change adaptation system. In addition to sectoral measures, a set of horizontal measures, i.e. cross-sectoral measures (spatial planning and disaster risk management) has been defined. The tables below provide an overview of the climate change adaptation measures by sectors.

The Adaptation Strategy proposes a total of 83 measures, of which three measures can be considered as general (climate modelling, knowledge and capacity building, development of the implementation impact indicators for the Adaptation Strategy). Adaptation measures were selected through the multi-criteria analysis conducted in cooperation with sectoral experts and in consultation with over 130 stakeholders from all represented sectors and thematic areas. Measures are evaluated according to the criteria and factors, and their impact on reducing the vulnerability of a certain sector.

The largest number of proposed measures is a part of the so-called "non-structural" measures (administrative, political, legislative, technical and planning measures, measures to raise awareness of the need for climate change adaptation, data gathering, monitoring and scientific-research work). A relatively small number of the so-called "structural" measures (measures involving any constructed object or natural structure whose purpose is to reduce or avoid possible climate change impacts) include certain technical interventions such as the construction of protective dams and walls, construction of hydro-technical facilities, as well as afforestation, building of green infrastructure, strengthening the absorption capacity of land for the absorption of excess water, etc. It should not be surprising that a great number of measures is of "non-structural" nature. Adaptation to climate change entails those human activities that require an extremely long planning horizon with a great deal of uncertainty and insecurity. Furthermore, most "structural" measures require exceptionally large financial investments for their implementation, and their overall effects will only be felt in the distant future – assuming that the anticipated climate change projections are realised.

It is very important to start with the implementation of "non-structural" measures as soon as possible in order to create an adequate social climate (primarily by extensively raising awareness of all stakeholders of the need to implement climate change adaptation measures), to properly analyse the situation where it is necessary to undertake such measures, to estimate their cost effectiveness and to determine all necessary prerequisites (including the necessary scientific data bases) for the effective implementation of the measures. For the latter, it is exceptionally important to create institutional prerequisites at all administrative levels, primarily by strengthening their relevant professional capacities. Finally, the implementation of "non-structural" measures is a fundamental prerequisite for the implementation of "structural" measures, which require a good foundation in scientific and measured data and incomparably greater financial resources, and which will be implemented mostly over a much longer period of time. Therefore, when planning and implementing the measures, especially "structural" ones, the vulnerability of the spatial environment from the aspect of biodiversity

and ecosystem services that contribute to adaptation or mitigate climate change effects should be taken into account and priority should be given to nature-based solutions (NbS) in order to reduce the possibility of negative impacts of climate change.

It should be highlighted that climate change adaptation measures will also contribute to the preservation and regeneration of the EU's natural capital and the conservation of its ecosystems, which is consistent with the objective of the European Green Deal.

Water resources

The climate change adaptation measures in this sector are identified as HM-01 to HM-10 and are, based on the overall assessment rating for individual measures, grouped into three categories according to their importance: measures of very high importance (01–03), of high importance (04–06) and of medium importance (07–10).

Table 5-1: Climate change adaptation measures in the sector of water resources: measures of very high importance (01–03), of high importance (04–06) and of medium importance (07–10)

Measure ID	Measure name	Key stakeholders
HM-01	Implementation of non-structural measures for protection against harmful effects of water and for water protection in cases of extreme hydrological conditions whose increase in intensity and frequency is conditioned by climate change	Ministry responsible for water management, ministry responsible for construction and spatial planning, ministry responsible for science and education, HV (Croatian Waters), DHMZ (Croatian Meteorological and Hydrological Service)
HM-02	Support to planning, construction, reconstruction and upgrading the system for protection against harmful effects of water and related hydro-technical systems (structural measures) and lowland natural floodplains flooded in a controlled fashion, as well as other water protection measures, giving priority to applying the "room for the river" approach and use of natural retention areas	Ministry responsible for water management, HV, spatial planning entities defined by the act governing spatial planning
HM-03	Strengthening professional, research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems in current and future climate conditions	Ministry responsible for water management, ministry responsible for construction and spatial planning, ministry responsible for nature, HV, DHMZ, HGI (Croatian Geological Survey), HHI (Croatian Hydrographic Institute), relevant faculties

Measure ID	Measure name	Key stakeholders
HM-04	Strengthening capacities of responsible institutions to act in cases of occurrence of extreme hydrological conditions	Ministry responsible for water management, ministry responsible for construction and spatial planning, HV, MUP (Ministry of the Interior), water supply companies
HM-05	Reducing adverse effects on the coastal water and municipal infrastructure and coastal water resources caused by rising sea levels brought about by climate change (non-structural measures)	Ministry responsible for water management, ministry responsible for construction and spatial planning, ministry responsible for the sea, transport and infrastructure, HV
HM-06	Strengthening the resilience of urban areas to anthropogenic pressures conditioned by climate change	Ministry responsible for construction and spatial planning, ministry responsible for water management, HV, LSGUs (local self-government units)
HM-07	Strengthening capacities for exploration and sustainable management of groundwater	Ministry responsible for environmental protection, HV, DHMZ, HGI
HM-08	Strengthening the resilience of the coastal water and municipal infrastructure and coastal water resources (structural measures)	Ministry responsible for water management, HV, LRSGUs (local and regional self-government units)
HM-09	Strengthening professional, research and management capacities for the protection of particularly valuable aquatic ecosystems	Ministry responsible for nature, JUZP (Public Institution for the Management of Protected Areas) and public institutions for the management of protected natural values at the county level
HM-10	Mapping of water sources outside the public water supply system	Ministry responsible for water management, ministry responsible for agriculture, LRSGUs, HZJZ (Croatian Institute of Public Health), county institutes of public health, HV

Agriculture

The climate change adaptation measures in this sector are identified as P-01 to P-08 and are, based on the overall assessment rating for individual measures, grouped into three categories according to their importance: measures of very high importance (01–05), of high importance (06–07) and of medium importance (08).

Table 5-2: Climate change adaptation measures in the sector of agriculture: measures of very high importance (01–05), of high importance (06–08) and of medium importance (09)

Measure ID	Measure name	Key stakeholders
P-01	Implementation of the climate change adaptation experimental-research programme in agriculture	Ministry responsible for agriculture, scientific research institutions, DHMZ, Academy of Agricultural Sciences, Advisory Service
P-02	Increasing the water absorption capacity of agricultural soil	Ministry responsible for agriculture, PG, HV
P-03	Application of appropriate soil tillage methods (e.g. soil conservation tillage and other methods of reduced soil tillage)Application of appropriate soil tillage methods (e.g. soil conservation tillage and other methods of reduced soil tillage)	Ministry responsible for agriculture, PG, Academy of Agricultural Sciences, scientific research institutions
P-04	Cultivation of species and varieties of agricultural crops for food and non-food supply chain and breeds of domestic animals that are more resilient to climate change	Ministry responsible for agriculture, scientific research institutions, DHMZ, Croatian Science Foundation
P-05	Integration of climate change risks into the development of irrigation systems	Ministry responsible for agriculture, ministry responsible for water management, PG, SMEs, HV
P-06	Application of anti-erosion measures	Ministry responsible for agriculture, PG
P-07	Reconstruction and construction of amelioration drainage structures	Ministry responsible for agriculture, ministry responsible for water management, HV, PG
P-08	Insurance of agricultural production from production losses caused by adverse climate conditions	Ministry responsible for agriculture, PG

Forestry

The climate change adaptation measures in this sector are identified as ŠU-01 to ŠU-12 and are, based on the overall assessment rating for individual measures, grouped into three

categories according to their importance: measures of very high importance (01–04), of high importance (05–06) and of medium importance (07–12).

Table 5-3: Climate change adaptation measures in the sector of forestry: measures of very high importance (01–04), of high importance (05–06) and of medium importance (07–12)

Measure ID	Measure name	Key stakeholders
ŠU-01	Incorporation of adaptation measures into key documents pertaining to forests and forestry sectors	Ministry responsible for forestry, HŠ (Croatian Forests), Union of private forest owners' associations, HŠI (Croatian Forest Research Institute), Faculty of Forestry, Croatian Forestry Society, HKIŠDT (Croatian Chamber of Forestry and Wood Technology Engineers), Academy of Forestry Sciences, public institutions for protected areas at the national and county level
ŠU-02	Increasing knowledge on the vulnerability of forests to climate change and possible response measures	Ministries responsible for forestry and nature protection, Croatian Science Foundation (HRZZ), HŠI, HŠ, Faculty of Forestry
ŠU-03	Strengthening capacities for systematic monitoring and reporting on the state of forest ecosystems as a prerequisite for informed planning and implementation of climate change adaptation	Ministry responsible for forestry, ministry responsible for nature protection, HŠI, HŠ, Faculty of Forestry, Croatian Science Foundation (HRZZ), association of forest owners
ŠU-04	Strengthening capacities for fire protection	MUP, Croatian Firefighting Association, DHMZ, HŠ, HKIŠDT, scientific community, LRSGUs, public institutions for protected areas at the national and county level
ŠU-05	Implementation of the green infrastructure concept aimed at strengthening climate resilience in urban and rural areas	Spatial planning entities defined by the act governing spatial planning, LRSGUs, city utility companies, HŠ, urban planners, landscape architects, scientific community, urban forestry experts, ministry responsible for forestry, ministry responsible for nature protection, HKIŠDT, biologists/ecologists, civil society associations, HV
ŠU-06	Prediction (forecast) of change in the distribution of harmful organisms	Ministry responsible for forestry, HŠI, Faculty of Forestry, DHMZ

ŠU-07	Afforestation and reforestation to strengthen resilience to climate change	Ministry responsible for forestry, HŠ, association of forest owners, civil society organisations
ŠU-08	Raising awareness of stakeholders in the forestry sector regarding climate change and adaptation measures	Ministry responsible for forestry, ministry responsible for nature protection, HKIŠDT, HŠI, Faculty of Forestry, HŠ, Academy of Forestry Sciences, Union of private forest owners' associations, JUZP and public institutions for the management of protected natural values at the county level, DHMZ
ŠU-09	Raising awareness and sensitisation of private forest owners for sustainable forest management as a prerequisite for adapting to climate change	Ministry responsible for forestry, Union of private forest owners' associations, LRSGUs
ŠU-10	Risk assessment and development of tools that ensure continuous adaptation of agricultural land and forest management to reduce damage from natural and weather-related disasters	HŠ, Faculty of Forestry, ministry responsible for forestry, ministry responsible for agriculture
ŠU-11	Identifying capacities and options for implementing adaptation measures and reducing the threat to populations of large wild animals	HŠI, Faculty of Forestry, ministry responsible for forestry, Faculty of Veterinary Medicine
ŠU-12	Defining communities and forest areas that are most susceptible to potential changes and defining measures to reduce the threat to the most vulnerable areas and communities	HŠI, Faculty of Forestry, ministry responsible for forestry

Fisheries and aquaculture

Climate change adaptation measures in the sector of fisheries and aquaculture are identified as RR-01 to RR-10. based on their overall assessment rating, individual measures were grouped into three categories according to their importance: measures of very high importance (01–07), of high importance (08–09) and of medium importance (10).

Table 5-4: Climate change adaptation measures in the sector of fisheries and aquaculture: of very high importance (01–07), of high importance (08–09) and of medium importance (10)

Measure ID	Measure name	Key stakeholders
RR-01	Strengthening the sector by investing in the development of new markets and expanding the range of products offered	Ministry responsible for fisheries and aquaculture, HGK (Croatian Chamber of Economy), HOK (Croatian Chamber of Trades and Crafts), LRSGUs, FLAGs (Fisheries Local Action Groups), fishermen
RR-02	Strengthening capacities to assess the future state of the sector due to climate change impacts	Ministry responsible for fisheries and aquaculture, ministry responsible for science and education, scientific institutions, DHMZ, fishermen, ministry responsible for water management, HV
RR-03	Strengthening the resilience of natural resources (the sea) through adaptive fisheries management	Ministry responsible for fisheries and aquaculture, scientific institutions, fishermen
RR-04	Increasing the involvement of fishermen in the tourism sector	Ministry responsible for tourism, tourist boards in counties, cities and municipalities, FLAGs, fishermen, scientific and professional institutions
RR-05	Strengthening aquaculture capacities by greater breeding of organisms at lower trophic levels and new forms of breeding	Ministry responsible for fisheries and aquaculture, scientific institutions, breeders
RR-06	Strengthening aquaculture capacities through breeding in recirculation systems	Ministry responsible for fisheries and aquaculture, scientific institutions, LRSGUs, breeders
RR-07	Strengthening aquaculture capacities by breeding new species of fish	Ministry responsible for fisheries and aquaculture, ministry responsible for environmental protection, ministry responsible for nature, scientific institutions, producers of fish feed and fish equipment, breeders
RR-08	Popularising the use of new fish species	Ministry responsible for fisheries and aquaculture, ministry responsible for environmental protection, ministry responsible for nature, scientific institutions, fishermen

RR-09	Strengthening aquaculture capacities by selective breeding	Ministry responsible for fisheries and aquaculture, ministry responsible for nature, scientific institutions, breeders
RR-10	Development of aquaculture by adapting the quantity and quality of food to changed climate conditions	Ministry responsible for fisheries and aquaculture, HAPIH (Croatian Agency for Agriculture and Food), scientific institutions, fish feed producers, breeders

Biodiversity

The climate change adaptation measures in this sector are identified as B-01 to B-09 and are, based on the overall assessment rating for individual measures, grouped into three categories according to their importance: of very high importance (01–04), of high importance (05–06) and of medium importance (07–09).

Table 5-5: Climate change adaptation measures in the sector of biodiversity: measures of very high importance (01–04), of high importance (05–06) and of medium importance (07–09)

Measure ID	Measure name	Key stakeholders
B-01	Improvement of knowledge and creation of databases to assess the vulnerability of (semi-)natural ecosystems, habitats, wild species, protected areas and ecological network areas for the purpose of improving predictive models	Ministry responsible for nature protection, ministry responsible for water management, ministry responsible for agriculture, Croatian Forests Ltd., speleological associations, individual experts, scientific and professional institutions
B-02	Establishment of a climate monitoring and early warning system for protected areas and ecological network areas and monitoring of ecosystems, habitats and wild species	Ministry responsible for climate change, DHMZ, ministry responsible for nature protection, JUZP
B-03	Development and implementation of measures for strengthening the resilience of vulnerable ecosystems, habitats and species	Ministry responsible for nature protection, ministry responsible for water management, ministry responsible for agriculture, ministry responsible for forestry, HŠ, HV, LRSGUs, scientific and professional institutions
B-04	Integrated management of (freshwater, marine and land) resources for the preservation	Ministry responsible for water management, HV, ministry responsible for nature protection, ministry responsible for agriculture, ministry responsible for

Measure ID	Measure name	Key stakeholders
	and revitalisation of natural ecosystems and biodiversity	environmental protection, ministry responsible for forestry, LRSGUs
B-05	Incorporation of climate change adaptation measures into key documents for the protection of nature and its components and management of areas, species and habitats	Ministry responsible for nature protection, JUZP, public institutions for the management of protected natural areas at the county level
B-06	Preservation and application of traditional agricultural practices and knowledge to strengthen the resilience of (semi-)natural ecosystems, habitats and wild species	Ministry responsible for agriculture, ministry responsible for regional development and EU funds, ministry responsible for nature, Academy of Agricultural Sciences
B-07	Improving sustainable management and reducing anthropogenic impacts on (semi-)natural ecosystems, habitats and wild species primarily via sustainable development measures by applying nature-based solutions (NbS)	Ministry responsible for nature protection, ministry responsible for construction and spatial planning, ministry responsible for agriculture, ministry responsible for tourism, HŠ
B-08	Strengthening professional and financial capacities of the nature protection system	Ministry responsible for nature protection, JUZP, public institutions for the management of protected natural areas at the county level, HŠ, HV
B-09	Transferring knowledge on the importance of ecosystems, habitats, wild species, protected areas and ecological network areas and the importance of preserving ecosystem services when adapting to climate change	Ministry responsible for nature protection, JUZP, public institutions for the management of protected natural areas at the county level, DHMZ

Energy

The climate change adaptation measures in this sector are identified as E-01 to E-08 below and are, based on the overall assessment rating for individual measures, grouped into three

categories according to their importance: of very high importance (01–03), of high importance (04–06) and of medium importance (07–08).

Table 5-6: Climate change adaptation measures in the sector of energy: measures of very high importance (01–03), of high importance (04–05) and of medium importance (06–07)

Measure ID	Measure name	Key stakeholders
E-01	Strengthening the resilience of production facilities through the storage of electrical energy	Ministry responsible for energy, HERA (Croatian Energy Regulatory Agency), HROTE (Croatian Transmission System Operator Ltd.), HOPS (Croatian Energy Market Operator Ltd.), HEP ODS (HEP Distribution System Operator), legal entities engaged in electricity production, eligible electricity producers
E-02	Strengthening capacities and ensuring an enabling legal framework to increase the capacity of renewable energy sources and distributed sources	Ministry responsible for energy, HERA (Croatian Energy Regulatory Agency), HROTE (Croatian Transmission System Operator Ltd.), HOPS (Croatian Energy Market Operator Ltd.), HEP ODS (HEP Distribution System Operator), legal entities engaged in electricity production, eligible electricity producers
E-03	Strengthening the resilience of the existing capacities for electricity and heat production	Ministry responsible for energy, ministry responsible for construction and spatial planning, HERA, legal entities engaged in electricity and thermal energy production, distribution and supply, DHMZ
E-04	Development of capacities for monitoring and rapid elimination of negative effects of climate impacts on the power system	Ministry responsible for energy, MUP, HERA, HOPS, HROTE, HEP ODS
E-05	Strengthening the resilience of the power system	Ministry responsible for energy, HERA, HROTE, HOPS, HEP ODS, legal entities engaged in electricity production and supply, DHMZ
E-06	Strengthening the resilience of the distribution grid	Ministry responsible for energy, HERA, HROTE, HEP ODS, DHMZ
E-07	Strengthening the resilience of the transmission grid	Ministry responsible for energy, HERA, HROTE, HOPS, DHMZ

Tourism

The climate change adaptation measures in this sector are identified as T-01 to T-06 and are, based on the overall assessment rating for individual measures, grouped into two categories according to their importance: of very high importance (01–04) and of high importance (05).

Table 5-7: Climate change adaptation measures in the sector of tourism: measures of very high importance (01–04) and of high importance (05)

Measure ID	Measure name	Key stakeholders
T-01	Integration of climate change into the tourism development strategy	Ministry responsible for tourism, ministry responsible for environmental protection, LRSGUs, tourist boards in counties, cities and municipalities, DHMZ
T-02	Raising awareness of persons involved in the tourism sector on climate change impacts, risks and adaptation options	Ministry responsible for tourism, HGK HTZ (Croatian National Tourist Board), tourist boards in counties, cities and municipalities, JUZP, public institutions for the management of protected natural areas at the county level
T-03	Promoting the education of high school and university students on climate change	Ministry responsible for science and education, Agency for Vocational Education, HGK, HOK
T-04	Strengthening the resilience of tourism infrastructure to different weather extremes	Ministry responsible for tourism, ministry responsible for construction and spatial planning, ministry responsible for environmental protection, ministry responsible for the sea, transport and infrastructure, LRSGUs, DHMZ
T-05	Strengthening the resilience of local communities in the tourism sector	Ministry responsible for tourism, LRSGUs, tourist boards in counties, cities and municipalities, DHMZ

Health

The climate change adaptation measures in this sector are identified as ZD-01 to ZD-09 and are, based on the overall assessment rating for individual measures, grouped into three categories according to their importance: of very high importance (01–03), of high importance (04–06) and of medium importance (07–09).

Table 5-8: Climate change adaptation measures in the sector of health: measures of very high importance (01–03), of high importance (04–06) and of medium importance (07–09)

Measure ID	Measure name	Key stakeholders
ZD-01	Establishment of a system for calculating health-economic indicators for climate change-related conditions	Ministry responsible for health, HZZO (Croatian Health Insurance Fund), HZJZ, county institutes of public health
ZD-02	Integration of various information systems within healthcare to monitor indicators associated with climate change	Ministry responsible for health, HZZO, HZJZ, county institutes of public health, HAPIH, DHMZ
ZD-03	Establishment of a framework for the implementation of human biomonitoring for tracking environmental factors related to climate change	Ministry responsible for health, HZZO, HZJZ, county institutes of public health, scientific institutes, medical faculties
ZD-04	Implementation of health impact assessments and health risk assessments related to climate change	Ministry responsible for health, ministry responsible for environmental protection, HZJZ, county institutes of public health, HAPIH, health risk and health impacts assessment experts
ZD-05	Networking and upgrading of the system of monitoring environmental indicators related to climate change	Ministry responsible for health, ministry responsible for environmental protection, ministry responsible for agriculture and forestry, ministry responsible for water management, HZJZ, county institutes of public health, HAPIH, HV, HŠ, private labs
ZD-06	Increasing the number of secure points in case of extreme meteorological conditions	Ministry responsible for health, ministry responsible for environmental protection, ministry responsible for construction and spatial planning, HZJZ, county institutes of public health,, LRSGUs, DHMZ
ZD-07	Strengthening the allergenic species monitoring system	Ministry responsible for health, ministry responsible for agriculture and forestry, ministry responsible for the sea, transport and infrastructure, ministry responsible for public utilities, HŠ, HV, HŽ (Croatian Railways), HZJZ, county institutes of public health, state administration offices in counties (UDUs), LRSGUs

Measure ID	Measure name	Key stakeholders
ZD-08	Raising awareness of the public and key stakeholders in health and other priority professions (e.g. educational and preschool institutions, facilities for elderly and helpless people, home care, etc.)	Ministry responsible for health, HZJZ, county institutes of public health, HAPIH, LRSGUs.
ZD-09	Integration of the climate change topic into the curriculum (for early childhood and preschool education; for primary and secondary education)	Ministry responsible for science and education, LRSGUs, public institutions that provide educational activities

Spatial planning

The climate change adaptation measures in this sector are identified as PP-01 to PP-05 and are, based on the overall assessment rating for individual measures, grouped into two categories according to their importance: of very high importance (01–04) and of high importance (05).

Table 5-9: Climate change adaptation measures in the area of spatial planning: measures of very high importance (01–04) and of high importance (05)

Measure ID	Measure name	Key stakeholders
PP-01	Strengthening knowledge bases as well as monitoring and evaluation systems	Ministry responsible for environmental protection, ministry responsible for construction and spatial planning, HV, LRSGUs, DHMZ, spatial planning entities defined by the act governing spatial planning
PP-02	Strengthening professional and institutional capacities of expert stakeholders in the spatial planning system	Ministry responsible for construction and spatial planning, spatial planning entities defined by the act governing spatial planning, HKA (Croatian Chamber of Architects), ministry responsible for environmental protection, persons authorised for the preparation of strategic studies, county institutes for spatial planning, LRSGUs
PP-03	Integration of adaptation measures into the spatial planning system	Ministry responsible for construction and spatial planning, spatial planning entities

		defined by the act governing spatial planning, LRSGUs
PP-04	Raising awareness and sensitisation of the public and decision-makers at all levels	Ministry responsible for environmental protection, ministry responsible for construction and spatial planning, spatial planning entities defined by the act governing spatial planning, LRSGUs, citizens, DHMZ, scientific organisations
PP-05	Preparation of rehabilitation programmes and projects	Ministry responsible for construction and spatial planning, ministry responsible for the sea, transport and infrastructure, ministry responsible for state assets, ministry responsible for tourism, ministry responsible for culture, LSGUs, LRSGUs, public and private property owners, competent legal entities with public authority, spatial planning entities defined by the act governing spatial planning

Risk management

The climate change adaptation measures in this sector are identified as UR-01 to UR-05 and are, based on the overall assessment rating for individual measures, grouped into two categories according to their importance: of very high importance (01–03) and of high importance (04–05).

Table 5-10: Climate change adaptation measures in the sector of risk management: measures of very high importance (01–03) and of high importance (04–05)

Measure ID	Measure name	Key stakeholders
UR-01	Strengthening the function and importance of the Croatian Platform for Disaster Risk Reduction (SROK) in the area of climate change	Members of the Committee of the Croatian Platform for Disaster Risk Reduction
UR-02	Multi-sectoral and sectoral risk assessment for various threat/risk scenarios related to climate change	Ministry responsible for health, ministry responsible for agriculture, ministry responsible for environmental and nature protection, ministry responsible for defence, ministry responsible for the sea, transport and infrastructure, security agencies, HVZ (Croatian Firefighting Association), HZJZ, HV, county institutes of public health, other

		competent state administration bodies and other institutions
UR-03	Strengthening the sector's capacities for the prevention and response to disasters and major accidents associated with climate change	MUP in cooperation with competent public authorities, DHMZ
UR-04	Creation of an integrated and standardised cross-sectoral database of threats, measures, damages and losses	State administration bodies that keep databases in their daily operations (DHMZ, HZJZ, MUP, Ministry of Environmental Protection and Energy (MEPE), Ministry of Health, Ministry of Agriculture, Ministry of Finance, HV)
UR-05	Expanding capacities and models for the coverage of risks related to climate change and catastrophic damages	MUP, competent state administration bodies, certification organisations, insurance companies

General measures

Table 5-11: General measures were identified by expert assessment as measures of very high importance, and, as such, should be included into the first Action Plan

Measure ID	Measure name	Key stakeholders
KM-01	Strengthening the professional and technical capacities for implementing research and applied activities and operational activities that include the area of climate modelling and predictive technologies for predicting weather and environmental conditions and related warnings of dangerous weather and environmental conditions, as well as analyses and interpretation of observed and expected climate changes and dangerous weather phenomena caused by them	DHMZ, universities, scientific research institutes, ministry responsible for environmental protection, ministry responsible for the sea, transport and infrastructure, HV, Croatian Hydrographic Institute, Institute of Oceanography and Fisheries, "Ruđer Bošković" Institute, Faculty of Natural Sciences of the University of Zagreb, Faculty of Forestry of the University of Zagreb, Plovput d.o.o., agencies, institutes and other expert bodies

OM-01	Increasing the level of knowledge and capacities for monitoring climate change impacts, risk assessment and climate change adaptation	Ministry responsible for environmental protection, ministry responsible for science and education, ministries and institutions with public authority and agencies competent for the management of natural resources and responsible for sectors vulnerable to climate change, universities, scientific research institutes, ministry responsible for finance
RP-01	Development of implementation impact indicators for the Adaptation Strategy	Ministry responsible for environmental protection, ministries and institutions with public authority and agencies competent for the management of natural resources and responsible for sectors vulnerable to climate change, universities, scientific research institutes, ministry responsible for finance

6. PRIORITIES OF THE CLIMATE CHANGE ADAPTATION STRATEGY

6.1. Procedure for defining priority measures and activities

Based on the list of a total of 85 identified climate change adaptation measures, 83 of which were identified as sectoral measures and divided into five groups of measures based on the national priorities of the Adaptation Strategy, which in turn were identified by all stakeholders during the process of harmonising the concept of climate change adaptation in the Republic of Croatia and ranked by the method of multi-criteria analysis. The remaining two general measures were not taken into account in this distribution because they are supra-sectoral. Five national priorities were identified, within which climate change adaptation measures are to be implemented. These are:

1. Ensuring sustainable regional and urban development

2. Ensuring preconditions for the economic development of rural areas, coastal areas and islands

3. Ensuring sustainable energy development

4. Strengthening of the management capacities through a networked monitoring and early warning system

5. Ensuring the continuity of research activities.

Climate change adaptation measures were grouped according to their type as regulatory and administrative measures (RE), implementation measures (PR), education and public awareness-raising measures (ED), and research-development measures (IR).

By integrating the above, climate change adaptation measures were further divided into three basic categories according to their urgency and importance of implementation:

- Measures of very high importance

- Measures of high importance
- Measures of medium importance.

Two general measures (KM-01 and RP-01) were identified by expert assessment as measures of very high importance, which is why they should be included in the first Action Plan.

6.2. Priority measures and activities

Measures were divided into groups following the five national priorities, and measures within each group were then divided into three categories of importance. For each measure, specific activities for implementing the measure are listed. As a result of the applied prioritization procedure, measures and activities were grouped into 14 tables (6-1 to 6-14).

Priority 1. Ensuring sustainable regional and urban development

Adaptation to climate change, prevention and risk management represent the backbone of future regional and urban development. Disaster prevention and management, as well as climate change adaptation, is a response to local/regional issues that local/regional administrations need to deal with to reduce the potential impacts of disasters in their area. Natural disasters and climate change impacts can significantly affect the socio-economic development and competitiveness of individual regions of Croatia, as well as the entire country, and can have far-reaching cross-border implications. Investments in prevention and adaptation contribute to the preservation of existing assets and bring a high economic return, where the cost of action is far lower than the cost of inaction. Therefore, with regard to the approach to solving and implementing adaptation measures, it is important to identify local/regional measures that will best respond to the vulnerability of a given area. Cities and urban areas are particularly exposed to the impact of climate change (heat waves, extreme precipitation, floods). In this sense, climate change adaptation, prevention and risk management become a priority in which cohesion policy supports urban development projects. Cities and urban areas, especially in coastal areas along rivers and the sea, show vulnerabilities that are usually larger than in the surrounding areas (e.g. floods, the urban heat island effect). Because of the concentration of population and economic activities in cities, special attention is paid to investments in climate-resistant urban infrastructure and activities aimed at strengthening local level resilience to climate change.

Table 6-1: Priority 1. – 1 Measures of very high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
OM-01	Increasing the level of knowledge and capacities for monitoring climate change impacts, risk assessment and climate change adaptation	OM-01-01. Development of programmes for awareness-raising, information and education of the public, decision-makers, experts, business sector and other stakeholders on climate change impacts and adaptation options	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
HM-01	Implementation of non-structural measures for protection against harmful effects of water and for water protection in cases of extreme hydrological conditions whose increase in intensity and frequency is conditioned by climate change	HM-01-01. Development of models for the prediction of extreme precipitation in the broader catchment areas and their local occurrence	PR
		HM-01-02. Development of models for simulating high water levels in the larger catchment areas and small torrential streams	PR
		HM-01-03. Preparation of projection studies on flood propagation, determination of flood zones and risks and opportunities for the provision of natural flood retention areas, prioritisation of flood zones (probability of flooding and socio-economic and environmental impacts) and their inclusion in spatial planning documents	PR
		HM-01-04. Preparation of new and revision of existing projects for protection against harmful effects of water and high sea levels (assessment of efficiency, sustainability and performance)	PR
		HM-01-05. Development of models, studies and analyses related to low water levels, environmentally acceptable flow and sustainability of the water management balance in the context of expected climate change	PR
HM-02	Support to planning, construction, reconstruction and upgrading the system for protection against harmful effects of water and related hydro-technical systems (structural measures) and lowland natural floodplains flooded in a controlled	HM-02-03. Preparation of project and planning documents for the construction, reconstruction and upgrading of water infrastructure intended for the protection against harmful effects of water (e.g. protective embankments, dikes and similar facilities and other systems), giving priority to the concept of	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	fashion, as well as other water protection measures, giving priority to applying the "room for the river" approach and use of natural retention areas	"room for the river" and use of natural retention areas	
		HM-02-04. Construction, reconstruction and upgrading of protective embankments, dikes and similar facilities related to the protection against harmful effects of water while giving priority to the concept of "room for the river" and use of natural retention areas	PR
		HM-02-05. Development of "green and blue infrastructure" – restoration of watercourse sections in line with their natural flow characteristics or with ecological remediation principles of river restoration, and provision of natural lowland areas for controlled flooding and retention/reduction of high water levels – "flood adaptation" measures	PR
		HM-02-06. Enhancing water status improvement measures to respond to deteriorated hydrological conditions caused by climate change	PR
		HM-02-07. Enhancing measures of control and release of treated wastewater to maintain good water status in case of deteriorated hydrological conditions caused by climate change	PR
HM-03	Strengthening professional, research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems in current and future climate conditions	HM-03-01. Provision of education for selected target groups in the form of thematic workshops for experts and interested public as well as for elementary, high-school and university students	ED
ŠU-01	Incorporation of adaptation measures into key documents	ŠU-01-01. Incorporating climate change adaptation measures into the Forestry Sector Strategy, the Forest	RE

Measure ID	Measure name	Activity's ID and name	Type of measure
	pertaining to forests and forestry sectors	Act and other legislation concerning forests and the forestry sector, including implementation indicators	
T-01	Integration of climate change into the tourism development strategy	T-01-01. Enhancing knowledge on the impact of climate change on tourism	RE
		T-01-02. Development of guidelines for implementing adaptation measures aimed at achieving, *inter alia*, sustainable development of tourism by monitoring the impact of tourism on components of the natural environment	RE
		T-01-03. Development of plans for protecting tourism infrastructure against climate change impacts and weather extremes	PR
		T-01-04. Development of plans for constructing future tourism infrastructure to be more resilient to weather extremes	PR
		T-01-05. Continuous monitoring of the state of tourism infrastructure, evaluation of the efficacy and practicality of implementing adaptation measures	PR
T-02	Raising awareness of persons involved in the tourism sector on climate change impacts, risks and adaptation options	T-02-01. Organisation of workshops for relevant tourism experts aimed at learning about specific climate change impacts, likelihood of their occurrence, and adaptation options	ED
		T-02-02. Preparation of educational materials to spread awareness of the impacts and risks of climate change and adaptation options intended for management structures in the tourism sector	ED
T-03		T-03-01. Training programmes on climate change, its impacts and risks,	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
	Enhancing competences of high school and university students on climate change	and adaptation measures in the tourism sector	
		T-03-02. Development of a subject/course in secondary schools and colleges for tourism on the impacts and risks of climate change and adaptation measures in the tourism sector	ED
T-04	Strengthening the resilience of tourism infrastructure to different weather extremes	T-04-01. Development and implementation of specific destination offers adapted to climate and spatial characteristics	PR
		T-04-02. Construction of tourism infrastructure adapted to climate change	PR
PP-01	Strengthening knowledge bases as well as monitoring and evaluation systems	PP-01-02. Implementing an integrated multidisciplinary assessment of the vulnerability of coastal areas to extreme sea levels, including socio-economic aspects and cost estimates as well as benefits of adaptation options	PR
		PP-01-04. Implementation of an assessment of vulnerability to the occurrence of heat islands and extreme precipitation in settlements focusing on their connection with spatial planning solutions	PR
PP-02	Strengthening professional and institutional capacities of expert stakeholders in the spatial planning system	PP-02-01. Strengthening of continuing professional development programmes for spatial planners related to the implementation of climate change adaptation measures	ED
PP-03	Integration of adaptation measures into the spatial planning system	PP-03-01. Amendments to the legal framework to develop the implementation of climate change adaptation measures in spatial planning	RE

Measure ID	Measure name	Activity's ID and name	Type of measure
		PP-03-02. Development and strengthening of the integrated spatial planning methodology and Strategic Environmental Assessment (SEA) with an emphasis on the implementation of climate change adaptation measures	RE
		PP-03-03. Development of programmes and guidelines for strengthening cross-sectoral coordination in the spatial planning process, with an emphasis on the planning of climate change adaptation measures by taking into account: – renaturalisation and regeneration of the urban fabric by using nature-based solutions – definition of zones and guidelines for climate-neutral and climate-positive urban districts – integration of optimal decarbonisation, energy transition and climate change adaptation solutions to protect the health of the population and increase air quality and life quality of the population	RE
		PP-03-04. Analysis and elaboration of methods of monitoring and evaluating the efficiency and effectiveness of spatial plans in the implementation of climate change adaptation measures	RE
PP-04	Raising awareness and sensitisation of the public and decision-makers at all levels	PP-04-01. Design and implementation of public information and education programmes focusing on targeted groups in vulnerable areas	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
		PP-04-02. Design and implementation of information programmes for decision-makers at all levels of government	ED
		PP-04-03. Raising awareness of social responsibility in the banking and insurance sectors regarding climate change	ED
UR-05	Expanding capacities and models for the coverage of risks related to climate change and catastrophic damages	UR-05-01. Multidisciplinary analysis/development of proposals for the improvement of legislative regulations related to mandatory insurance models for the purpose of more efficient planning and maintenance of public and private facilities or high risk processes (such as those within the agricultural or construction sector) due to climate change	RE
		UR-05-02. Expanding the types of services and insurance models	
		UR-05-03. Raising public awareness and promoting the use of different insurance models	ED
B-04	Integrated management of (freshwater, marine and land) resources for preserving (semi-)natural ecosystems, habitats and wild species and strengthening their resilience	B-04-01. Preserving and revitalising natural floodplains important for maintaining biodiversity by implementing protection measures against extreme climate events (e.g. flood, drought), including the use of nature-based solutions	PR
		B-04-02. Defining and implementing the measures for ensuring favourable hydrological conditions to preserve and restore freshwater, stagnant water, wetland and hygrophylic ecosystems, including the use of nature-based solutions	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		B-04-03. Preserve coastal sources and wetland habitats from salinisation and other threats by establishing dams, embankments and other measures, including the use of nature-based solutions	PR
		B-04-04. Developing predictive models of change in the distribution of wild species, habitats and ecosystems to be used for sustainable spatial planning and land use and adaptive management	PR

Table 6-2: Priority 1. – 2 Measures of high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
HM-05	Reducing adverse effects on the coastal water and municipal infrastructure and coastal water resources caused by rising sea levels brought about by climate change (non-structural measures)	HM-05-01. Developing a forecasting model for rising sea levels depending on global climate change and local coastal conditions	PR
		HM-05-02. Creating a preliminary map of the vulnerability of coastal infrastructure, particularly valuable natural sites (natural strands, transitional waters) and coastal karst water resources	PR
		HM-05-03. Detailed analysis of the most vulnerable components of the water sector	PR
		HM-05-04. Proposal of the solution (protection measure)	PR
HM-06	Strengthening the resilience of urban areas to anthropogenic pressures conditioned by climate change	HM-06-01. Education of employees related to the management of urban water phenomena and urban water infrastructure and education of spatial planners and water infrastructure designers related to new tendencies and project solutions for adaptation of urban	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
		water systems to climate change and increased anthropogenic pressures	
		HM-06-02. Developing a plan for rationalisation of water use in cases of increased demand caused by adverse hydrological conditions due to climate change	PR
		HM-06-03. Analysis of the possibilities of reusing treated wastewater and rainwater	PR
		HM-06-04. Analysis of using water supply systems of lower quality for secondary water use and reduction of the pressure on drinking water resources	PR
		HM-06-05. Analysis of the possibilities of constructing projects to increase the use of rainwater	PR
		HM-06-06. Analysis of the possibilities of constructing desalination equipment for salinised water (brackish water and exceptionally sea water)	PR
		HM-06-07. Local containment, retention and infiltration of rainwater and reduction of the pressure on channel or pipe drainage systems	PR
		HM-06-08. Formation of green areas within urban areas intended for temporary or permanent retention and treatment of rainwater and recreational amenities, and development of blue infrastructure by environmental restoration and revitalisation of watercourses in urban and rural areas at both local and regional level	PR
ŠU-05	Implementation of the green infrastructure concept aimed	ŠU-05-01. Analysis of the existing network of green areas and water	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	at strengthening climate resilience in urban and rural areas	surfaces in urban and rural areas (forests, forest parks, parks and other urban green areas, streams, rivers and lakes) and options to improve linkages between individual elements of green and blue infrastructure of local and regional importance (e.g. linear infrastructure, watercourses, rivers and lakes)	
		ŠU-05-02. Strategic planting of trees and other tree species in order to achieve physical and/or functional linkages between individual elements of green infrastructure, including the establishment of park and/or forest areas along the surface flow beds, and environmental restoration and revitalisation of watercourses in urban and rural areas at both regional and local level	PR
		ŠU-05-03. Strengthening capacities of state administration bodies at all levels for the implementation of participatory planning	ED
		ŠU-05-05. When planning new green areas, giving priority to tree species before grass that requires large amounts of water for maintenance, while trees have a better impact on reducing the heat island effect	RE
B-03	Development and implementation of measures for strengthening the resilience of vulnerable ecosystems, habitats and species	B-03-01. Strengthening the resilience of vulnerable habitats, e.g.: revitalisation, restoration, inclusion in protected areas, maintenance by using traditional knowledge, ensuring the connectivity of habitats, removing of invasive alien species	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		B-03-02. Strengthening the resilience of vulnerable species: propagation of plant species, introduction, reintroduction, translocation, provision of optimal corridors and resting areas for migratory species, genetic diversity conservation *in situ* and *ex situ* (including gene banks)	PR
B-05	Incorporation of climate change adaptation measures into key documents for the protection of nature and its components and management of areas, species and habitats	B-05-01. Incorporating climate change adaptation measures into the Nature Protection Strategy, laws and subordinate regulations, management and preservation documents and guidelines concerning nature protection, including implementation indicators	RE
T-05	Strengthening the resilience of local communities in the tourism sector	T-05-01. Assessment of tourism development at local level under the impact of climate change	PR
		T-05-02. Proposing adaptation measures and their implementation at local levels	PR
PP-05	Preparation of rehabilitation programmes and projects	PP-05-01. Development of good and sustainable practice guidelines for the design of rehabilitation projects for typical situations of exposure and vulnerability to sea flooding of different physical structures on the coast, especially those identified as priorities, with an emphasis on spatial planning aspects	PR
		PP-05-02. Provision of technical and financial support for the design of rehabilitation projects and the plan for financing the realisation of these projects	PR
		PP-05-03. Establishing a national programme for the rehabilitation of cultural heritage threatened by	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		extreme sea levels and other climate change risks	
		PP-05-04. Encouraging and stimulating cooperation between LSGUs and LRSGUs on joint and coordinated planning of adaptation measures	PR
ŠU-10	Risk assessment and development of tools that ensure continuous adaptation of agricultural land and forest management to reduce damage from natural and weather-related disasters	ŠU-10-01. Preparing analyses of climate change impacts on the method of agricultural land and forest management (for the needs of research and management institutions) aimed at identifying quality planning in agriculture and forestry and defining the national agriculture and forestry policy	PR
		ŠU-10-02. Developing new tools (remote research, forest growth and dynamics modelling, etc.) that enable continuous adaptation of the method of managing forests, their restoration and protection aimed at ensuring sustainable forest management	PR
		ŠU-10-03. Informing relevant stakeholders on the analyses and developed tools	ED
ŠU-11	Identifying capacities and options for implementing adaptation measures and reducing the threat to populations of large wild animals	ŠU-11-01. Creating analytical backgrounds and defining indicators of the impact of climate parameters on the stability of populations of large wild animals in changed habitat conditions	PR
		ŠU-11-02. Preparing adaptation models aimed at controlling the number, growth rate and health condition of large wild animals to ensure uniform habitat conditions	PR
		ŠU-11-03. Informing relevant stakeholders on the analyses and developed models	ED

Table 6-3: Priority 1. – 3 Measures of medium importance

Measure ID	Measure name	Activity's ID and name	Type of measure
HM-07	Strengthening capacities for exploration and sustainable management of groundwater	HM-07-01. Supplementing groundwater monitoring in the Danube river basin district with the aim of more reliable monitoring of climate change impacts on the quantitative and chemical status of groundwater	PR
		HM-07-02. Supplementing groundwater monitoring in the Adriatic river basin district with the aim of more reliable monitoring of climate change impacts on the quantitative and chemical status of groundwater	PR
		HM-07-03. Modelling of interdependencies between climate and hydrological conditions concerning the ecological and chemical status of surface water and the quantitative and chemical status of groundwater	PR
		HM-07-04. Modelling of interdependencies between the groundwater status and rise in sea levels	PR
		HM-07-05. Creating groundwater vulnerability maps in situations of reduced natural inflows due to climate change impacts	PR
		HM-07-06. Developing proposals for methods of protection and sustainable use of groundwater in changed climate conditions	PR
HM-08	Strengthening the resilience of the coastal water and	HM-08-01. Reconstruction and rehabilitation of water and municipal	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	municipal infrastructure and coastal water resources (structural measures)	infrastructure and other abstractions of water resources	
		HM-08-02. Relocation of water intakes outside the influence of the sea	PR
		HM-08-03. Artificial replenishment of coastal aquifers	PR
		HM-08-04. Construction of controlled mobile barriers at the mouths of watercourses and the like while taking into account the longitudinal continuity of watercourses (ecological corridors for migratory species)	PR
HM-09	Strengthening the protection of particularly valuable aquatic ecosystems	HM-09-01. Evaluation of existing anthropogenic pressures on the ecological and chemical status of water, the status of aquatic water systems in protected areas and ecological network areas and the risk of exacerbating adverse impacts under changed climate conditions, and the development of solutions for reducing pressures (e.g. relocation of water intakes outside of protected areas, solution for precipitation drainage, etc.)	PR
		HM-09-02. Carrying out an analysis of climate change impacts on changes in abiotic and biotic features of aquatic ecosystems in protected areas and ecological network areas (e.g. changes in indicators for hydromorphological quality elements of the ecological status of water, change in water quantity and temperature and related biogenic changes, change in water volume in surface and groundwater, change in water velocity and the like)	PR
		HM-09-03. Planning of structural and non-structural solutions for	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		reducing climate change impacts on aquatic water systems and their implementation and/or construction	
ŠU-07	Afforestation and reforestation to strengthen resilience to climate change	ŠU-07-01. Development of a plan for afforestation with suitable tree species	PR
		ŠU-07-02. Afforestation with suitable tree species	PR
B-07	Improving sustainable management and reducing anthropogenic impacts on (semi-)natural ecosystems, habitats and wild species primarily via sustainable development measures by applying nature-based solutions (NbS)	B-07-01. Development of guidelines for the preservation of ecosystems, habitats and wild species with respect to climate change adaptation based on predictive models, and align sectoral documents related to spatial use	PR
		B-07-02. Enhancing (semi-)natural and anthropogenic ecosystems to increase biodiversity for better adaptation to climate change (encouraging green architecture and green and blue infrastructure by selecting native plant species, green belts, flower strips, shelters for birds, bats, insects)	PR
B-08	Strengthening professional and financial capacities of the nature protection system	B-08-01. Educating, specialising and strengthening capacities of expert teams	ED
		B-08-02. Ensuring the financing of adaptation and resilience building measures for ecosystems, habitats and species and the nature protection system through structural and other EU funds, EU programmes, etc.	ED
B-09	Transferring knowledge on the importance of ecosystems, habitats, wild species, protected areas and ecological network areas and the importance of preserving ecosystem services when adapting to climate change	B-09-01. Carrying out professional communication and informative-educational activities (professional and scientific conferences, workshops and the like)	ED
		B-09-02. Establishing a wider public information and education system by	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
		developing communication and interpretation programmes	
ZD-08	Raising awareness of the public and key stakeholders in health and other priority professions (e.g. educational institutions, etc.)	ZD-08-01. Preparation of annual plans for media activities and public education plans (educational materials and tools) on climate change impacts and adaptation	ED
		ZD-08-02. Planning of knowledge transfer work packages tailored to the roles of key stakeholders for the promotion of proper procedures, identification and monitoring of health consequences associated with meteorological and climate influences	ED
		ZD-08-03. Preparation, promotion and implementation of educational workshops for key stakeholders with international experience and exchange of experience at regional and national level	ED
ZD-09	Integration of the climate change topic into the national curriculum	ZD-09-01. Defining priority groups for introducing a customised inter-subject topic of health, safety and environmental protection	ED
		ZD-09-02. Identification and education of educators within the school system	ED
		ZD-09-03. Preparation, promotion and implementation of workshops for stakeholders in the school system by educated educators	ED
ŠU-12	Defining communities and agricultural and forest areas that are most susceptible to potential changes and defining measures to reduce the threat to the most vulnerable agricultural and forest areas and communities	ŠU-12-01. Developing climate change risk assessment index maps for agricultural and forest communities of high economic value by applying GIS, ICT and digital technologies	PR
		ŠU-12-02. Developing adaptation maps for the most vulnerable	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		agricultural and forest areas of high economic value	

Priority 2. Ensuring preconditions for the economic development of rural areas, coastal areas and islands

Adaptation of rural areas, coastal areas and islands to key climate challenges becomes a prerequisite for survival of the economy and further economic development of these areas. The lack of moisture in the soil hinders the growth and maturation of agricultural crops and decreases their yield as well as cattle productivity. High air temperatures reduce or completely inhibit the growth of agricultural crops and increase evapotranspiration. Long dry periods can completely destroy the harvest of agricultural crops. Existing research points to a frequent lack of water in Croatian agricultural soils, and climate models suggest that this problem will become even more pronounced in the future. Spring frosts and hail damage agricultural crops and often destroy their harvest, especially in fruit, wine and vegetable growing. Many agricultural areas have compacted soil with poor permeability. In cases of heavy rainfall on such soils, water saturation and surface water stagnation quickly endanger soil fertility and agricultural crops. Damages resulting from the rise in sea levels in the narrow coastline and low coasts of the Croatian Adriatic will be reduced by applying appropriate measures to plan new and rehabilitate existing vulnerable parts of settlements and infrastructure. In coastal areas and islands, fisheries and aquaculture should adapt to potentially new conditions based on the results of climate modelling that predicts sea temperature rise, which can result in the migration of cold-water species (shrimp, hake) to colder or deeper seas, and increasing the number of alien species and impacts on domestic species. Changes in water circulation due to thermohaline causes can lead to reduced primary production coupled with the declining number of pelagic fish, while the increase in acidity of the sea can result in reduced growth and greater mortality of shellfish.

Table 6-4: Priority 2. – 1 Measures of very high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
P-02	Increasing the water absorption capacity of agricultural soil	P-02-01. Development of activities to increase the water absorption capacity of agricultural soil	RE
		P-02-02. Design and implementation of a promotional and educational programme for popularising the implementation of activities to increase the water absorption capacity of agricultural soil among farmers	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
		P-02-03. Implementation of activities to increase the water absorption capacity of agricultural soil	ED
P-03	Application of appropriate soil tillage methods (e.g. soil conservation tillage and other methods of reduced soil tillage) among farmers	P-03-01. Design and implementation of a promotional and educational programme for popularising the use of appropriate soil tillage methods (e.g. soil conservation tillage and other methods of reduced soil tillage) as well as integrated pest management (IPM) methods among farmers	ED
		P-03-02. Implementation of appropriate soil tillage methods (e.g. soil conservation tillage and other methods of reduced soil tillage) as well as integrated pest management (IPM) methods	PR
P-04	Cultivation of species and varieties of agricultural crops for food and non-food supply chain and breeds of domestic animals that are more resilient to climate change	P-04-01. Identification of varieties, species and breeds resilient to climate change for individual agrotechnical regions	PR
		P-04-02. Development and implementation of a promotional and educational programme for popularising activities of cultivating species and varieties of agricultural crops for food and other types of use and breeds of domestic animals that are more resilient to climate change among farmers and the general public	ED
		P-04-03. Implementing activities of cultivating species and varieties of agricultural crops and breeds of domestic animals that are more resilient to climate change	PR
P-05	Integration of climate change risks into the development of irrigation systems	P-05-01. Implementation of a promotional and educational programme for popularising water-saving irrigation methods and other methods of securing water for	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
		agricultural purposes (e.g. green infrastructure) among farmers	
		P-05-02. Analysis of the possibilities of constructing innovative irrigation systems	PR
ŠU-03	Strengthening capacities for systematic monitoring of the state of forest ecosystems as a prerequisite for informed planning and implementation of climate change adaptation	ŠU-03-01. Evaluation of the existing forest ecosystem monitoring system with identification of strengths and weaknesses and development of guidelines for its improvement	PR
		ŠU-03-02. Creating a register of monitoring, experiments, and research conducted by state institutions that are not part of systematic monitoring, their evaluation, and proposal for inclusion of selected items in the monitoring system	PR
		ŠU-03-03. Upgrading and integration of selected existing monitoring/experimentation/research into the forest ecosystem monitoring system and enabling the availability of results in compliance with the INSPIRE Directive	PR
RR-01	Strengthening the sector by investing in the development of new markets and expanding the range of products offered	RR-01-01. Implementation of research on the acceptability of new types of cultivated organisms and products by consumers	PR
RR-02	Strengthening capacities to assess the future state of the sector due to climate change impacts	RR-02-01. Encouraging the development of application models for predicting future trends in fish biomass	PR
RR-03	Strengthening the resilience of natural resources through adaptive fisheries management	RR-03-01. Developing a system for monitoring the state of bioresources in marine and fresh water that also includes monitoring of the food chain of marine organisms	PR
RR-04		RR-04-01. Educating fishermen to carry out tourism activities	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
	Increasing the involvement of fishermen in the tourism sector	RR-04-02. Supporting fishermen to reconstruct vessels for the purpose of carrying out tourism activities	PR
RR-05	Strengthening aquaculture capacities by greater breeding of organisms at lower trophic levels and new forms of breeding	RR-05-01. Implementation of a programme for encouraging shellfish farming	PR
		RR-05-02. Implementation of a programme for encouraging controlled farming of juvenile shellfish in hatcheries instead of collecting them in nature	PR
		RR-05-03. Preparation of a study on the feasibility of farming aquatic plants and their acceptance on the market	PR
		RR-05-04. Design and implementation of an educational programme for breeders on the advantages and benefits of integrated breeding of aquatic organisms	ED
		RR-05-05. Raising awareness of the general public on the benefits of consuming shellfish, aquatic plants and non-carnivorous fish species	ED
RR-06	Strengthening aquaculture capacities through breeding in recirculation systems	RR-06-01. Analysis of the possibilities of using recirculation breeding systems in fisheries	PR
		RR-06-02. Design and implementation of an educational programme for breeders on the benefits of recirculation breeding systems	ED
		RR-07-01. Preparation of a study on the possibilities of farming new (alien) fish species adapted to climate change	PR
		RR-07-02. Market research to determine the possibility of consumers accepting new (alien) fish species	PR

Table 6-5: Priority 2. – 2 Measures of high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
P-05	Integration of climate change risks into the development of irrigation systems	P-05-03. Continuing and extending the implementation of the National Project for Irrigation and Management of Agricultural Land and Water in the Republic of Croatia (NAPNAV): elaboration of conceptual solutions, preparation of pre-investment studies and project documentation, rehabilitation and reconstruction of existing systems and construction of new irrigation systems	PR
		P-05-04. Ensuring sufficient funds for irrigation of at least 100,000 ha	PR
		P-05-05. Establishing a system for monitoring and evaluation of the implementation of irrigation systems	PR
P-06	Application of anti-erosion measures	P-06-01. Defining soil erosion prevention activities	RE
		P-06-02. Implementation of a promotional and educational programme for popularising the use of anti-erosion measures among farmers	ED
		P-06-03. Implementation of soil erosion prevention activities	PR
P-07	Reconstruction and construction of amelioration drainage structures	P-07-01. Defining needs for reconstruction of existing and construction of new drainage systems	RE
		P-07-02. Ensuring sufficient funds to implement the measure on at least 100,000 ha	PR
RR-08	Popularising the use of new fish species	RR-08-01. Investigate the acceptability of potential new (alien) species among consumers	PR
		RR-08-02. Selecting techniques and tools for harvesting new (alien) species	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		RR-08-03. Exploring all possibilities of exploiting new (alien) species for different purposes and popularising their use	PR
RR-09	Strengthening aquaculture capacities by selective breeding	RR-09-01. Educating staff that will be involved in selective breeding at all levels	ED
		RR-09-02. Developing models for predicting future trends in fish biomass	PR
		RR-09-03. Preparation of a study on the possibilities of selective fish breeding; determining fish species to be subjected to selective breeding; determining the characteristics of fish to be selected	PR
		RR-09-04. Encouraging breeders to participate in selective breeding	ED
B-06	Preservation and application of traditional agricultural practices and knowledge to strengthen the resilience of (semi-)natural ecosystems, habitats and wild species	B-06-01. Identification of traditional varieties and breeds that are environmentally and genetically best adapted to climate change impacts for the purpose of strengthening the resilience of vulnerable ecosystems, habitats and wild species	PR
		B-06-02. Design and implementation of models for restoring traditional agriculture in vulnerable (semi-)natural ecosystems	PR
		B-06-03. Strengthening capacities of local communities to upgrade systems for monitoring (semi-)natural ecosystems, habitats and wild species by using elements of traditional knowledge	PR
		B-06-04. Establishment of systematic monitoring of (semi-)natural ecosystems covered through models for restoring	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		traditional agriculture in view of climate change adaptation	
		B-06-05. Valorisation and promotion of traditional agricultural practices that strengthen climate resilience of ecosystems, habitats and species	PR

Table 6-6: Priority 2. – 3 Measures of medium importance

Measure ID	Measure name	Activity's ID and name	Type of measure
P-08	Insurance of agricultural production from production losses caused by adverse climate conditions	P-08-01. Definition of preventive activities and continuing the implementation of activities related to the restoration of agricultural land and production potential, under which aid is granted for the restoration of production potential damaged by natural disasters and catastrophic events and for the introduction of appropriate preventive activities	PR
		P-08-02. Continuing to grant aid for co-financing a part of the crop, animal and plant insurance premium; the subject of aid is plant and livestock production entered in appropriate registers of agricultural land and domestic animals	PR
ŠU-08	Raising awareness of stakeholders in the forestry sector regarding climate change and adaptation measures	ŠU-08-01. Education of licensed and other forestry engineers, forestry technicians, employees of public institutions for the management of protected natural areas in the context of climate change risks	ED
ŠU-09	Raising awareness and sensitisation of private forest owners for sustainable forest management as a prerequisite	ŠU-09-01. Developing education and awareness-raising programmes for private forest owners on climate change and adaptation to climate change	ED

Measure ID	Measure name	Activity's ID and name	Type of measure
	for adapting to climate change		
RR-10	Development of aquaculture by adapting the quantity and quality of food to changed climate conditions	RR-10-01. Researching the influence of elevated water temperature on fish metabolism	PR
		RR-10-02. Researching the influence of eating habits, the amount and composition of meals on the intensity of fish growth in elevated water temperature conditions	PR

Priority 3. Ensuring sustainable energy development

On the one hand, reduction in the average annual precipitation reduces the production of electricity in hydropower plants and, on the other hand, poses a serious problem in ensuring efficient cooling of thermal power plants and thermal power plants – heating plants (district heating systems – DHS). The rise in outdoor temperature also leads to a reduction in the energy demand of buildings, which poses a problem for the sustainability and profitability of existing district heating systems if they are not technically prepared to extend services in terms of providing not only district heating services, but also district cooling services for buildings. However, challenges in the energy sector need to be approached with extreme attention in order to ensure sustainable energy, both in terms of electricity and heat production, as well as their distribution and transmission. Also, increasingly frequent damage to the power system and its facilities due to extreme weather events represent a major financial burden for all energy sector stakeholders, ending with citizens as end-consumers of heat and electricity who ultimately pay the final price of heat and electricity.

Table 6-7: Priority 3. – 1 Measures of very high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
E-01	Strengthening the resilience of production facilities through the storage of electrical energy	E-01-01. Conducting a vulnerability analysis of more important existing production plants to the adverse impacts of climate change to define the most vulnerable ones and create a priority list	PR
		E-01-02. Analysis of the possibilities of constructing energy storage facilities	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		E-01-03. Preparation of project documentation for the construction of an energy storage test facility	PR
		E-01-04. Construction of an energy storage test facility	PR
		E-01-05. Preparation of a study on the possibilities of constructing small autonomous RES-based energy systems and battery energy storage systems on islands and in rural areas	PR
		E-01-06. Preparation of project documentation for the installation of small autonomous RES-based energy systems and battery energy storage systems on islands and in rural areas	PR
		E-01-07. Construction of small autonomous RES-based energy systems and battery energy storage systems on islands and in rural areas	PR
E-02	Strengthening capacities and ensuring an enabling legal framework to increase the capacity of renewable energy sources and distributed sources	E-02-01. Creating a map of the climate potential (positive and negative) of Croatian regions for the production of energy from alternative sources in different climate scenarios	PR
		E-02-02. Preparation of a study on the possibilities of developing diversified energy sources with an emphasis on the exploitation of alternative (renewable) energy sources in the territory of the Republic of Croatia	PR
		E-02-03. Preparation of a study on the possibilities of using renewable energy sources in rural areas such as agricultural micro-installations	PR
E-03	Strengthening the resilience of the existing capacities for electricity and heat production	E-03-01. Conducting a vulnerability analysis of existing thermal power plants to extreme weather and climate hazards and reduced precipitation to define the most vulnerable thermal power plants and create a priority list	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		E-03-02. Conducting a detailed vulnerability analysis of the most vulnerable thermal power plants and proposing measures that will include a technical and economic analysis	PR
		E-03-03. Conducting a preliminary vulnerability analysis of existing hydropower plants to extreme weather and climate hazards, particularly the impact of reduced precipitation to define the most vulnerable hydropower plants and create a priority list.	PR
		E-03-04. Conducting a detailed vulnerability analysis of the most vulnerable hydropower plants and proposing measures that will include a technical and economic analysis	PR
		E-03-05. Preparation of project documentation for the revitalisation of parts of settlements in urban areas connected to the district heating system (DHS) by introducing a low-temperature regime in heating pipes, thus increasing cost-effectiveness of the DHS	PR
		E-03-06. Revitalisation of parts of settlements in urban areas connected to the district heating system (DHS) by introducing a low-temperature regime in heating pipes, thus increasing cost-effectiveness of the DHS	PR

Table 6-8: Priority 3. – 2 Measures of high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
E-04	Development of capacities for monitoring and rapid elimination of negative effects of	E-04-01. Establishing a working group for crisis situations in the energy system, which will be composed of stakeholders from the energy sector (institutional representatives and representatives of larger power companies) and other relevant sectors	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	climate impacts on the power system	(climatology, protection and rescue, internal affairs, etc.) and independent experts as needed	
		E-04-02. Conducting a detailed analysis of the identified vulnerabilities of the existing power system (power plants and infrastructure) (detailed analysis should target the most vulnerable parts of the power system for which the adverse impact of climate change is expected); considering the need to establish a national centre for crisis situations in the energy sector, as well as a list of stakeholders that should be involved in the work of the national centre and intervention teams, including their roles and responsibilities during and after emergencies (crisis situations)	PR
		E-04-03. If a decision on the establishment is made, taking all the steps necessary to establish a national centre for crisis situations in the energy sector and intervention teams	PR
		E-04-04. Developing emergency action plans	PR
		E-04-05. Strengthening capacities of all stakeholders, particularly of newly established intervention teams through a continuous training system	ED
E-05	Strengthening the resilience of the power system	E-05-01. Developing detailed maps (mapping) of the existing power system and seasonal climate modelling results according to parameters important for the energy sector	PR
		E-05-02. Developing and introducing advanced IT tools and solutions for the management of power systems, for the prediction of weather conditions and hazards as well as favourable/unfavourable climate conditions for the production, transmission, distribution and consumption of energy	PR
		E-05-03. Strengthening capacities of all stakeholders involved in the EES	ED

Table 6-9: Priority 3. – 3 Measures of medium importance

Measure ID	Measure name	Activity's ID and name	Type of measure
E-06	Strengthening the resilience of the distribution grid	E-06-01. When preparing new plans for developing the distribution grid, taking into account the expected climate change and the identified vulnerabilities of the power system	PR
		E-06-02. Determining the most vulnerable parts of the existing distribution grid with regard to the identified vulnerabilities and making a list of priority parts of the grid when exposed to adverse weather and climate hazards	PR
		E-06-03. Conducting a detailed vulnerability analysis of the most vulnerable parts of the existing distribution grid and proposing measures that will include a technical and economic analysis	PR
		E-06-04. Taking the results of the conducted analyses into account when preparing sectoral strategies, plans and development programmes	RE
E-07	Strengthening the resilience of the transmission grid	E-07-01. When preparing new plans for the development of the Croatian transmission grid, taking into account the expected climate change and the identified vulnerabilities of the power system	RE
		E-07-02. Determining the most vulnerable parts of the existing transmission grid with regard to the identified vulnerabilities and making a list of priority parts of the grid when exposed to adverse weather and climate hazards	PR
		E-07-03. Conducting a detailed vulnerability analysis of the most vulnerable parts of the existing transmission grid and proposing measures	PR

		that will include a technical and economic analysis	
		E-07-04. Taking the results of the conducted analyses into account when preparing sectoral strategies, plans and development programmes	RE
		E-07-05. Strengthening capacities of all stakeholders	ED

Priority 4. Strengthening of the management capacities through a networked monitoring and early warning system

Climate change adaptation as well as risk prevention and management are a horizontal topic, which means that a solid and efficient administration needs to be established to ensure the quality of investment. Responsibilities of the ministries, particularly for aspects of the cohesion policy, need to be completely clear and need to include regional and local authorities in the implementation. Therefore, it is necessary to plan investments in training, building capacities and strengthening adaptation-based expert knowledge, especially for those local units that are most vulnerable to climate change.

Table 6-10: Priority 4. – 1 Measures of very high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
KM-01	Strengthening professional and technical capacities for implementing research and applied activities and operational activities that include the area of climate modelling and predictive technologies for predicting weather and environmental conditions and related warnings of dangerous weather and environmental conditions, as well as analyses and interpretation of observed and expected climate changes and dangerous weather phenomena caused by them	KM-01-01. Development of climate models at spatial resolutions of 1–4 km and preparation of climate scenarios for the wider area of Croatia	ED
		KM-01-02. Development of combined climate models (atmosphere-ocean-soil) and preparation of climate scenarios for the Adriatic and Mediterranean area	
		KM-01-03. Supporting the development of applied sector models and strengthening capacities for using these models	
		KM-01-04. Involvement of new professional capacities in the development of predictive technologies for high-reliability prediction of weather and technological conditions	
		KM-01-05. Supporting the development of combined multi-	

Measure ID	Measure name	Activity's ID and name	Type of measure
		sectoral models for predicting the occurrence and impact of climate change and extreme weather events on different economic sectors and strengthening capacities for applying these models	
RP-01	Development of implementation impact indicators for the Adaptation Strategy	RP-01-01. Defining the best dataset required for monitoring the impact of implementing the Adaptation Strategy	ED
		RP-01-02. Development of a protocol for monitoring climate change adaptation indicators	
HM-03	Strengthening professional, research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems in current and future climate conditions	HM-03-03. Improvement of a system for monitoring the ecological and chemical status of surface inland water, the quantitative and chemical status of groundwater and the status of the Adriatic Sea, and of the public availability of their results (measurement, information, updating of the climate change risk analysis, report on adaptation options)	PR
ŠU-04	Strengthening capacities for fire protection	ŠU-04-01. Improving the early warning system for forest fires	PR
		ŠU-04-02. Developing forest fire spread models and agricultural and forest fire prediction models entailing all elements of fire spread prediction and relevant risks	PR
		ŠU-04-03. Preparing a plan and raising public awareness on the importance of implementing preventive measures to prevent agricultural and forest fires	ED
		ŠU-04-04. Maintenance of existing fire roads in the Mediterranean and Sub-Mediterranean zone and construction of new ones	RE
B-01	Improvement of knowledge and creation of databases to assess the vulnerability of (semi-)natural ecosystems,	B-01-01. Assessing the vulnerability of habitats through the systematic updating of the map of terrestrial non-forest and forest habitats as well as marine habitats along with upgrading	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	habitats, wild species, protected areas and ecological network areas for the purpose of improving predictive models	databases and monitoring systems with climate change vulnerability elements	
		B-01-02. Assessing the vulnerability of (semi-)natural ecosystems through systematic mapping along with upgrading databases and monitoring systems with climate change vulnerability elements	PR
		B-01-03. Assessing the vulnerability of wild species through systematic inventory and mapping along with upgrading databases and monitoring systems with climate change vulnerability elements	PR
		B-01-04. Assessing the impact of invasive alien species that are particularly aggressive in the climate change process through systematic monitoring along with the development and implementation of suppression and adaptive management measures and upgrading databases and monitoring systems	PR
		B-01-05. Assessing the vulnerability of underground habitats through the systematic data collection and updating of the Cadastre of Speleological Objects along with upgrading databases and monitoring systems with climate change vulnerability elements	PR
B-02	Establishment of a climate impact monitoring and early warning system for protected areas and ecological network areas and monitoring of ecosystems, habitats and wild species Integration of knowledge on climate change effects	B-02-01. Establishment of a climate impact monitoring and early warning system for all protected areas and ecological network areas for the purpose of adaptive management	PR
		B-02-02. Preparation and inclusion of climate change adaptation measures into the adaptive management of protected areas and ecological network areas	PR
		B-02-03. Establishment of expert monitoring of ecosystems, habitats and	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
	into the nature protection system	wild species for monitoring climate change impacts and consequences to assess the vulnerability and strengthen the resilience for the purpose of adapting to climate change	
ZD-01	Establishment of a system for calculating health-economic indicators for climate change-related conditions	ZD-01-01. Development of a system for calculating health-economic indicators by selecting priority diagnoses according to the International Classification of Diseases and Related Health Problems that can be associated with the impact of meteorological or climate parameters	PR
		ZD-01-02. Establishment of a network of persons conducting health and economic analyses	RE
		ZD-01-03. Establishment of an automated calculation within the central information healthcare system / health-ecological / public health subsystem	PR
		ZD-01-04. Establishment of a networked database and of authorised stakeholders in the evaluation and monitoring of health and economic indicators associated with climate change	PR
ZD-02	Integration of various information systems within healthcare to monitor indicators associated with climate change	ZD-02-01. Defining and positioning key stakeholders within the network of public health institutes, primary healthcare system, hospital system, emergency reception system, veterinary supervision system and others	RE
		ZD-02-02. Expansion of the knowledge base through scientific and expert definition of health indicators associated with climate change	PR
		ZD-02-03. Networking of meteorological information systems and air quality monitoring systems	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		with preventive, hospital, and primary health care systems	
PP-01	Strengthening knowledge bases as well as monitoring and evaluation systems	PP-01-05. Ensuring the availability of research results through existing information systems for spatial planning, environmental protection and water protection or the Open Data Portal or Geoportal of the National Spatial Data Infrastructure	PR
HM-10	Mapping of water sources outside the public water supply system	HM-01-01. Mapping of water sources outside the public water supply system (natural springs, private wells, water captures, etc.)	PR
		HM-01-02. Water testing and initial health risk assessment and their application to the mapped water sources outside the public water supply system	PR
		HM-01-03. Comprehensive health risk assessment and its application based on results of field inspections, documentation, and laboratory analyses	PR
UR-02	Multi-sectoral and sectoral risk assessment for various threat/risk scenarios related to climate change	UR-02-01. Conducting sectoral risk assessments based on scientific research	PR
		UR-02-02. Conducting sectoral capacity assessments based on scientific research	PR
		UR-02-03. Expansion of relevant working groups and persons responsible for certain types of threats/risks related to climate change	RE
		UR-02-04. Further elaboration of algorithms and action guidelines for different disaster and major accident scenarios	RE
		UR-02-05. Amendments to the legislative framework related to decentralisation and centralisation of	RE

Measure ID	Measure name	Activity's ID and name	Type of measure
		management functions depending on the type of disaster, major accident, emergency and incident/crisis situation	
		UR-02-06. Interconnectivity of information systems of key stakeholders	PR
		UR-02-07. Connecting civil, security, and defence services during interventions	RE
		UR-02-08. Establishment of vertical and horizontal data and information exchange systems	RE
		UR-02-09. Appointment of key stakeholders with regard to complex risks associated with climate change	RE
UR-01	Strengthening the function and importance of the Croatian Platform for Disaster Risk Reduction (SROK) in the area of climate change	UR-01-01. Increasing the intensity of activities of the Croatian Platform for Disaster Risk Reduction on the inclusion of climate change adaptation measures in the Disaster Risk Reduction Strategy	RE
		UR-01-02. Encouraging cooperation of environmental sectors with other sectors represented in activities of the Croatian Platform for Disaster Risk Reduction to raise awareness and provide education on the common objectives of disaster risk reduction and climate change adaptation, and integration of disaster risk reduction and climate change adaptation measures into regulations and documents at national and local levels	RE

Table 6-11: Priority 4. – 2 Measures of high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
HM-04	Strengthening management capacities of responsible institutions to act in cases of occurrence of extreme hydrological conditions	HM-04-01. Development of scenarios for extreme situations (floods, droughts, etc.) at different spatial and temporal scales for areas where there is an increased risk of adverse consequences of climate extremes	PR
		HM-04-02. Revision of existing management systems in critical hydrological conditions caused by climate extremes	ED
		HM-04-03. Updating, modifying and improving management and coordination systems of responsible institutions according to new (possible) scenarios and preparing management responses to minimise adverse consequences	PR
ZD-04	Implementation of health impact assessments and health risk assessments related to climate change	ZD-04-01. Amendments to the legislative framework related to the obligation to prepare and adopt an ordinance on the minimum content of the Health Impact Assessment Study (HIA) and the Health Risk Assessment Study (HRA); defining a list of strategic projects; defining the minimum composition of the multidisciplinary team according to the types of risk and content of the studies	PR
		ZD-04-02. Creating an analytical background and defining the minimum content of the Health Impact Assessment Study (HIA) and the Health Risk Assessment Study (HRA)	PR
		ZD-04-03. Education of key stakeholders on the methodology for implementing and using tools for health risk assessment and health impact assessment studies (temporal-spatial modelling,	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		mandatory statistical data processing programmes in public health institutes, etc.)	
		ZD-04-04. Implementation of experimental health impact assessment and health risk assessment studies at the local level	PR
ZD-05	Networking and upgrading of the system of monitoring environmental indicators related to climate change	ZD-05-01. Linking systems of all existing monitoring indicators by developing the GIS system, cross-sectoral cooperation in the preparation and adoption of plans, revising monitoring plans and increasing/decreasing the number of parameters (indicators of environmental factors harmful for human health) based on the results of research and risk assessment	PR
		ZD-05-02. Definition of health impact indicators for meteorological/climate parameters via environmental media	PR
		ZD-05-03. Evaluation of the success of implementation of health risk assessments related to climate change	PR
ZD-06	Increasing the number of secure points in case of extreme meteorological conditions	ZD-06-01. Definition of the priority points proposal by the multidisciplinary team with an optimal solution in relation to the spatial plan, microclimate conditions and architectural micro-environment and at least one public water site with water safe for human consumption in urban and rural areas (points of public mass gatherings, recreational and sports areas, construction sites, agricultural areas)	PR
		ZD-06-02. Planning and construction of secure points in case of extreme meteorological	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		conditions (such as heat waves) in public areas at the local level	
		ZD-06-03. Establishment of a system and assessment of the compliance of monthly laboratory controls of water for human consumption at public water sites or aerosol dispensers	PR
		ZD-06-04. Establishment of a system for monthly laboratory controls of water for human consumption at public water sites or aerosol dispensers	
UR-03	Strengthening the sector's capacities for the assessment, prevention and response to disasters and major accidents associated with climate change	UR-03-01. Defining events related to meteorological and climate variations in accordance with the area/region/county determinants	PR
		UR-03-02. Defining subgroups/processes/locations sensitive to climate change-related risks	PR
		UR-03-03. Education of stakeholders exposed to specific risks	ED
		UR-03-04. Raising awareness of events related to climate change in the local community	ED
		UR-03-05. Appointment and training of key stakeholders in response to complex risks associated with climate change (e.g. flooding or landslides in areas of previously contaminated and polluted sites, contamination of areas affected by climate or meteorological disasters, etc.)	ED
		UR-03-06. Ensuring continuous preparedness of key stakeholders	ED
		UR-03-07. Establishment of a system for issuing requests,	PR

Measure ID	Measure name	Activity's ID and name	Type of measure
		monitoring and refunding the costs of laboratory and expert analyses for the purpose of assessing a disaster, major accident, state of emergency or incident/crisis situations related to climate change	
UR-04	Creation of an integrated and standardised cross-sectoral database of threats, measures, damages and losses	UR-04-01. Establishment of an integrated database of climate change-related threats	RE
		UR-04-02. Development of an integrated database of key stakeholders	ED
		UR-04-03. Integration of the results of health-environmental and social databases – number of vegetation and forest fires, areas prone to flooding or rising sea levels, the condition of crops or soil determinants and other threats at the site of disasters and major accidents	RE
UR-05	Expanding capacities and models for the coverage of risks related to climate change and catastrophic damages	UR-05-01. Multidisciplinary analysis/development of proposals for the improvement of legislative regulations related to mandatory insurance models for the purpose of more efficient planning and maintenance of public and private facilities or high risk processes (such as those within the agricultural or construction sector) due to climate change	PR
		UR-05-02. Expanding the types of services and insurance models	PR
		UR-05-03. Raising public awareness and promoting the use of different insurance models	PR

Table 6-12: Priority 4. – 3 Measures of medium importance

Measure ID	Measure name	Activity's ID and name	Type of measure
ZD-07	Strengthening the allergenic species monitoring system	ZD-07-01. Amendments to legislative provisions and the management plan for planting non-allergen plants in public areas for the prevention and control of spreading of aeroallergenic species	PR
		ZD-07-02. Establishment of the legally mandatory monitoring of allergenic pollen species within the network of public health institutes, development of a tool for assessing the temporal-spatial expansion and appearance of new species and the influence of allergenic pollen on outdoor air quality indicators and indicators within the health system	PR
		ZD-07-03. Multidisciplinary planning of planting non-allergenic species at the LRSGU level	PR
		ZD-07-04. Planning of public awareness-raising actions and capacity building in the health and other sectors (municipal management, spatial planning, etc.) based on the results of monitoring and modelling the movement of aeroallergens	PR

Priority 5. Ensuring the continuity of research activities

The main obstacle to successful climate change adaptation is the lack of knowledge in planning adaptation measures in all sectors. The key support for approaching the issue of reducing the vulnerability to climate change refers to building a knowledge base, strengthening data monitoring and processing capacities and information exchange mechanisms, and developing local and sector-specific action plans for climate change adaptation as well as risk prevention and management plans at national, regional and local level. The development of the necessary ICT tools (geographic information systems – GIS, detection and monitoring systems, early warning systems, risk mapping and assessment systems) is a necessity and is crucial to their development.

Table 6-13: Priority 5. – 1 Measures of very high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
OM-01	Increasing the level of knowledge and capacities for monitoring climate change impacts, risk assessment and climate change adaptation	OM-01-02. Programme for funding research and development of innovative climate change adaptation solutions	IR
		OM-01-03. Establishment and development of a national professional, research and education centre for climate change adaptation and ecosystem preservation	IR
HM-03	Strengthening professional, research and management capacities to assess the occurrence and risk of adverse impacts of climate change and adaptation of freshwater and marine water systems in current and future water conditions	HM-03-02. Promoting research related to analysing possible climate change scenarios at national and regional level (for the needs of research and management institutions) aimed at identifying climate change impacts, analysing their impact on water and marine resources and also the impacts of these changes on the environment, urban areas, infrastructural amenities, protected areas and human activities largely related to water (water supply, water protection, agriculture, hydropower, etc.)	IR
		HM-03-04. Development of international cooperation in the implementation of monitoring the state of transnational watercourses and the Adriatic Sea aimed at sustainable management and protection	IR
		HM-03-05. Implementation of initial activities necessary for the realisation of measures whose implementation is planned in the next stages of realisation in the area	IR

Measure ID	Measure name	Activity's ID and name	Type of measure
		of water use, protection of water and marine resources and protection from harmful effects of water	
P-01	Implementation of the climate change adaptation experimental-research programme in agriculture	P-01-01. Preparation of the climate change adaptation research programme in agriculture	IR
		P-01-02. Implementation of the climate change adaptation research programme in agriculture	IR
		P-01-03. Transferring and promoting the achievements of the climate change adaptation research programme in agriculture	IR
ŠU-02	Increasing knowledge on the vulnerability of forests to climate change and possible response measures	ŠU-02-01. Vulnerability analysis of forest tree species and research of possible responses through the provenance of forest trees that are more adaptable to the expected climate change	IR
		ŠU-02-02. Elaboration of forest growth and dynamics models depending on climate change alongside the integration of risk assessment, and elaboration of forest management adaptation scenarios and options	
RR-06	Strengthening aquaculture capacities through breeding in recirculation systems	RR-06-03. Implementation of research related to the use of recirculation systems only for certain breeding stages and on the breeding of new fish species in recirculation systems	IR
ZD-03	Establishment of a framework for the implementation of human biomonitoring for tracking environmental factors related to climate change	ZD-03-01. Selection of authorised stakeholders for human biomonitoring	IR
		ZD-03-02. Collecting epidemiological/descriptive population data and analysing	IR

Measure ID	Measure name	Activity's ID and name	Type of measure
		environmental factors related to climate change amongst people	
		ZD-03-03. Publishing research results and creating a national knowledge base	IR
PP-01	Strengthening knowledge bases as well as monitoring and evaluation systems	PP-01-01. Implementation of targeted research on the impact of rising sea levels on the most vulnerable parts of the coast as a basis for the preparation of priority intervention plans	IR
		PP-01-03. Implementation of targeted research on climate change impacts related to spatial planning decisions in the function of tourism development	IR
B-01	Improvement of knowledge and creation of databases to assess the vulnerability of (semi-)natural ecosystems, habitats, wild species, protected areas and ecological network areas for the purpose of improving predictive models	B-01-06. Implementation of targeted research on ecosystems, habitats and species to improve the quality of predictive models of climate change impacts (for the purpose of elaborating the best possible adaptation measures)	IR
		B-01-07. Implementation of targeted multidisciplinary research on soil biodiversity depending on the degree of soil degradation to assess soil vulnerability and methods of revitalisation and sustainable use for the purpose of increasing climate resilience	IR
		B-01-08. Implementation of targeted multidisciplinary research on pollinators to assess threats and vulnerabilities for the purpose of increasing climate resilience through measures for nature-based solutions (e.g. selection of honey trees and plants, flower corridors and islands, pesticide use method and selection)	IR
		B-01-09. Implementation of targeted research on ecosystem services with	IR

Measure ID	Measure name	Activity's ID and name	Type of measure
		the aim of valorising their loss due to climate change	

Table 6-14: Priority 5. – 2 Measures of high importance

Measure ID	Measure name	Activity's ID and name	Type of measure
ŠU-05	Implementation of the green infrastructure concept aimed at strengthening climate resilience in urban and rural areas	ŠU-05-04. Implementation of research on the impact of trees and other green areas as well as natural watercourses and water surfaces on the mitigation of climate change impacts in urban environments (reduction of heat island effects)	IR
ŠU-06	Prediction (forecast) of change in the distribution of harmful organisms	ŠU-06-01. Implementation of research on the distribution of harmful organisms in forests	IR

7. IMPLEMENTATION OF THE ADAPTATION STRATEGY

7.1. Financial framework for the implementation of climate change adaptation measures

The EU's multiannual financial framework for the period 2014 –2020 (MFF) for the first time introduced the obligation of EU Member States to devote at least 20 % of the total budget for the seven year period for planning and spending on investments related to climate change. Accordingly, the Republic of Croatia defined the topic of climate change adaptation, risk prevention and management for financing through the European Structural and Investment Funds (ESIF).

The topic of climate change adaptation is very broad, and the measures implemented for this purpose can also contribute to reducing greenhouse gas emissions (climate change mitigation) and improving disaster risk management. However, it is necessary to notice their differences:

- The causes of natural disasters are primarily climate change, but also urbanisation, irrational water use, etc.;
- Adapting to climate change is a much wider challenge than just preventing natural disasters. Moreover, reducing our society's vulnerability to the effects of global warming implies a comprehensive effort to adapt many sub-systems such as health, electricity production, transport infrastructure, water management, and so on.

Within the programming period 2014 –2020, the Republic of Croatia, under the thematic objective 5 – *Promoting climate change adaptation, risk prevention and management*, planned specific projects that contribute to strengthening climate change adaptation capacities. The funding of these projects is provided under the Operational Programme "Competitiveness and Cohesion" (OPCC) through two specific objectives (Table 7-1).

Table 7-1: Financing climate change adaptation measures in the programming period 2014 – 2020

Investment priority / specific objective	**Climate change adaptation measures**
5a / Supporting investments in climate change adaptation, including ecosystem-based approaches 5a1 / Improving monitoring, forecasting and planning of climate change adaptation measures	• Measures to improve the quality and availability of data for climate monitoring purposes, data collection, modelling, analysis and forecasting of climate related information, including a warning system as the key precondition for appropriate planning and implementation of adaptation measures. This includes applied research related to climate change impacts and adaptation needs. • Strengthening administrative and technical capacities of public institutions dealing with climate change (primarily training of administrative officers with the aim of improving expertise). • Building awareness of climate change impacts at national and local level, thus enabling a more effective introduction of adaptation measures. This will include communication strategies, workshops and public events, preparation and sharing of educational materials, counselling of the population, internet information portals, etc. • Integration of climate change into the planning process by preparing action plans for climate change adaptation at local levels, integrating adaptation measures into all strategic and development documents, developing plans to prevent climate change impacts in sectors sensitive to climate change, and developing methods and standards to implement adaptation measures.
5b / Promoting investments related to special risks, ensuring disaster resilience and developing the disaster management system 5b1 / Strengthening the disaster management system	• Prevention Implementation of risk awareness raising, promotion and education programmes, thus creating resilient communities; Preparation of specific projects in the sectors affected by the most common catastrophic events and identified in the existing national strategy documents (Risk Assessment).

	• Preparedness Measures to develop organisational systems and capacities for the protection against disasters as well as management organisations, including the development and establishment of an early warning system, thus creating preconditions for appropriate disaster prevention, response and management measures (i.e. before ending the risk assessment, raising awareness of the importance of knowing that the risks are a priority). • Response Procurement and construction of equipment and infrastructure to reduce disaster damage, i.e. disaster response, but not limited to the communication system used for rescue operations and mitigating consequences in the areas covered. • Flood risk management measures (*classified according to the categories of measures defined by the State Flood Protection Plan*): Planning measures, preventive and preparatory measures, measures for natural water retention, measures for preventive disaster risk management (infrastructural measures) and horizontal training and awareness-raising activities.

Taking into account the wider issues of climate change adaptation, many other projects planned within this programming period will contribute to strengthening climate resilience, although that may not be highlighted as the primary objective to be achieved. Likewise, many projects under the Rural Development Programme 2014 –2020 and the Operational Programme for Maritime and Fisheries 2014 –2020 directly and/or indirectly contribute to strengthening the resilience of natural systems and society to climate change. These are the so-called "no regret measures", i.e. those that provide benefits even without climate change or contribute to sustainable development.

In addition, a guide for the inclusion of both climate change aspects, i.e. mitigation (reduction of greenhouse gas emissions) and adaptation, into the projects co-financed from the ESI Funds 2014 –2020 period. A rule was set for major projects, i.e. those above EUR 50 million of total eligible costs (EUR 75 million for transport projects), which are generally infrastructure projects, to introduce measures for adapting infrastructure to the expected climate change and introduce measures that contribute to climate change mitigation when preparing projects. Adaptation considers appropriate resilience of major projects to adverse impacts of climate change, which is based on vulnerability and risk assessment. In turn, mitigation requires that greenhouse gas emissions are reduced by selecting low-carbon options. This is processed through the quantification of greenhouse gas emissions and their inclusion in cost-benefit analysis. When doing so, it is recommended to integrate appropriate adaptation measures and mitigation options at the earliest possible project stage.

As regards the implementation of the OPCC, instructions for applicants and beneficiaries on the implementation of horizontal principles were prepared, which prescribed that, when preparing projects, climate challenges should be taken into account and strengthening climate resilience should be considered. In addition, during the environmental impact assessment of all interventions/projects subject to the environmental impact assessment (EIA), it should be assessed how the planned intervention affects climate change, i.e. how climate change can affect the planned intervention.

7.2. Financing climate change adaptation measures in the period up to 2040

The implementation of climate change adaptation measures and activities will be, in the long-term, funded from a variety of sources – public and private. The financial mechanisms for climate change adaptation will be established by using national and supranational (European) funds, namely from five sources:

- state budget (SB)
- European Structural and Investment Funds (ESIF)
- private sector (also includes Public Private Partnerships – PPPs)
- extra-budgetary funds, including funds of local and regional self-government units
- companies owned by the Republic of Croatia and local self-government units.

The state budget includes funds collected via the tax system, as well as the extra-budgetary funds collected from the auctioning of emission allowances and from water fees. The state budget funds will not be used for larger infrastructure projects, but primarily for measures and activities related to public awareness, capacity building, project documentation preparation, pilot projects, etc.

The ESI Funds will be the main source of funding for infrastructure measures and activities for which funds will be planned and allocated on the basis of action plans for climate change adaptation.

Private sector investments in climate change adaptation measures and activities require coordination of the public and private sectors primarily for identifying those measures, whereby the private sector will find an interest in investing in climate change adaptation projects that benefit the wider society in the communities in which this sector is operable, and at the same time reduce risk and increase business resilience.

The total amount of investment needed to implement the Adaptation Strategy at this point can be estimated at around HRK 27 billion (around EUR 3.6 billion) for the period up to 2040. These estimates may be useful for planning projects for funding from the ESI Funds. More than half of the estimated amount refers to the implementation of "structural" measures, particularly in the sectors of agriculture, forestry and water management (water resources) and to a lesser extent energy and tourism. Investments in the first two sectors can be considered as "no regret measures", i.e. measures that are already planned to be implemented, and their effects will also be positive for climate change adaptation. When looking at the 20-year period, it is estimated that the average annual cost of implementing the Adaptation Strategy would amount to around HRK 1.3 billion (around EUR 183 million). This may seem like a large sum,

but it should be compared to the amount of average annual damages (in the period from 2013 to 2018) in the Republic of Croatia, and that only as a result of extreme weather and climate events registered to date (around EUR 295 million per year). In case nothing is done, this amount could, in the context of the projected climate change, only increase over the years, thus seriously jeopardising the sustainable development of the Republic of Croatia. Assuming that these measures will contribute to positive economic impacts, it can be concluded that the benefits of implementing the Adaptation Strategy, despite high costs, will be significant.

These are only estimated amounts, but when action plans are prepared as implementing documents of the Adaptation Strategy, it will be possible to determine a more precise cost of the measures and activities, as well as the sources of funding, taking into account the ESI Funds and the new MFF for 2021 –2027 period. Climate change is the priority focus of all EU Member States, so significant funds from the ESI Funds will still be, namely in an even larger scope, directed to addressing the issue of climate change adaptation and climate change mitigation. This creates the preconditions for investing in the implementation of adaptation measures that the Republic of Croatia identified in this Adaptation Strategy. It is strategically important to recognise in time what Croatia is lacking and to continue planning through the preparation of action plans and use of the opportunities for co-financing from the ESI Funds under the new MFF for 2021–2027. Without a strategic plan, it will not be possible to use this opportunity and absorb the EU funds earmarked for climate change adaptation.

Table 7-2: Estimate of the amounts and sources of funding climate change adaptation measures e by sectors (in HRK millions) for the implementation period of the Adaptation Strategy up to 2040

Sector	**TOTAL (HRK million)**
General measures	7.50
Water resources	5,449.00
Agriculture	12,588.25
Forestry	5,240.40
Fisheries	48.25
Biodiversity	251.50
Energy	1,880.50
Tourism	683.80
Health/Health system	336.78
Spatial planning	60.50
Risk management	322.46
TOTAL	**27,618.94**

According to the estimate, the highest costs are attributed to the first two priorities: ensuring sustainable regional and urban development and ensuring preconditions for the economic development of rural areas, coastal areas and islands. The reason for this is that they contain most of the "structural" measures. Another important emphasis should be placed on the fact that the implementation of the Adaptation Strategy by funding these two priorities puts it in function of achieving sustainable development.

7.3. Creation of action plans for the implementation of the Adaptation Strategy

The Adaptation Strategy will be implemented through action plans, which will include the elaboration of concrete measures and activities for a specific five-year period (Climate Change and Ozone Layer Protection Act). Action plans are adopted by the Government of the Republic of Croatia. Action plans will provide a description, method of implementation, sequence of performing activities, deadline for execution, obligated parties and coordinators for the implementation of measures and activities as well as funding sources for each measure and activity. The first action plan will be prepared on the basis of this Adaptation Strategy, and it will contain a detailed presentation of priority measures and activities from this Adaptation Strategy for the first five year period. In doing so, all measures and activities should be complementary to the objectives of the European Green Deal.

7.4. Need to strengthen the capacity to implement the Adaptation Strategy

The capacity-building needs assessment study for the implementation of the Adaptation Strategy is based on the analysis conducted in cooperation with various experts and bodies, which provided guidance on strengthening the capacity of experts and the capacity of institutions to adapt to climate change. This is particularly important in the context of economic and social transformation necessary to achieve sustainability, which is strongly supported through the European Green Deal.

- There is a need to develop a professional, advisory and educational centre on climate change adaptation and ecological transition for the purpose of further development of cross-sectoral cooperation and better decision-making at a strategic level (currently it is mostly conducted at an operational and project level).
- Public sector stakeholders that are part of the national administrative-management-regulatory group related to the environment and nature in a wider sense, i.e. the sectors covered by the Adaptation Strategy, are better equipped for adaptation than other public sector stakeholders (e.g. LRSGUs, but with some exceptions) and a larger part of the private sector stakeholders, except for those whose business is related to renewable energy sources. Consequently, the implementation of the Adaptation Strategy at the regional and local level is extremely important.
- There is a lower level of private sector representation among stakeholders, particularly where this might have been expected to a larger extent, e.g. in the tourism sector, but also in the financial and economic sector. As regards the insurance companies sector, no progress has been made in addressing the challenges of climate change, although they may pose a business risk but also a business opportunity for this sector.

- As regards the tourism sector, it should be emphasised that climate change, over a longer period and in the absence of recognising this topic in a proper sectoral strategy, may lead to great risks for sustainable operations and survival of the current models of tourism development.
- There is a large number of topics per sector that may be the subject of capacity building, which also speaks of the great existing shortages in knowledge about this issue, but also of the great interest shown in this issue.
- The Adaptation Strategy has a national character, but most adaptation measures are local or regional. A lack of awareness and knowledge on the topic of climate change adaptation, with a few exceptions, has been observed in all LRSGUs. In this regard, the strengthening of professional and implementation capacities of LRSGUs is of crucial importance for the successful implementation of measures from action plans.
- Although the awareness of the topic of adaptation is somewhat satisfactory in certain components of the public sector (mainly ministries, agencies, public administrations and others directly related to vulnerable sectors covered by the Adaptation Strategy), it is proposed to further strengthen the capacity in terms of:
    - providing more material and financial resources for the implementation of future planned adaptation measures
    - employing more professionals who can deal with such topics. Although the lack of a sufficient number of relevant experts is already present, this will be even more pronounced when implementing action plans that are being adopted for the implementation of the Adaptation Strategy.
    - further education of experts within the public sector on climate change and climate change adaptation within their scope of activity, particularly those components of the public sector that are directly involved in the implementation of action plans.
- It is required to strengthen the education of experts working outside the public sector on climate change and climate change adaptation, particularly in parts of the economy whose business is directly related to climate or natural features.
- It is required to work on further targeted education of experts within non-governmental organisations and civil society so they could work on further education of wider groups of citizens.
- It is required to provide more material and financial resources to all the components of society for the implementation of already available adaptation programmes and topics or closely related topics, especially those for which funds are already secured in EU funds.
- The following general topics that require further attention have been recognised:
    - integrating the issues of climate change adaptation into the strategic planning and into the development of institutions and public policies
    - strengthening technical-technological knowledge on individual aspects of adaptation
    - strengthening the financing mechanism for adaptation by the public sector

- strengthening the implementation mechanism for adaptation programmes and plans
- strengthening the financing mechanism for adaptation by the private sector.

7.5. Institutional framework for the implementation of the Adaptation Strategy

The Adaptation Strategy refers to the period up to 2040 with a view to 2070. It is an extremely long time horizon (more than fifty years in the future), which is very unusual even for strategic planning. Namely, climate change is most often monitored over a 30-year period because changes and trends can only be seen in the long run, which the name of the Adaptation Strategy itself wanted to highlight. For this reason, climate change adaptation is not a "one-time" project, but a long-term planning process that will be supplemented and adjusted to climate challenges over several generations. However, revisions of the Adaptation Strategy will only be possible if an effective system for continuous monitoring of the implementation of adaptation measures and evaluation of their effect, as well as of climate parameters and their impact, is established. Therefore, the implementation of the Adaptation Strategy will require constant updating of knowledge on all aspects of climate change impacts, vulnerability and climate change adaptation options.

An essential component of the Adaptation Strategy's implementation is the gradual nature of its implementation. Given that the Adaptation Strategy has a long time horizon, it is impossible to fully detail all the elements of its implementation up to 2040. The Adaptation Strategy will be implemented, as prescribed by the Climate Change and Ozone Layer Protection Act, through short-term strategic planning documents, i.e. action plans for each five-year period. In strategic planning practice, such duration of action plans is considered standard in a situation when wanting to define in detail all the elements of implementation in that period. Bearing this in mind, the first action plan should contain priority measures and activities elaborated in detail, and each next action plan should complement and follow the basic framework of the Adaptation Strategy. Along with a description of each measure and activity, the action plan will indicate the competent authorities responsible for the implementation and co-competent authorities and will contain implementation indicators. Finally, it should be said that at this time it is very difficult to accurately determine the time intervals in which the Adaptation Strategy will be evaluated and possibly revised. It is only possible to determine the first interval after which it will be possible to do so, which will be after the first action plan has expired. Revisions of the Adaptation Strategy will depend on the information that will be generated by the implementation monitoring system, as well as the climate change monitoring system in general.

The basic principle for defining the institutional framework for the implementation of the Adaptation Strategy is that it does not foresee the establishment of new institutions and bodies, and that the existing jurisdictions within the governmental organisation will be fully respected. Naturally, this does not mean that in the future, if circumstances related to climate change and appropriate adaptation were to change, a modified institutional framework will not be proposed.

The state administration body responsible for coordinating climate change policy is the Ministry responsible for environmental protection, which includes the development of strategic and planning documents and carrying out the work of a national contact authority for reporting to EU bodies and other international bodies on climate change adaptation policy.

An important role in implementing the Adaptation Strategy is played by the Croatian Meteorological and Hydrological Service (DHMZ), the Environmental Protection and Energy Efficiency Fund (FZOEU) and spatial planning entities that provide expert bases for spatial plans.

The DHMZ manages the meteorological and hydrological infrastructure (in cooperation with the Croatian Waters Ltd. (HV)), the air quality monitoring infrastructure and the national archive of meteorological, hydrological and related data. The DHMZ's tasks include the monitoring of climate and climate change as well as climatological research. Its role in the implementation of the Adaptation Strategy will be primarily in climate modelling and monitoring of climate indicators.

The FZOEU carries out the financing of projects, programmes and similar activities in the field of conservation, sustainable use, protection and improvement of the environment and in the field of energy efficiency and the use of renewable energy sources. Although the focus of the FZOEU's activities in the field of climate change is to finance climate change mitigation, it is recommended to extend the scope of activities which can be financed by the FZOEU to include measures and activities related to climate change adaptation.

The Institute for Spatial Planning of the City of Zagreb and county institutes for spatial planning are key stakeholders because they develop, i.e. coordinate the development and monitor the implementation of spatial plans at the local (regional) level and the City of Zagreb, prepare the report on the spatial situation, keep the spatial planning information system and manage it within their authority, prepare starting points for developing or repealing spatial plans, etc. Decarbonistation, energy transition and climate change mitigation, i.e. adaptation will permeate all areas of human life and activity. As a multidisciplinary activity, spatial and urban planning integrates all sectors only through planning solutions, so spatial plans are the main instruments for implementing climate policies with the power and legal nature of subordinate legislation.

Since climate change is cross-sectoral by nature, it is necessary to ensure appropriate cross-sectoral coordination. The Inter-Sectoral Coordination Commission for Policy and Measures for Climate Change Mitigation and Adaptation (hereinafter: the Commission), which is appointed by the Government of the Republic of Croatia, can assume a role in defining the framework for monitoring the implementation of the Adaptation Strategy and action plans. The ministry responsible for environmental protection is the Commission's coordinating body.

In addition, more active involvement of professional institutions and scientific community is expected through the provision of professional support and work on targeted research related to climate change and climate change adaptation.

Other than at the national level, climate change adaptation should be equally seriously addressed at regional (county) and local levels (LRSGUs), primarily because in many respects climate change adaptation is a matter of local importance and stakeholders at these levels are considered key for taking adaptation measures. This includes activities that, to a lesser or greater extent, have contact points with climate change adaptation activities: settlement and housing planning, public utilities, spatial and urban planning, protection and improvement of the natural environment, fire and civil protection. For LRSGUs to act towards climate change adaptation as efficiently as possible, it is necessary to significantly strengthen their competences and capacities, both at the strategic level (preparation of regional development

plans and spatial plans that will include the component of climate change adaptation) and the technical level by training officers and experts in specific areas of climate change adaptation.

The engagement of LRSGUs is improved by the global initiative "Covenant of Mayors for Climate and Energy", where signatory cities signal their commitment to work on climate change mitigation and adaptation. Of those Croatian cities that signed this Covenant, around ten of them committed to undertake climate change adaptation measures and they can use this platform to share their experiences and good practice examples in implementing adaptation measures.

7.6. Monitoring the implementation of the Adaptation Strategy

The effective implementation of the Adaptation Strategy must be supported by an appropriate system for monitoring the implementation of measures and activities and for monitoring the impact and effectiveness of these measures and activities related to the overall vulnerability to climate change and minimising the damage caused by climate change.

The system for monitoring the implementation of the Adaptation Strategy needs to be selected and established. The Adaptation Strategy must be implemented in coordination with all sectors combined with a participatory approach and involvement of all stakeholders in its implementation and monitoring.

The system of indicators for monitoring the implementation of measures and activities of the Adaptation Strategy and the system of indicators for monitoring their impact arise from a set of indicators, and it should be selected which of them will be acceptable for monitoring the Adaptation Strategy as a whole as well as individual action plans. The information obtained from monitoring will provide a basis for making periodic evaluations of the implementation of the Adaptation Strategy. When defining individual adaptation indicators, the following will need to be taken into account:

- Check whether some of the indicators are already being used for other similar processes, or see whether, after minor modifications, some of the existing indicators can be used for monitoring the process of climate change adaptation
- Analyse whether some of the effects of adaptation are a result of some other processes than just implementing the measures envisaged by the Adaptation Strategy
- Develop a combination of implementation indicators (indicators showing that a specific measure and its activities have been taken) and results indicators pointing to an actual change in a system as a result of applying a specific measure of the Adaptation Strategy
- Check whether the data needed to control the performance of indicators can be collected in a relatively simple and inexpensive way. This requirement is much easier to apply in case of implementation indicators.

Indicators on the implementation of adaptation measures and activities should provide answers primarily to the following questions:

- Are measures and activities being implemented
- Are any improvements possible in the implementation of measures and activities
- Which measures are not achieving the expected effects.

Indicators on the impacts of implemented adaptation measures should show whether the measures taken have contributed to reducing the vulnerability to climate change and increased the ability of social and natural systems to recover from the consequences of climate change. These indicators refer to the parameters of a particular sector that point to the effects of climate change on the state of socio-economic and physical systems. These indicators allow decision-makers in state administration bodies and entities involved in the implementation to assess the effectiveness and efficiency of the taken climate change adaptation measures. In addition, they ensure the monitoring of the goals of the Adaptation Strategy, in particular its primary goal – the reduction of vulnerability of social and natural systems to climate change and the reduction of damages. From the financial perspective, the evaluation of the taken adaptation measures can help justify the funds spent on adaptation measures and achieving maximum value for money.

At the EU level, there is no common methodology and evaluation nor a group of agreed indicators because climate change impacts are potentially different for each country and region, so the measures are adjusted to the context. However, the indicator "reducing the share of damages from extreme weather events in relation to gross domestic product (GDP)" is often used, which refers to the cumulative effect of the measures taken by society to realise the vision of "strengthening climate resilience".

Therefore, it is up to each country to determine the group of indicators that will be used to monitor the effectiveness of the measures taken. A list of **possible indicators** is provided below. Some of the listed indicators are already being monitored or partially monitored, but most of them are not systematically monitored, so it is required to develop a methodology for monitoring and measuring the data required for the calculation of indicators. Therefore, one of the priorities in the first action plan should be to implement the measure RP-01 Development of implementation impact indicators for the Adaptation Strategy.

Proposals of possible indicators:

- Water resources
    - number of inhabitants in the area where the state of natural disaster of extreme drought was declared
    - number of areas designated for flood protection as precautionary measures
    - number of developed and tested tools
    - number of experts who attended adaptation courses
    - number of inhabitants in the area where the state of natural disaster of flood was declared
    - number of areas with declining drinking water quality
    - percentage of the area of particularly valuable aquatic ecosystems threatened by the effects of climate change
    - total length of the wastewater and rainwater network threatened by climate risks in the coastal area
    - mean water levels and flow rates at state network stations
    - extreme water levels and flow rates at state network stations

- mean sea levels
- extreme sea levels
- maintenance of good ecological and chemical status of water

- Agriculture
  - increase in agricultural production due to irrigation
  - increase in agricultural areas under irrigation
  - percentage of agricultural land sown with crops and varieties resistant to climate change
  - mass (in thousand tonnes) of eroded agricultural soil
  - area of agricultural land with a functional drainage system
  - quantity (in thousand tonnes) of cubic meters of irrigation water saved as a result of improved methods of agricultural production
  - area of agricultural land on which preventive activities are implemented
  - area of agricultural land restored after natural disasters
  - area of agricultural land on which soil conservation tillage or other methods of reduced soil tillage are implemented
  - sufficient quantity of quality agricultural products ensured as a result of the effective protection of agricultural crops from harmful organisms

- Forestry
  - number of forest fires
  - area of burned forest
  - length and density of fire roads
  - annual wood mass loss caused by extreme meteorological events (e.g. icing events, strong winds)
  - number of examined species and provenances of forest trees that are more adaptable to climate change and are of economic significance
  - forest area and/or number of trees affected by forest pests occurring as a result of climate change
  - number of areas where comprehensive monitoring of the state of forest ecosystems is carried out
  - number of cities in which green infrastructure is established
  - number of private forest owners and other forestry stakeholders who are familiar with climate change issues in forestry and adaptation measures

- Fisheries
  - number of areas with declining seawater quality

- increase in seawater acidity
- loss of habitat due to sea temperature rise and acidification
- reduced annual catch as a result of temperature changes
- percentage of coastal and marine areas under protection
- change in the distribution of native species
- distribution, number and diversity of alien species

- Biodiversity
  - list, proportion and categorisation of endangered and rare habitat types threatened by the effects of climate change
  - list, proportion and categorisation of strictly protected native species threatened by climate change
  - proportion of the total biodiversity of the Republic of Croatia threatened by climate change
  - list and proportion of protected areas and ecological network areas under continuous climate monitoring
  - assessment of the negative impact of climate change on endangered and rare habitat types and strictly protected native species assessment of the negative impact of climate change on endangered and rare habitat types and strictly protected native species
  - list of invasive alien species whose spreading is enhanced by climate change with their ranges and populations
  - proportion of protected areas and ecological network areas with implemented climate change mitigation and adaptation measures
  - value of investments made by protected area and ecological network area managers into activities related to climate change adaptation, risk prevention and remediation of climate change consequences
- Energy
  - number of weather events that caused power outages
  - GDP losses occurring as a result of the reduced amount of water for electricity production
  - percentage of new energy facilities that incorporate climate change adaptation measures
  - number of water saving measures used in electricity production
  - number of new energy facilities located in risk areas
- Tourism

- losses in tourism-generated GDP as a result of extreme weather and climate events
- percentage of coastal and marine areas under protection
- amount of water and energy consumed in tourist facilities per overnight stay
- areas protected as particularly valuable landscapes (areas) that are degraded by climate change
- number of areas with declining drinking water quality
- number of areas with declining seawater quality

- Health
  - number of experts who attended adaptation training
  - number of households in the area where the state of natural disaster of extreme drought was declared
  - number of inhabitants in the area where the state of natural disaster of flood was declared
  - number of people with a high risk of health consequences due to heat waves and extreme weather events
  - number of hospital beds in risk zones
  - number of low income households in risk areas
  - indicators of morbidity and mortality from chronic non-infectious diseases
  - indicators of morbidity and mortality from acute infectious diseases
  - number of inter-sectoral indicators (environmental monitoring indicators compatible for monitoring in the health-ecological/health system)
  - proportion of non-compliant results of analyses of water for human consumption
  - percentage of treated wastewater
  - proportion of households connected to the public wastewater drainage system
- Spatial planning
  - number of LRSGUs within the coastal area for which, based on conducted strategic environmental assessments (SEA), vulnerability assessments were carried out and adaptation measures integrated into spatial plans
  - number/proportion of spatial plans for which adaptation measures contained and prescribed in spatial plans are implemented or applied
  - increase in green infrastructure in settlements assessed as vulnerable to extreme weather conditions (heat islands, extreme precipitation)

- length of the coast (proportion of the coastline assessed as vulnerable to coastal flooding) where the planned coastal flood protection measures were implemented
- trend of annual damage from extreme weather events for which adaptation measures (coastal flooding and flooding in settlements) are planned under the Adaptation Strategy
- number of people living in risk areas
- number of flood-affected properties
- percentage of households living in areas with a lower risk of extreme weather and climate events
- number of new infrastructure facilities located in risk areas
- percentage of the area of particularly valuable ecosystems threatened by the effects of climate change
- coastal areas covered by coastal and marine environment management plans
- percentage of coastal and marine areas under protection

- Risk management
  - number of experts who attended training (trainings, courses) on adaptation, i.e. risk management and recovery
  - number of extended cross-sectoral action guidelines
  - surface area of the areas with mapped water sources outside the public water supply system
  - number of implemented health impact assessment and health risk assessment studies
  - number of newly developed notification systems for risks related to climate change developed at regional and local level
  - proportion of properties, legal entities and other entities insured against risks related to climate change

In addition to the above mentioned indicators, a set of **climate indicators** will be used for monitoring the impacts of the implementation of the Adaptation Strategy. Climate indicators are geared towards monitoring the climate and are essential for evaluating impacts and vulnerabilities.

Possible climate indicators for monitoring climate parameters as part of the implementation of the Adaptation Strategy are as follows:

- Mean air temperature trend
- Mean maximum air temperature trend
- Mean minimum air temperature trend
- Trend in hot extreme temperature indices

- Trend in cold extreme temperature indices
- Precipitation trend
- Trend in dry extreme precipitation indices
- Trend in wet extreme precipitation indices
- Standardised Precipitation Index (SPI)
- Assessment of air temperature and precipitation anomalies by using percentiles
- Assessment of aridity.

In addition to the above mentioned climate indicators, it is proposed to further develop climate indicators which are relevant to the assessment of impacts and vulnerabilities:

- Mean wind speed trend
- Mean maximum wind speed trend
- Evapotranspiration
- Solar irradiance (input solar energy flux)

7.7. Reporting

Reporting on the implementation of measures and activities and assessment of the impact of the implementation of the Adaptation Strategy will follow reporting formats and deadlines under EU and UN legislation in this area. Wherever possible, reporting procedures need to be harmonised and rely on the existing systems.

The ministry responsible for the environment is also responsible for the climate change adaptation policy; however, as this issue permeates many sectors, it is necessary to ensure good coordination and cooperation in monitoring, reporting and evaluating the implementation of the Adaptation Strategy. Other than relevant ministries, LRSGUs and other bodies play an important role in the implementation of measures and activities. Barriers should be identified in periodic reports, which will serve as a basis for preparing new measures and/or activities in subsequent action plans.

At its sessions, the Commission will follow the implementation of the Adaptation Strategy and action plans, review reports and propose measures to remove barriers and enhance implementation.

8. STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE ADAPTATION STRATEGY AND MAIN ASSESSMENT OF THE IMPACT ON THE ECOLOGICAL NETWORK

The Environmental Protection Act (Official Gazette 80/13, 153/13, 78/15 and 12/18) prescribes that the strategic environmental assessment, *inter alia*, must be carried out for strategies adopted at the national level. Furthermore, the strategic environmental assessment should be carried out during the development of the draft proposal of the strategy, prior to the establishment of the final proposal of the strategy and its submission into the adoption procedure, in the manner prescribed by the Environmental Protection Act and the Regulation

on the strategic environmental assessment of strategies, plans and programmes (Official Gazette 03/17). The strategic environmental assessment is used to identify, describe and assess likely significant impacts on the environment which may occur due to the implementation of the Adaptation Strategy, and to propose environmental protection measures and the monitoring programme depending on the identified impacts. Its integral part is also the main assessment of the impact on the ecological network.

The strategic environmental assessment analysed the impact of measures and activities of the Adaptation Strategy on specific environmental components (air, water and water bodies, soil, landscape, cultural heritage), economic activities, population and human health, spatial planning and disaster risk management. The results of the conducted analyses have shown: (1) that measures and activities can for the most part have positive impacts; (2) that a part of measures and activities will have no impact or their impact will be neutral; and (3) that impacts on a strategic level cannot be determined for some measures and activities.

Environmental protection measures, which arise from the strategic environmental assessment of the Adaptation Strategy, and measures to mitigate adverse impacts of the measures of the Adaptation Strategy on the conservation objectives and integrity of ecological network areas, which arise from the main assessment of the impact on the ecological network, were taken from the Strategic Environmental Assessment of the Climate Change Adaptation Strategy in the Republic of Croatia for the period to 2040 with the view to 2070.

General protection measures

1. When developing strategies, plans and programmes for a particular sector, as well as in the case when individual structural measures can be applied without acts for the implementation of spatial plans or construction acts, the implementation of nature-based solutions (NbS) should, along with the inclusion of relevant nature protection experts and/or state administration bodies responsible for environmental and nature protection activities, be encouraged already at an early stage of preparing a project, plan, programme or strategy.

2. Lower level plans and specific project plans (construction, upgrading/improvement of systems) should promote the integration of nature protection measures already at early stages of their preparation (design).

3. When developing and using the envisaged indicators, models, maps, scenarios, reviews and guidelines in all sectors, wherever possible (relevant), the vulnerability of the spatial environment from the aspect of biodiversity, ecosystem services and nature-based solutions (NbS) should be taken into account in order to reduce the possibility of negative impacts on the ecological network conservation objectives, i.e. endangered species and habitats as well as fundamental values of protected areas.

4. As part of educational and promotional activities in all sectors, highlight the importance of services provided by preserved ecosystems, as well as the need and opportunities for using Nature-based Solutions (NbS) such as:

    - implementation of Green Infrastructure (GI) or Blue-Green Infrastructure (BGI)
    - Ecosystem-based Disaster Risk Reduction (Eco-DRR)
    - Ecosystem-based Climate Change Adaptation (EbA).

When doing so, it is suggested to consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

Water resources

Activities envisaged by the Adaptation Strategy:

- HM-01-04. Preparation of new and revision of existing projects for protection against harmful effects of water and high sea levels (assessment of efficiency, sustainability and performance).
- HM-02-03. Preparation of project and planning documents for the construction, reconstruction and upgrading of water infrastructure intended for the protection against harmful effects of water (e.g. protective embankments, dikes and similar facilities and other systems), giving priority to the concept of "room for the river" and use of natural retention areas
- HM-02-05. Development of "green and blue infrastructure" – restoration of watercourse sections in line with their natural flow characteristics or with ecological remediation principles of river restoration, and provision of natural lowland areas for controlled flooding and retention/reduction of high water levels – "flood adaptation" measures
- HM-06-08. Formation of green areas within urban areas intended for temporary or permanent retention and treatment of rainwater and recreational amenities, and development of blue infrastructure by environmental restoration and revitalisation of watercourses in urban and rural areas at both local and regional level
- HM-08-01. Reconstruction and rehabilitation of water and municipal infrastructure and other abstractions of water resources
- HM-08-02. Relocation of water intakes outside the influence of the sea
- HM-08-04. Construction of controlled mobile barriers at the mouths of watercourses and the like while taking into account the longitudinal continuity of watercourses (ecological corridors for migratory species)
- HM-09-03. Planning of structural and non-structural solutions for reducing climate change impacts on aquatic water systems and their implementation and/or construction

5. At the early stages of project planning and development, i.e. during the preparation of project documentation, carry out a cost-effectiveness analysis of planned projects taking into account negative impacts on the conservation objectives and integrity of the ecological network, i.e. endangered species and habitats, and on fundamental values of protected areas. This should also include ecosystem services as a valid measure when making decisions on the financial cost effectiveness.

6. For projects planned within or in immediate vicinity of ecological network areas, as well as for projects planned further from ecological network areas which, due to their characteristics, can have an impact on them, nature-based solutions (NbS) should be used, including:

    - in the protection against harmful effects of water, using natural retention areas and watercourses as areas for retaining flood waters, i.e. their drainage;

- avoiding fortification of river banks as well as the canalisation and regulation of watercourses unless it is necessary for the protection of human life and settlements;
- preserving the favourable composition and structure of the coast, coastal areas and river estuaries;
- maintaining favourable dynamics and water regime, including the groundwater level, for the purpose of preserving aquatic and wetland habitats;
- preserving connections between watercourses and planning barriers that allow for species migration;
- preserving favourable physical and chemical properties of water in estuaries for the survival of target habitats and favourable habitats for target species.

Agriculture

Activities envisaged by the Adaptation Strategy:

- P-04-01. Identification of varieties, species and breeds resilient to climate change for individual agrotechnical regions

7. When selecting new (alien) species/varieties/breeds in agriculture, consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities to avoid the possibility of negative impacts on target species and habitats and integrity of the ecological network, i.e. endangered species and habitats, and negative impacts on existing (endangered) populations of wild species and habitats, i.e. the possibility of invasiveness of a selected species.

Activities envisaged by the Adaptation Strategy:

- P-05-02. Analysis of the possibilities of constructing innovative irrigation systems
- P-05-03. Continuing and extending the implementation of the National Project for Irrigation and Management of Agricultural Land and Water in the Republic of Croatia (NAPNAV): elaboration of conceptual solutions, preparation of pre-investment studies and project documentation, rehabilitation and reconstruction of existing systems and construction of new irrigation systems
- P-06-01. Defining soil erosion prevention activities
- P-07-01. Defining needs for reconstruction of existing and construction of new drainage systems

8. At the early stages of project planning and development as well as defining technical measures, i.e. during the preparation of project documentation (conceptual solutions, pre-investment studies and the like), carry out a cost-effectiveness analysis of planned projects taking into account negative impacts on the conservation objectives and integrity of the ecological network, i.e. endangered species and habitats, and on fundamental values of protected areas. This should also include ecosystem services as a valid measure when making decisions on the financial cost effectiveness.

9. For projects planned within or in immediate vicinity of ecological network areas, nature-based solutions (NbS) should be used, including:
    - avoiding fortification of river banks and the canalisation and regulation of watercourses;
    - maintaining favourable dynamics and water regime, including the groundwater level, for the purpose of preserving aquatic and wetland habitats.

Forestry

Activities envisaged by the Adaptation Strategy:

- ŠU-02-02. Elaboration of forest growth and dynamics models depending on climate change alongside the integration of risk assessment, and elaboration of forest management adaptation scenarios and options

10. When elaborating forest management adaptation scenarios and options, consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities to ensure sustainable forest management, i.e. avoid the possibility of negative impacts on the conservation objectives and integrity of the ecological network, endangered species and habitats at the national level, and on fundamental values of protected areas.

Activities envisaged by the Adaptation Strategy:

- ŠU-05-01. Analysis of the existing network of green areas and water surfaces in urban and rural areas (forests, forest parks, parks and other urban green areas, streams, rivers and lakes) and options to improve linkages between individual elements of green and blue infrastructure of local and regional importance (e.g. linear infrastructure, watercourses, rivers and lakes)
- ŠU-05-02. Strategic planting of trees and other tree species in order to achieve physical and/or functional linkages between individual elements of green infrastructure, including the establishment of park and/or forest areas along the surface flow beds, and environmental restoration and revitalisation of watercourses in urban and rural areas at both regional and local level.

11. When analysing the existing network of green areas in urban areas, prepare a plan for the strategic planting of trees and other tree species that will include a list of species and locations for planting, i.e. examine the possibility of negative impacts of selected species and locations for planting on the conservation objectives and integrity of ecological network areas. When preparing the plan, it is suggested to consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

12. When selecting species, give preference to autochthonous species, particularly when planting outside urban areas or when establishing park and/or forest areas along the surface flow beds.

13. At the early stages of project planning and development as well as defining technical measures for environmental restoration and revitalisation of watercourses in urban and rural areas, i.e. during the preparation of project documentation (conceptual solutions, pre-investment studies and the like), consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities to avoid the possibility of negative impacts on the conservation objectives and integrity of ecological network areas and negative impacts on existing (endangered) populations of wild species and habitats.

Activities envisaged by the Adaptation Strategy:

- ŠU-07-01. Development of a plan for afforestation with suitable tree species

14. When developing the Afforestation Plan, consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities in order to avoid the destruction of endangered grassland habitats (target habitat type, but also a favourable habitat for target and/or endangered species) and negative impacts on the integrity of ecological network areas and/or fundamental values of protected areas due to inadequate selection of a particular species and/or location for afforestation.

15. For projects planned within or in immediate vicinity of ecological network areas, negative impacts of the envisaged activities on ecological network areas can be significantly mitigated (or at least reduced to an acceptable level) through the use of nature-based solutions (NbS), i.e. forest and forest land management, namely by:

    - carrying out afforestation of non-forest areas only where justified, under the condition that target non-forest habitat types are not endangered
    - preserving forest clearings (meadows, pastures) and forest edges
    - preserving vegetation of tall herbs in contact zones between forests and open areas
    - paying attention to preserve target (non-forest) habitats and species associated with them.

Fisheries and aquaculture

Activities envisaged by the Adaptation Strategy:

- RR-08-02. Selecting techniques and tools for harvesting new (alien) species
- RR-08-03. Exploring all possibilities of exploiting new (alien) species for different purposes and popularising their use

16. Prepare a plan for exploiting new (alien) species which will include an analysis of:

- possibilities of exploiting new (alien) species for different purposes
- potential techniques and tools for harvesting new (alien) species

- possible impacts of selected species, as well as techniques and tools, on endangered species and habitats and fundamental values of protected areas
- possible further expansion of new (invasive alien) species due to their harvesting or use.

Already at the early stage of preparing the plan, involve relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities to avoid the possibility of negative impacts on target species and habitats and the integrity of the ecological network.

Activities envisaged by the Adaptation Strategy:

- RR-05-03. Preparation of a study on the feasibility of farming aquatic plants and their acceptance on the market
- RR-07-01. Preparation of a study on the possibilities of farming new (alien) fish species adapted to climate change
- RR-09-03. Preparation of a study on the possibilities of selective fish breeding; determining fish species to be subjected to selective breeding; determining the characteristics of fish to be selected

17. When preparing a study on the feasibility of farming aquatic plants and new (alien) species in aquaculture and preparing a study on the possibilities of selective fish breeding and selecting the characteristics of fish to be selected, it is necessary to examine possible impacts of selected species, their characteristics and breeding techniques and tools on the ecological network conservation objectives, i.e. endangered species and habitats, and on fundamental values of protected areas. It is also required to analyse possible further expansion of new (invasive alien) species due to their harvesting and use. Already at the early stage of preparing these studies, involve relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities to avoid the possibility of negative impacts on target species and habitats and the integrity of the ecological network.

Energy

Activities envisaged by the Adaptation Strategy:

- E-01-01. Conducting a vulnerability analysis of more important existing production plants to the adverse impacts of climate change to define the most vulnerable ones and create a priority list
- E-01-02. Analysis of the possibilities of constructing energy storage facilities
- E-01-03. Preparation of project documentation for the construction of an energy storage test facility

- E-01-05. Preparation of a study on the possibilities of constructing small autonomous RES-based energy systems and battery energy storage systems on islands and in rural areas
- E-01-06. Preparation of project documentation for the installation of small autonomous RES-based energy systems and battery energy storage systems on islands and in rural areas
- E-02-02. Preparation of a study on the possibilities of developing diversified energy sources with an emphasis on the exploitation of alternative (renewable) energy sources in the territory of the Republic of Croatia
- E-02-03. Preparation of a study on the possibilities of using renewable energy sources in rural areas such as agricultural micro-installations
- E-03-01. Conducting a vulnerability analysis of existing thermal power plants to extreme weather and climate hazards and reduced precipitation to define the most vulnerable thermal power plants and create a priority list
- E-03-02. Conducting a detailed vulnerability analysis of the most vulnerable thermal power plants and proposing measures that will include a technical and economic analysis
- E-03-03. Conducting a preliminary vulnerability analysis of existing hydropower plants to extreme weather and climate hazards, particularly to the impact of reduced precipitation, to define the most vulnerable hydropower plants and create a priority list
- E-03-04. Conducting a detailed vulnerability analysis of the most vulnerable hydropower plants and proposing measures that will include a technical and economic analysis

18. At the early stages of project planning and development, i.e. during the preparation of project documentation (vulnerability analyses, possibility studies and the like), carry out a cost-effectiveness analysis of planned projects taking into account negative impacts on the conservation objectives and integrity of the ecological network, endangered species and habitats, i.e. fundamental values of protected areas. This should also include ecosystem services as a valid measure when making decisions on the financial cost effectiveness.

19. For projects planned within or in immediate vicinity of ecological network areas, in order to mitigate (or at least reduce to an acceptable level) negative impacts of the envisaged activities, it is required to:

- use nature-based solutions (NbS);
- examine the vulnerability of the spatial environment from the aspect of biodiversity when selecting an appropriate location, i.e. at the early stages of project planning and development by:

  – analysing the distribution of target habitat types,

– analysing the use of the spatial environment by target species of birds, bats and large wild animals.

Tourism

Activities envisaged by the Adaptation Strategy:

- T-04-01. Development and implementation of specific destination offers adapted to climate and spatial characteristics

20. When developing destination offers within protected areas and ecological network areas or in their immediate vicinity, examine the vulnerability of the spatial environment from the aspect of biodiversity, ecosystem services and/or carrying capacity of the environment for visitors, and consult relevant biology and nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

Spatial planning

Activities envisaged by the Adaptation Strategy:

- PP-01-02. Implementing an integrated multidisciplinary assessment of the vulnerability of coastal areas to extreme sea levels, including socio-economic aspects and cost estimates as well as benefits of adaptation options
- PP-01-03. Implementation of targeted research on climate change impacts related to spatial planning decisions in the function of tourism development

21. When implementing an integrated multidisciplinary assessment of the vulnerability of coastal areas to extreme sea levels and targeted research on climate change impacts related to spatial planning decisions in the function of tourism development, take into account possible negative impacts on the conservation objectives and integrity of the ecological network, endangered species and habitats, i.e. fundamental values of protected areas. This should include ecosystem services as a valid measure when making decisions on the financial cost effectiveness.

Activities envisaged by the Adaptation Strategy:

- PP-03-01. Amendments to the legal framework to develop the implementation of climate change adaptation measures in spatial planning

22. At the early stages of preparing amendments to the legal framework to develop the implementation of climate change adaptation measures in spatial planning, include relevant nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

Activities envisaged by the Adaptation Strategy:

- PP-03-02. Development and strengthening of the integrated spatial planning methodology and Strategic Environmental Assessment (SEA) with an emphasis on the implementation of climate change adaptation measures
- PP-05-01. Development of good and sustainable practice guidelines for the design of rehabilitation projects for typical situations of exposure and vulnerability to sea flooding of different physical structures on the coast, especially those identified as priorities, with an emphasis on spatial planning aspects
- PP-05-03. Establishing a national programme for the rehabilitation of cultural heritage threatened by extreme sea levels and other climate change risks

23. At the early stages of developing the methodology for integrated spatial planning, preparing different guidelines as well as rehabilitation programmes and projects, examine the possibility of negative impacts on the ecological network conservation objectives, endangered species and habitats as well as fundamental values of protected areas, followed by (where necessary) introducing adequate guidelines to avoid such negative impacts. When doing so, it is suggested to include relevant nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

Disaster risk management

Activities envisaged by the Adaptation Strategy:

- UR-02-04. Further elaboration of algorithms and action guidelines for different disaster and major accident scenarios

24. When preparing algorithms and action guidelines for different scenarios in the risk management sector, take into consideration the vulnerability of the spatial environment from the aspect of biodiversity and take into account the services provided by natural and semi-natural ecosystems. In doing so, it is suggested to include relevant nature protection experts and/or the state administration body responsible for environmental and nature protection activities.

Spatial planning

25. In the spatial planning process, based on data and analyses of individual sectors related to the topic of adverse effects of climate change, integrate climate change adaptation solutions in the form of planning the green infrastructure network. For this purpose, it is suggested to, as expert bases which will serve as a basis for the preparation of amendments to spatial plans, develop green infrastructure network plans that include an analysis of ecosystem services and multiple benefits of the existing green infrastructure, as well as a proposal of the future green infrastructure network that would be used for climate change adaptation.
26. Specific projects (that can cause adverse impacts and are used for climate change adaptation) should whenever possible be planned outside cultural landscapes, cultural

and historical units, archaeological sites or zones, protected areas of national importance (strict nature reserve, national park, special nature reserve and nature park) and particularly valuable arable agricultural land. Special emphasis in spatial planning should be on the protection of natural resources: water (drinking water) and sea, air, forests and particularly valuable agricultural land.

Finally, the Strategic Environmental Assessment of the Adaptation Strategy concludes that the environmental monitoring programme is not envisaged.