Strategy on Adaptation to Climate Change in the Czech Republic

EXECUTIVE SUMMARY

Drawn up by the Ministry of Environment in inter-ministerial collaboration, using climatological documents of the Czech Hydrometeorological Institute.

The preparation of the document involved primarily Ministries of Environment, Agriculture, Industry and Trade, Regional Development, Health and Interior.

The draft strategy was reviewed by the Charles University Environment Centre in Prague and consulted with the Global Change Research Institute of the Czech Academy of Sciences.

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Contents of Executive Summary

1. Introduction

Climate change means any long-term changes, including natural climate variability and changes caused by human activity. It is of course desirable to seek to minimize adverse anthropogenic impacts on global or regional climate, which is the goal of climate policies. In addition, however, it is necessary to respond to the already ongoing changes (particularly extreme weather events such as torrential rain, long periods of drought, heat waves, warmer and wetter winters, less snow, etc.) and to prepare in time for the expected development in order to mitigate or eliminate the negative consequences.

In response to climate change, we can take two basic types of action: (1) **mitigation measures**, i.e. direct or indirect measures to reduce greenhouse gas emissions (e.g. a more efficient use of energy sources, use of solar or wind energy, thermal insulation of buildings, etc.), and (2) **adaptation measures**, i.e. measures to adapt the natural or anthropogenic system to a real or expected climate change, including its impacts. **Climate change adaptation is understood as the process of continuous adaptation of natural and socio-economic systems to the current or expected climate change, or its influences and impacts, in order to mitigate the damage and utilise the potential benefits.** That process consists of **preventive measures, measures to increase the resilience of the system, preparatory measures, responses to adverse events and activities helping to restore the function of the system.** Regardless of the warming scenarios and how successful the efforts to mitigate climate change turn out to be, the effects of climate change will increase in the next decades due to the delayed impact of greenhouse gas emissions. It is therefore necessary to take measures to adapt and deal with the inevitable economic, environmental and social impacts of climate change and the costs associated with them. **Measures to adapt to climate change will be needed even if European and global efforts to reduce emissions succeed, because it is desirable that the society deals with the unavoidable impacts of changes already underway.**

The aim of adaptation to climate change is a timely reduction of the vulnerability of systems (natural and socio-economic) and their higher resilience to its impacts without compromising the quality of the environment and the economic and social development potential of the society. Adaptation is a set of measures implemented continuously, gradually and in the long term, as well as the actual process of their implementation over time.

Adapting to climate change will require a proactive approach at local, national and international levels. Through the Adaptation Strategy of the Czech Republic, the government will cooperate with strategic partners to reduce the vulnerability of the Czech Republic to the effects of climate change. **This process must involve state administration bodies, local governments and organizations providing public services.** With an effective and coordinated planning we can ensure that the Czech Republic will

be significantly more resilient to future climate change impacts and at the same time will grow economically.

Adapting to climate change also requires measures in the field of protection of the population and the environment, in particular the readiness of crisis management bodies and integrated rescue system components for emergency events arising as a result of climate change. **Strategy on Adaptation to Climate Change in the Czech Republic was prepared under inter-ministerial cooperation** based on a task given to all ministers in Government Resolution No 1452 of 30 November 2009, the Ministry of Environment was appointed as the inter-ministerial coordinator of preparation of the whole document. The Adaptation Strategy of the Czech Republic and its content is based on the White Paper of the European Commission **Adapting to Climate Change: Towards a European Framework for Action** (2009) and reflects the scale and conditions of the Czech Republic. Creating and implementing adaptation plans and actions is an integral part of the commitments made under **the United Nations Framework Convention on Climate Change** (UNFCCC). In addition, support towards measures for adapting to the negative impacts of climate change is one of the important priorities **of the State Environmental Policy 2012 - 2020**, **the Concept of Environmental Security** and **The Security Strategy of the Czech Republic 2015 - 2020 With an Outlook to 2030**.

2. Climate change trends in the Czech Republic

In the Czech Republic, the changes observed indicate an increasing trend in winter and summer temperatures, which has been more pronounced after 1980. In recent decades, an increasing trend is apparent in the average annual values, summer temperatures are increasing faster than winter or yearly ones. The changes in the average values are also related to extreme temperatures - the number of tropical summer days and tropical nights has grown in recent years, while the number of days of frost and ice falls. Annual precipitation in Bohemia shows a slight increase, which is more pronounced in winter, while in summer the trend is slightly downward. In Moravia, as opposed to Bohemia, the difference between winter precipitation increase and its summer decline is more significant.

In the Czech Republic conditions, climate change is seen to cause especially the more significant weather events manifested by more frequent torrential rains, longer droughts, heat waves, warmer and wetter winters with smaller amounts of snow, etc. A side-effect of regional climate change is the occurrence of episodes of high wind speeds associated with the passing of deep atmospheric depressions over the continent, especially in winter, which represents risks e.g. for forests, agriculture (soil and some crops), buildings, energy (transmission and distribution networks) and the population.

The prognosis for the Czech Republic

Up to 2030, the results of simulations using a regional climate model indicate a continuing trend of increasing average air temperatures. The average annual air temperature in our territory according to the ALADIN-CLIMATE/CZ model will increase by about 1°C, the warming in summer and winter is only slightly smaller than in spring and autumn. A systematic increase in temperatures, relatively little varying in space, is apparent. The simulations further suggest that the temperature change will be concurrent with a change in some related temperature characteristics. In summer, we can expect a slight increase in the occurrence of summer and tropical days and tropical nights, in winter, on the contrary, a decreasing occurrence of frost, ice and arctic days. Changes in precipitation totals are more complicated. In most of its nodal points, the model has simulated a decrease in future precipitation in winter (depending on the area up to 20%), its increase in spring (from 2 to about 16%), in summer and mainly in autumn the situation in different parts of our territory differs (in autumn, several locations will see a slight decrease by a few percent while other locations will have an increase by 20-26%, a slight decrease prevails in summer, at places (e.g. western Bohemia), however, there will be an increase by up to 10%). Also, a relatively significant spatial variability of changes is apparent, it is therefore possible that a climatic signal may be, in this near term, overlaid by manifestations of natural (year-on-year) fluctuations in total precipitation. The simulated changes in seasonal averages of daily sums of global radiation are the largest in winter (by more than 10%), in the other seasons they range in most places up to 4%, however, compared with the model errors, the changes in global solar radiation reaching the Earth's surface are small.

As of 2050, the simulated warming is already significant, the greatest increases will be in air temperature in summer (by 2.7°C), the least in winter (by 1.8°C). It is worth mentioning that the increase of temperatures in

August will be by nearly 3.9°C. At each grid point, the values of changes may range in spring and summer from 2.3 °C to 3.2 °C, in autumn from 1.7 °C to 2.1 °C and in winter from 1.5 °C to 2.0 °C. Declines in winter precipitation totals are already noticeable (e.g. Giant Mountains, Czech-Moravian Highlands, the Beskids up to 20%) as well as their increase in autumn. In summer, the decline in rainfall begins to dominate in our territory, which will be even more pronounced in the long run, while the decline in winter precipitation totals will be lower compared to the previous period. Changes in relative humidity are small, but the model for all seasons and timeframes indicates declines - in winter up to 5%, in summer 5-10% and for the end of the 21st century, in some places up to 15% (a part of central Bohemia, the Highlands). This finding is consistent with the expected increase in air temperature and the decreasing precipitation totals.

3. The Adaptation Strategy

Strategy on Adaptation to Climate Change in the Czech Republic (hereinafter referred to as "Adaptation Strategy of the Czech Republic") identifies the priority areas (sectors), which are expected to be the most affected by climate change. The Strategy contains a structured overview of the risks and anticipated impacts of climate change in those areas, defines general principles of adaptation measures, outlines the priorities, points out intersectoral linkages and links with mitigation measures and provides guidelines for and examples of suitable adaptation measures. The Strategy analyses the current state of legislation in a given context and proposes the necessary legislative changes.

The Strategy also provides a framework evaluation of the financial demands of the proposed adaptation measures, it analyses the impact on the business environment and quantifies the costs of inaction, and moreover it gives an overview of the current and prospective economic instruments and the options of their use. Further specification of and complements to the economic aspects are part of the National Action Plan on Adaptation to Climate Change. To support the implementation of adaptation measures it is not recommended to introduce new economic instruments, but rather to use the existing tools, because, to a certain extent, they are already used to adapt to climate change. When using the existing tools and when modifying them, it is necessary to consider whether they are to serve as motivators or only as sources of income.

The aim of the Adaptation Strategy of the Czech Republic is to mitigate the impacts of climate change by adapting to that change as much as possible, to maintain welfare and to preserve and possibly enhance the economic potential for the next generations.

The Adaptation Strategy of the Czech Republic:

- comprehensively presents the observed climate change, projections of future development and expected impacts
- identifies priority areas of the economy, public administration and the environment in relation to the expected impacts of climate change (hereinafter referred to as "sectors") and identifies priority areas of implementation,
- defines appropriate adaptation measures in response to the anticipated manifestations of climate change,
- identifies barriers hindering the implementation of adaptation measures at the extent needed and with the desired effect and suggests ways to eliminate them,
- defines targeted research and analytical needs,
- identifies possible sources of funding.

Adaptation to climate change should be directed towards climate-resilient sustainable development - the target state of adaptation of the Czech Republic is preparedness for climate change. As climate change is a dynamic process, the deadline for accomplishing the target state is not set.

The Adaptation Strategy of the Czech Republic also defines the general tasks the fulfilment of which must involve all ministries, with the support of the government:

- to ensure targeted research and sufficient sharing of information and to apply the research results;

- to analyse the effectiveness of measures related to climate change adaptation;
- to quantify more precisely the funds needed for the implementation of adaptation measures;
- to quantify more precisely the amounts of money needed to remedy the damage caused by climate change impacts in case of insufficient implementation of adaptation measures or inaction.

The Adaptation Strategy of the Czech Republic is prepared for the years 2015-2020 with a view to 2030. The continuous implementation of the Adaptation Strategy of the Czech Republic will be evaluated in 2019 and then every four years. The implementing document of the Adaptation Strategy of the Czech Republic is the **National Action Plan on Adaptation to Climate Change**.

4. Impact of climate change on selected sectors of the economy and the environment (sectors) and basic principles of adaptation measures

Adaptation measures should, if possible, be conducted in accordance with the measures to reduce emissions and increase removals by sinks (mitigation). Positive synergy and interaction in the area of adaptation and mitigation is possible and desirable (e.g. in the field of landscape management).

The most important principles of adaptation to climate change in the Czech Republic are considered to be an integrated approach both to assessing the synergy of adaptation and mitigation measures and to assessing the suitability of the proposed measures for the individual components of the environment, the economy and the social sphere, also the priority implementation of solutions with multiple effects on the side of benefits (the so-called "*win-win*" solutions) and with low negatives on the side of risks or costs (so-called "*low-regret*" options), identification of opportunities associated with the adaptation process, prevention of inappropriate adaptations, and finally building the knowledge base and providing objective information for decision-making processes at all levels.

Inappropriate adaptation measures are those that do not increase the resilience of ecosystems or increase their vulnerability, are environmentally unbalanced, financially ineffective or inconsistent with the objectives of other policies.

Adaptation Strategy of the Czech Republic focuses on all priority areas affected by climate change in the Czech Republic:

1) **Forest management**
2) **Agriculture**
3) **Water regime in the landscape and water management**
4) **Urban landscape**
5) **Biodiversity and ecosystem services**
6) **Health and hygiene**
7) **Tourism and recreation**
8) **Transportation**
9) **Industry and energy sector**
10) **Emergency events and protection of the population and the environment**

The subchapters summarize **impacts of climate change on various sectors** and **general characteristics of adaptation measures** including inter-sectoral linkages, coherence with mitigation measures and the main recommendations. The main part of each chapter is **a list and description of appropriate adaptation measures**.

A general overview of adaptation measures and an overview of the main recommendations for adapting to climate change of the Adaptation Strategy of the Czech Republic are provided in Annex 4 and Annex 5.

5. Applicable laws and draft amendments thereto

The Adaptation Strategy of the Czech Republic analyses the current state of legislation in the given context and proposes the needed legislative changes. It covers in detail the fields of forestry, agriculture, water regime in the landscape and water management, land use planning and building regulations, protection of biodiversity and of ecosystem services and the energy sector.

6. The economic aspects

The chapter contains an overview of the existing and prospective economic instruments including the options of their use, a framework evaluation of the financial demands of the proposed adaptation measures, an analysis of the impact on the business environment and it quantifies the costs of inaction. Further specification of and complements to the economic aspects are part of the National Action Plan on Adaptation to Climate Change.

i. **The implementation of adaptation measures should be supported with the existing tools.** When using the tools and possibly modifying them it is necessary to consider whether the instrument should have a motivating effect (a behaviour change) or whether it should only serve as a source of income (e.g. to ensure funds for providing aid). Out of the existing tools, e.g. **payments, fees, levies and taxes** can be used. Adaptation measures will, in sum, demand large investments and, therefore, financial support will play an important role in their implementation and enforcement. Some aid schemes already exist and are being used - out of the national programmes these are mainly **the Programme for restoration of natural landscape functions**, **the Landscape Care Programme** and the **Flood Prevention Programme**. Those programmes are complemented by interventions from **EU operational programmes** and **the Rural Development Programme for the period 2014 - 2020**, which will draw funding for the supported actions from the ESI Funds. Out of the Community instruments (financed directly from the EU budget), especially **LIFE** should be mentioned. **More information about support options for adaptation measures is provided in Annex 6 and Annex 7.** Besides the mentioned economic instruments, use should be made of other types of instruments and measures, such as **technical standards, legislative measures with sanctions and voluntary instruments.**

ii. **It is very complicated to quantify the financial demands of the implementation of adaptation measures because the implementation of some measures is planned or runs even without a direct link to climate change, some measures may overlap with mitigation measures, measures may overlap between the different fields (sectors) and the measures cannot yet be defined in sufficient detail.** In addition, climate change adaptation is a long-term process responding to the continuously complemented and evaluated information from the different areas (sectors) in a link to the ongoing evaluation of the effectiveness and economic impact on the state budget.

iii. **It is generally assumed that the adaptation will have, especially in the long run, a positive impact on the business environment, despite the fact that the implementation of some measures represents costs or investment for businesses[1].**

General estimate of the impact on the business environment

In forestry, in the short term, the higher costs of wood felling and transport will be offset by reduced costs of restoration and aftercare of the established stands and, in the medium term, by reduced costs of the upbringing of young stands and by a higher production mainly of coniferous wood. For entrepreneurs in agriculture, the economic impact of all the proposed adaptation measures is positive already at the time of implementation, regardless of the final level of reduced negative impacts of climate change. In water management, the business environment will be affected by the implementation of adaptation measures especially in the areas of preparation and design of plans, source documents and other materials and construction, limitation of construction in designated areas, compliance with the required criteria, increasing the efficiency of production processes that use water, a reassessment of the current permits and reduction of the abstracted amount of water, increased charges for water abstraction and changes in the environment due to subsidies. In the sector of health and hygiene, the business environment is not expected to be immediately affected by the adaptation measures. In the area of tourism, the monitoring and minimization of natural hazards will minimize the impact of crisis situations on the business environment. In the area of transportation, the new targets and measures are a challenge for innovation, research and development and also for modern business activities in industry, transport, logistics and the environment. In the area of industry and energy, the financial impact on the business environment depends on the number of elements of critical infrastructure determined by the Crisis Act; currently, entities of the critical infrastructure have been established that take part in the fulfilment of tasks set out in emergency plans and they draw up their own emergency preparedness plans; the most significant financial impact can be expected especially in connection with the acquisition of the means of protection of the individual elements of the critical infrastructure, but even in this case, for the same reason, this will rather concern individual cases.

iv. **Any inaction on climate change would mean significant socio-economic impacts and economic losses.** Although the effects of inactivity in the Czech Republic have not yet been comprehensively quantified, a certain idea can be obtained from the analyses conducted abroad and partial studies that have been drawn up for some sectors. Estimates of future costs and benefits of the EU show that every euro spent on flood protection could save six euros of costs of clearing up damage, **and failure to adapt to climate change would cost the whole EU at least EUR 100 billion annually by 2020 and EUR 250 billion in 2050,** as estimated (EC, 2013). Similar results of an analysis of selected agricultural climate change adaptation measures in the Czech Republic showed that mid-term and long-term financial benefits of most adaptation measures exceed the investments in their implementation. The Adaptation Strategy of the Czech Republic and timely implementation of adaptation measures will, on the contrary, enhance sustainable growth, encourage investment in increasing resilience to climate change and create new jobs.

[1] The National Action Plan on Adaptation to Climate Change (2017) sets out in this respect that adaptation measures, despite their costs, will reduce several times the cost of addressing the negative impacts of inaction or will ensure sustainable profits from farming in areas where revenues would decrease due to negative impacts of climate change (e.g. in forestry or agriculture). Some costs can be financed as part of activities that are carried out without regard to climate change - e.g. maintenance or periodic renewals, a number of costs will be spread over a longer period. The social impacts of climate change (e.g. mortality) are also important.

7. Communication strategy and public engagement, education and awareness

The Strategy on Adaptation to Climate Change in the Czech Republic formulates the basic tasks for **the communication strategy and plans to involve the public; therefore, it is necessary to ensure public awareness of the likely impacts of climate change and of the possible adaptation measures in the conditions of the Czech Republic.** Education and awareness are a necessary and effective tool reflecting climate change. Their aim is to systematically professionally educate key target groups and to build a positive attitude and active approach of the population to adaptation measures. The issue of adaptation to climate change should be reflected in all relevant strategic documents in the field of education and training. Environmental education and awareness has a long tradition in the Czech Republic, a fundamental strategic document for this area is the "State programme of environmental education and awareness".

Research and development play a crucial role in terms of adaptation to climate change, because they enable us to obtain, evaluate and interpret new knowledge on climate change, on the occurrence and impacts of climate extremes, to specify their prediction and improve the possibilities of climate modelling, as well as the quantification of future costs associated with negative impacts, adaptation to and mitigation of climate change.

The focus of basic research areas in relation to the Adaptation Strategy of the Czech Republic

- modelling of climate change impacts on social and economic systems, and development of adaptation measures and mechanisms;
- research and modelling of climate change impacts on the water regime, ecosystems and agri-ecosystems;
- monitoring and exploration of climate extremes and their impacts on society in the regional, national and global context;
- research in methods aimed at reducing the vulnerability of the society and at increasing its resilience to climatic extremes, natural risks;
- research in environmental security;
- estimates of the number of people affected by climate variability based on simulations of climate models (regional, national level);
- economic analysis and evaluation of the benefits of adaptation measures in selected sectors of the economy and the development and application of methods for selecting the optimal combination of those measures;
- analysis and evaluation of negative external effects related to climate change and their internalization in designing appropriate measures;
- the issue of ecosystem services.

8. Coordination of the strategy implementation and organizational measures

A prerequisite for monitoring and optimizing the process of adaptation to climate change and for implementing those activities is an effective system of monitoring and evaluation of the implemented adaptation measures including the establishment of adequate indicators. As the topic of climate change impacts and prevention of potential damage is cross-cutting, it requires the involvement of all relevant ministries. The Strategy is a framework document that cannot cover all of the relevant areas in detail; therefore, the **National Action Plan on Adaptation to Climate Change** has been drawn up, containing specific implementation parts with proposed implementing measures, including the responsibility for implementing the proposed tasks and the timeframe of the implementation.

The coordination of adaptation and mitigation measures, monitoring, and evaluation of the implementation of the climate change adaptation in the Czech Republic is ensured by the Ministry of the Environment. As this is a crosscutting theme and adaptation measures need to be promoted in all

relevant sectors, an advisory body on adaptation to climate change has been established by the Minister of the Environment in January 2015. The body is the Inter-ministerial Working Group focused on climate protection. The central coordinating and methodological role of MoE is based on the basic principles of effective management:

- the existence of a single official partner for the European Commission on the implementation of adaptation and mitigation measures aimed at eliminating the effects of climate change,
- existence of a single entity that evaluates each proposed measure,
- the existence of one central methodological body on climate change.

Implementation of the strategy objectives will be monitored by the Inter-ministerial Working Group on Climate Protection. In order to keep the Adaptation Strategy of the Czech Republic up to date, it is necessary to continuously acquire and evaluate new knowledge both on climate change and its impacts on the individual sectors and on defining new and monitoring the effectiveness of the implemented measures. With regard to those facts and the need to optimize the approach at national and international level, it is necessary to update the Adaptation Strategy of the Czech Republic. Due to the planned revision of the EU Member States' approach to adaptation to climate change (incl. the level of their adaptation strategies) in 2017, the **nearest revision of the Adaptation Strategy of the Czech Republic** has been planned to start soon after, so that the first update could be approved **in 2020. Subsequently, updates will be made regularly every 10 years.**

9. List of annexes

Annex 1: Pilot projects, implementation of appropriate adaptation measures
- *Research*
- *Planning and Support*
- *Implemented examples*

Annex 2: Overview of underlying documents and bibliography

Annex 3: Table of terms and explanatory notes

Annex 4*: Summary of adaptation measures

Annex 5*: Summary of the main recommendations for adapting to climate change in the Czech Republic

Annex 6: Indicative list of European structural and investment funds (ESIF) suitable for financing the adaptation measures

Annex 7: The usability of the LIFE programme for financing the adaptation measures

Note:
* … included in the executive summary

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http://www.mzp.cz/cz/zmena_klimatu_adaptacni_strategie

Annex 4: Summary of adaptation measures

Forest management
Utilization of natural processes and cultivation of spatially varied and species-rich forest stands
Changing the preference of species and ecotypes of forest tree species
Stabilization of carbon volumes bound in forest ecosystems
Determination of priorities for support of adaptation measures in forest ecosystems
Genetic resources of forest tree species
Agriculture
Land consolidation
Genetic resources, research, breeding and agricultural biotechnology
Standards of Good Agricultural and Environmental Condition (GAEC)
Afforestation and grassing
Organic farming
Reducing soil erosion
Measures combating agricultural drought
Protection of biodiversity in agriculture
Diversification of agriculture
Monitoring, risk analysis, and early warning systems
Addressing the impact of extreme meteorological phenomena on farming
Greening of the European Common Agricultural Policy
Water regime in the landscape and water management
Measures to ensure stability of water regime in the landscape
Systems of rainwater management and water reuse
River Basin Management Plans and Flood Risk Management Plans
Plans for the Development of Water Supply and Sewerage
Measures at water supply systems
Measures at wastewater treatment plants and sewerage systems
Optimizing the function of existing water reservoirs and systems of water management structures
Restoration of small water reservoirs and enhancing their reliability
Modifications of watercourses and floodplains
Rationalization of the licensing system for water abstraction and discharges
Protection of existing and prospective water resources
Infiltration of surface water into groundwaters
Water transfers
Water reservoirs in the areas protected for accumulation of surface water
Hydric utilization of mines and quarries
Urban landscape
Measures to minimize surface runoff
Measures to reduce pollution of surface runoff
Ensuring variability of the urbanized area
Measures to ensure a functional and ecologically stable system of urban greenery
Measures in the field of urban development, construction and architecture
Mitigation of flood impacts in urbanized areas
Measures to reduce the risks associated with air temperature and quality
Responsible management and reducing the footprint of urbanized areas

Biodiversity and ecosystem services
Analyses of climate change impacts on biodiversity
Measures to protect, restore, and improve ecosystems and natural or close-to-natural areas and elements contributing to adaptation to the impacts of climate change
Measures to increase the capacity of ecosystems to provide key services
Measures to protect and restore the connectivity and permeability of the landscape
Measures to prevent and limit the spread of invasive species
Measures to protect and improve the status of populations of rare and endangered species in key biotopes
Ensuring concurrency of adaptation measures and nature protection tools
Health and hygiene
Measures for infectious and non-infectious disease reduction or even elimination
Awareness and healthcare
Tourism and recreation
Measures in public administration
Tourism sectors and destinations
Consumer measures in tourism
Research and communication in tourism
Transportation
Ensuring flexibility and reliability of the transport sector, ensuring operation after extreme weather conditions
Identifying and monitoring the unsatisfactory technologies in transport infrastructure, promoting research and development of new materials
Optimizing temperatures in the means of transport
Measures to shade the roads
Industry and energy sector
Measures of industrial facilities and their safety
Measures in the electricity sector
Measures in the gas industry
Measures in the oil industry
Measures in the heating sector
Measures in the field of renewable energy sources
Emergency events and protection of the population and the environment
Protection of the population, early warning systems in emergency
Development and strengthening of the Integrated Rescue System
Measures protecting critical infrastructure
Environmental security
Enhancing security research and development

Annex 5: Summary of the main recommendations for adapting to climate change in the Czech Republic

Forest management

The possibilities of forest management in adapting to climate change lie in differentiating the forms of farming by habitat and in a shift to more natural forms of farming. Changes in the species and spatial composition are designed to increase stability and resilience of forest stands.

Agriculture

The basic conditions of successful adaptation include flexible and careful land use, introduction of new technologies as well as diversification of agriculture. In the landscape, this means adaptation-preventive measures with a combined effect on the quality of soil, water (with an emphasis on water retention in the landscape) and agricultural biodiversity. A key condition is sustainable land use. Solutions should be based primarily on the following principles of sustainable farming: suitable spatial arrangement of farmland, soil protection and erosion control measures, improving soil structure, increasing the proportion of organic matter in soil, breeding and using the varieties and breeds resilient to the changed climatic conditions.

Water regime in the landscape and water management

To promote integrated water planning and to integrate influences and impacts of the other sectors of the economy, e.g. tourism, energy, agriculture, forestry, health, industry, territorial development and other in terms of forecast demands on water resources under different scenarios of climate change and societal development.

To optimize water regime in the landscape in a comprehensive and integrated manner, i.e. by planned support of measures on watercourses and floodplains (revitalization of watercourses and floodplains, implementation of flood protection measures, natural-friendly if possible - restoring natural overflowing, construction of detention basins (polders) and relocation dykes, etc.), conjunction with measures in the river basin area (measures to slow surface runoff, erosion control measures, support for infiltration of rainwater, etc.).

To use a rating system for prospective water balance in the six-year cycles of River Basin Management Plans in order to assess the development of water balance in its spatial and temporal variability in the Czech Republic (hydrology and water management) and rational decision-making of the state administration in permitting abstractions and discharges.

To address conceptually and legislatively the issue of long-term water scarcity, and thus to prevent the escalation of incidents caused by such extreme weather phenomena.

To optimize and ensure the functions of water infrastructure (water supply and sewerage) in the case of extreme hydrological situations (drought, floods, poor water quality) and in the case of long-term changes in the hydrological cycle.

To revise and update the definition of areas of water protection within the meaning of the Water Act (protective zones of water resources, protected areas of natural water accumulation, vulnerable areas, sensitive areas and others).

To use effective instruments (legislative, financial, regulatory) to enhance rainwater infiltration and systems of capturing and reuse of rainwater from paved areas in urban areas in order to increase water retention in the landscape and strengthen water resources. To consider alternative ways of managing water resources e.g. by controlled artificial infiltration.

To modify the system of permitting the discharge of wastewater so that it puts maximum emphasis on the application of BAT (*best available techniques*).

To reduce consumption of quality drinking water for purposes for which such a high quality is not necessary (e.g. for toilet flushing, washing, watering gardens, etc.) and promote reuse of partially treated wastewater (*grey water*).

To mainstream the issue of approach to the management of smaller watercourses and farming in their river basins, as these are key locations in terms of the impacts of increased climate variability at regional level (numerous occurrence of flash floods, etc.).

To revise the list of sites in the Master Plan of the areas protected for natural water accumulation - to prepare and carry out a revision in order to assess the existing list of locations in the master plan and to identify further areas of sites suitable for constructing water reservoirs, assessing whether the function of the envisaged reservoirs is secured in the conditions of climate change and the expected water demand (primarily to meet the needs of the population and energy).

Urban landscape

To ensure sustainable management of water (infiltration or use of rainwater, austerity measures) and functionally interconnected systems of areas dominated by natural components forming the system of urban greenery. An important role here will be played by water and vegetation areas and elements.

To promote the overall improvement of preparedness of urban areas for manifestations of climate change by a transition to passive and close-to-passive standards of new buildings and by thorough renovation of existing buildings at least in line with scenario No 3 of the Strategy for renovation of buildings of the NAPEE. To promote structural and technical adaptation of buildings through legal standards and norms.

Biodiversity and ecosystem services

To preserve and improve the natural resistance and resilience of natural and man-affected parts of the landscape, and thus preserve their ability to provide essential ecological functions necessary for the provision of ecosystem services.

To ensure a thorough and integrated land-use planning for the long term (spatial planning, comprehensive land consolidation, landscape planning, forest management plans and curricula, etc.) taking account of biodiversity protection and of ensuring key ecosystem services incl. water retention in the landscape.

To increase the capacity of ecosystems to fix carbon both by limiting inappropriate transformations of biotopes and ecosystems, and by preserving and restoring natural biotopes with a high carbon content, esp. of aquatic and wetland ecosystems.

To invest in restoring and improving the connectivity between ecosystems and natural or near-natural areas and elements contributing to climate change adaptation.

To preserve or improve the state of biodiversity and ecosystem services through appropriate care with a primary focus on improving the condition of populations of rare species and on biotopes and ecosystems most vulnerable to climate change, or creating conditions for their spread to other or new suitable habitats.

Health and hygiene

Adaptation in terms of health and hygiene concerns in particular measures on prevention of infectious and non-infectious diseases (such as tick-borne encephalitis, Lyme disease, cardiovascular diseases and allergic disorders) and on prevention of injuries caused by extreme weather phenomena.

Tourism and recreation

Specific short-term adaptation measures in the tourism sector have not been determined at this time due to insufficient knowledge base.

Transportation

Adaptation measures in transport require integrating the impact of climate change both in long-term investments and in sectoral policies and strategies. It is necessary to promote research and to use appropriate tools for evaluating the impacts of climate change, such as assessment of risks, vulnerability, *cost-benefit* analysis. It is also necessary to systematically increase the glaze frost resistance of electrical railways.

Industry and energy sector

Adaptation measures in industry and energy concern in particular ensuring the functioning of critical infrastructure whose failure would have an impact on end consumers and on protected interests of the State. It is important to ensure security of industrial facilities.

Emergency events and protection of the population and the environment

Adaptation measures consist mainly in supporting the development of civil protection and the environment, i.e. an integrated system of emergency prediction, a system of warning and informing the inhabitants, the integrated rescue system, critical infrastructure protection and environmental security.

Adaptation measures must be carried out so that the public administration is able to effectively ensure the readiness for all relevant types of emergency events, and for an effective response. Such measures must be carried out in the interest of ensuring a rapid response to emergency events in order to maximize the effectiveness of protecting the life of the affected inhabitants and the infrastructure ensuring their survival. It is equally important that the public administration is able to efficiently and quickly take appropriate action in the recovery phase after the incident, as the length and course of this phase can have a substantial impact on the functioning of the national economy.