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Sustainability and Tourism

The Austrian strategy for adaptation to climate change

Part 1 - Context

IMPRINT

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THE AUSTRIAN STRATEGY FOR ADAPTATION TO CLIMATE CHANGE

PART 1 – CONTEXT

Updated version, January 2017

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Vienna, October 2017

TABLE OF CONTENTS

Table 1: Changes of acromys and names of the respective Austrian Federal Ministries between 2017 and 2018

Changes acronyms and names of the respective Austrian Federal Ministries between 2017 and 2018	
2017	**2018**
BMLFUW - Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry of Agriculture, Forestry, Environment and Water Management)	**BMNT** – Bundesministerium für Nachhaltigkeit und Tourismus (Federal Ministry for Sustainability and Tourism) www.bmnt.gv.at
BMWFW – Bundesministerium für Wissenschaft, Forschung und Wirtschaft (Federal Ministry of Science, Research and Economics)	**BMBWF** – Bundesministerium für Bildung, Wissenschaft und Forschung (Federal Ministry of Education, Science and Research) www.bmbwf.gv.at
	BMDW – Bundesministerium für Digitalisierung und Wirtschaftsstandort (Federal Ministry for Digital and Economic Affairs) www.bmdw.gv.at
BMASK - Bundesministerium für Arbeit, Soziales und Konsumentenschutz (Federal Ministry of Labour, Social Affairs and Consumer Protection)	**BMAGSK** - Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz (Federal Ministry of Labour, Social Affairs, Health and Consumer Protection) www.bmasgk.gv.at (www.sozialministerium.at)
BMG – Bundesministerium für Gesundheit (Federal Ministry of Health)	
BMLVS – Bundesministerium für Landesverteidigung und Sport (Federal Ministry of Defence and Sports)	**BMLV** – Bundesministerium für Landesverteidigung (Federal Ministry of Defence) www.bmlv.gv.at
BMEIA – Bundesministerium für Europa, Integration und Äußeres (Federal Ministry for Europe, Integration and Foreign Affairs) www.bmeia.gv.at	
BMF – Bundesministerium für Finanzen (Federal Ministry of Finance) www.bmf.gv.at	
BMI – Bundesministerium für Inneres (Federal Ministry oft he Interior) www.bmi.gv.at	
BMOEDS – Bundesministerium für öffentlichen Dienst und Sport (Federal Ministry for the Civil Service and Sport) www.bmoeds.gv.at)	
BMVRDJ - Bundesministerium für Verfassung, Reformen, Deregulierung und Justiz (Federal Ministry of Constitutional Affairs, Reforms, Deregulation and Justice) www.bmvrdj.gv.at	
BMVIT – Bundesministerium für Verkehr, Innovation und Technologie (Federal Ministry for Traffic, Innovation and Technology) www.bmvit.gv.at	

EXECUTIVE SUMMARY

In Austria, climate change is making itself more and more clearly noticeable. Its existence is demonstrated by measurements and observations, and it is proceeding faster than the global average (APCC14).

For some years now, Austria has increasingly devoted itself to the question of how best to tackle climate change in its own country.

The Austrian Strategy for Adaptation to Climate Change was adopted by the Council of Ministers in October 2012 and was endorsed by the Provincial Governors' Conference in May 2013. Austria was thus one of the first EU member states to link a strategic concept for adaptation to climate change with a comprehensive action plan for implementing concrete recommendations for action.

The implementation of measures listed in the plan has been under way since then. In 2015, an initial evaluation of the level of implementation was published in accordance with the government program mandate. This progress report was also adopted by the Federal and by the Provincial governments.

For the first time, the Paris Agreement (UNFCCC 2015) adopted a legally binding global climate change agreement with commitments for industrialized and developing countries. Adaptation to climate change is treated as an objective of equal importance with mitigation. Austria had been pursuing this two-pronged principle in climate policy even before this international decision, focusing on the one hand on the reduction of greenhouse gas emissions to directly mitigate climate change and, on the other, on adapting to the effects of climate change that can no longer be avoided.

Adaptation to climate change must be based on the most up-to-date scientific knowledge and current political conditions.

In fulfillment of the mandate of the Council of Ministers, the existing 2012 adaptation strategy has therefore been updated. Its structure has been preserved; the overall document is divided into a strategic part (context) and an action plan with concrete recommendations for action. In the revised version of the strategy, in which among other things all relevant ministries, the states, representatives of special interest groups, stakeholders and NGOs were involved, key findings from the 2015 progress report have also been integrated.

Although there have been many changes in climate in the history of the earth, the changes currently under way are presenting enormous challenges, especially in view of their speed. On their own, and without any guiding intervention, the environment and society can scarcely keep up with the changes. A forward-looking adaptation policy must signpost the path into the future.

This requires a "policy of small steps" with comprehensive consideration of aspects of climate change in all relevant planning. But it also requires long-term restructuring of society and renewed awareness of sustainability in its full meaning.

It seems essential for the potential consequences of climate change to be taken into account in all relevant future planning and decision-making processes from the national to the local levels.

The strategy presented here provides a framework for such an adaptation policy.

The adaptation goals and the recommendations for the 14 areas of action discussed in the strategy are presented below in tabular form:

Agriculture

Objective: Ensuring sustainable, resource-conserving and climate-friendly (agricultural) production and maintaining and improving the ecological services of agriculture under changing climatic conditions.

- Sustainable soil composition and protection of soil fertility, structure, and stability
- Enhanced establishment and promotion of water-saving irrigation systems and improvements in irrigation planning
- Breeding and targeted use of water-saving, heat-tolerant plants (species/varieties) for regionally adapted management
- Adjustment of fertilizer management to seasonal weather patterns
- Provision of scientific advice on potential new agricultural diseases and pests
- Environmentally sound and sustainable use of plant protection products (pesticides)
- Review of site suitability based on changing climatic conditions, and development of recommendations for the selection of a site-adapted crop
- Risk minimization and the development and extension of risk-sharing instruments
- Integrated landscaping for soil protection and the improvement of agricultural ecology, including the conservation and maintenance of landscape features
- Preservation of existing pastures and revitalization of abandoned pastures
- Optimization of greenhouse cultivation in terms of energy, water, and cooling supply strategies
- Promotion of animal welfare and animal health under changed climatic conditions
- Consideration of future requirements for the cooling of stables due to increasing thermal stress
- Optimization of adaptation and combat strategies for new diseases and pests

Forestry

Objective: Maintaining the multifunctional effects of the forest through sustainable management adapted to climatic changes.

- Modification in the selection of tree species and provenance,
- including targeted promotion of diversity through appropriate silvicultural management and rejuvenation of overaged stock
- Soil-friendly management
- Reduction of game damage
- Development of an advisory service for forest owners as concerns adaptation of forests to climate change
- Adjustment and improvement of crisis and calamity management
- Establishment of preventative measures with regard to potential increases in forest fires
- Forest pollution control – Integrated forest inventory and monitoring of immissions
- Development of modified and innovative techniques for wood processing taking into account potential changes in wood quality and tree species

Water Resources and Water Management

Objective: To secure sustainable water resources as the basis of existence and habitat, as well as to ensure the supply of high-quality drinking water, the environmentally sound treatment of wastewater and the protection of the population from natural hazards under changed climatic conditions.

- Analysis of existing data and promoting collection of further data on water resources
- Improving coordination/information concerning water consumption and water demand
- Guarantee of future water supply
- Responsible use of water resources
- Increased consideration of low water in the management of water resources
- Achieving and securing the good ecological and chemical status of water bodies (including groundwater)
- Proactive water management planning for groundwater resources
- Adaptive flood risk management with robust measures
- Greater emphasis on water temperature in water management measures
- Installation of industrial water management instruments

Tourism

Objective: Securing Austria's position as an attractive and sustainable tourism location by exploiting climate change-related potentials and promoting environmentally friendly adaptation measures.

- Taking account of climate change in tourism strategies
- Development of climate-friendly adaptation measures based on tourism strategies
- Development, provision, and improvement of regional data as the basis for decision-making for adaptation measures
- Support for climate change-endangered winter sports regions by creating offers not dependent on snow
- Strengthening Alpine summer tourism
- Expansion of city tourism in Austria

Energy – Focus on the Electricity Industry

Objective: Ensuring the security of the energy supply in general, and in particular in the electricity sector, taking account of the consequences of climate change; diversification of energy sources and decentralization of the energy system as well as reduction of energy consumption in order to reduce vulnerability to the consequences of climate change.

- Optimization of the network infrastructure
- Promotion of decentralized energy production and feed-in
- Increased research on potential methods of energy storage
- Stabilization of the transport and distribution network through appropriate climate-adapted system planning
- Optimization of the interaction between generation (from various sources) and consumption in the power supply system under varying supply and demand

- Factoring in the effects of climate change when making decisions on energy and research activities, such as from the point of view of further diversification
- Reduction of internal loads to avoid summer overheating in buildings by reducing power consumption and increasing final energy efficiency
- Consideration of the impact of climate change on energy demand and energy supply in energy strategies

Construction and Housing

Objective: Ensuring the quality of housing by imposing planning, construction and use-related adaptation requirements on buildings and in the adjacent environment.

- Implementation of structural measures (in new buildings and in renovations) to ensure thermal comfort
- Encouraged use of passive and active cooling with alternative, energy-efficient, and resource-saving technologies
- Climatological improvement of urban spaces, with particular emphasis on micro- and meso-climatic conditions in urban and open space planning
- Implementation of structural measures on buildings to protect them from extreme weather events
- Increase of water retention
- Adaptation of building standards and norms to climate change
- Evaluation and further development of funding instruments for taking account of climate change aspects in new constructions and renovations
- Research on adaptation to the consequences of climate change in the area of construction and housing
- Pilot projects on “climate change-adapted architecture”
- Public information and raising of awareness of the issue of adaptation to the consequences of climate change in the area of construction and housing
- Training and further education on adaptation to the consequences of climate change in the area of construction and housing

Protection from Natural Hazards

Objective: Strengthening the precautionary principle through area-wide actions, private actions and changes in behavior, in order to reduce the negative consequences of climate change-related natural hazards.

- Development (education) and promotion of danger and risk awareness as well as individual responsibility in the population
- Promotion of sustainable spatial development strategies, including increased consideration of planning in hazard areas and identification of risks
- Promotion of water retention in catchment areas and reactivation of natural floodplains (and areas), particularly as a contribution to provision of additional inundation area
- Promotion of the development of forecasting, (early) warning and measurement systems
- Promoting research into the impact of climate change on extreme events, on changes in the natural environment, on human use and on how to deal with uncertainties in decision-making

Protection from Natural Hazards

Objective: Strengthening the precautionary principle through area-wide actions, private actions and changes in behavior, in order to reduce the negative consequences of climate change-related natural hazards.

- Promoting adoption of measures for reducing risk while taking account of appropriate risk transfer mechanisms
- Promotion of property protection measures (permanent and temporary) to encourage individuals to take safeguarding measures

Disaster Management

Objective: Rapid and professional management of disasters through better networking and preparation of all actors involved, especially with regard to changing climatic conditions.

- Continuous implementation of the objectives of the SCCM Strategy 2020, with greater consideration of the effects of climate change
- Establishment of a national risk reduction platform
- Preservation and, if necessary, improvement of the conditions for volunteering in the field of disaster management
- Increasing the flexibility of financing and funding instruments in the field of disaster management
- Risk communication as a contribution to strengthening individual provision in the area of disaster management
- Increase in training offers in the field of disaster management
- Continuation of the national risk analysis and development of a uniform methodology for carrying out risk analyses
- Promoting participative approaches to the integration of all players in disaster management
- Continuation and networking of research activities and development of innovations related to disaster management

Health

Objective: Coping with and avoiding direct (e.g., due to heat waves) and indirect (e.g., through the spread of allergenic plants and animals) climate-related health effects through appropriate measures, even, if needed, early adoption of precautionary measures.

- General public relations and specific work on preparing for extreme events or outbreaks of infectious diseases
- Dealing with heat and drought
- Dealing with floods, mudslides, avalanches, landslides and rock falls
- Advancement of knowledge and preparation for handling pathogens/infectious diseases
- Risk management with regard to the spread of allergenic and toxic species
- Dealing with pollutants and ultraviolet radiation
- Linking in and further development of monitoring and early warning systems
- Incorporation of climate-relevant topics in the training and further education of doctors and personnel in medical, therapeutic, and diagnostic health professions (MTDG)

Ecosystems and Biodiversity

Objective: Preservation and promotion of biodiversity and ecosystems and their functions by protecting species susceptible to climate change, facilitating the connectivity of habitats, sustainable land use and adaptation of conservation concepts to climate change-related changes.

- Improving the knowledge base through research on the effects of climate change on ecosystems/biodiversity
- Increased consideration of climate change in existing monitoring systems and further establishment of monitoring and early warning systems
- Integration of climate change in nature conservation
- Strengthening of knowledge transfer on the importance of biodiversity and ecosystems for adaptation to climate change in training, and increased public relations efforts
- Maintenance of extensive land use in mountainous and Alpine elevations and in selected locations
- Adapting leisure and vacation activity offers
- Adjustment in the design of public and private open spaces in residential areas to the objectives of nature conservation and the effects of climate change
- Strengthening of threatened populations and species
- Maintaining and improving the embedding and networking of protected areas and habitats
- Protection of wetland habitats by ensuring the quality and quantity of groundwater and by raising the water storage and retention capacity of landscapes
- Promotion of restoration of waters, reinforcement of integrated watershed management, and prevention of the substantial warming of bodies of water
- Conservation of ecosystem services in sustainable land use and nature conservation
- Consideration of ecosystems/biodiversity issues in a global context

Transport Infrastructure Including Aspects of Mobility

Objective: Maintenance of a functioning, safe and climate-compatible transport system by means of transport infrastructure that is adapted to climate change.

- Further expansion of information and early warning systems
- Safeguarding a functional transportation system
- Ensuring thermal comfort by reducing thermal loads in public transport stations and their vicinity
- Reduction of potential heat stress for passengers and personnel in public transportation through appropriate air conditioning
- Review and, if necessary, adaptation of legal standards for the construction and operation of transport infrastructure under changed climatic conditions
- Consideration of micro- and meso-climatic conditions in urban and open space planning
- Reduction of the increase in permanently sealed surfaces for transportation infrastructure as flood protection
- Research on adaptation to the consequences of climate change in the area of transportation infrastructure
- Pilot projects on transportation infrastructure adapted to climate change

Transport Infrastructure Including Aspects of Mobility

Objective: Maintenance of a functioning, safe and climate-compatible transport system by means of transport infrastructure that is adapted to climate change.

- Improved public information methods
- Training and further education on adaptation to the consequences of climate change in the area of transportation infrastructure

Spatial Planning

Objective: Addressing the challenges of climate change in order to ensure sustainable spatial development through the consistent application and further development of existing planning objectives and instruments, as well as by preserving ecosystem functions

- Development and provision of practice-relevant data and information bases, raising awareness, and improved networking of actors
- Establishment and protection of flood retention and drainage zones and clear regulation of zoning prohibitions and restrictions
- Reinforced legal links between zoning and hazard-zone planning
- Regulations for handling existing zoning and building in hazardous areas
- Promotion of intermunicipal cooperation
- Protection of fresh/cold air production areas, ventilation paths, and “green” and “blue” infrastructure within residential areas
- Review and (if necessary) adjustment of bioclimatically active measures in development plans
- Increased protection of water resources and improved integration of spatial planning, water management planning, and usage with water demand
- Increased protection of ecologically important open spaces (undeveloped semi-natural areas, habitat corridors, biotope networking) and minimization of further habitat fragmentation
- Increased cooperation between spatial planning and tourism to promote a climate change-adapted, sustainable tourist infrastructure
- Promotion of energy-optimized spatial structures
- “Climate proofing” spatial plans, development concepts, procedures and spatial projects
- Promotion of quantitative soil protection and consideration of soil quality in land use

Business/Industry/Trade

Objective: Increasing the resilience of production and trade by minimizing climate change-related risks and developing climate-friendly and adaptation-promoting products.

- Securing of supply, transport networks, and production through differentiated supply networks, regional clusters and production close to the market
- Securing supply and production through long-term contracts and expansion of stock held in warehouses
- Measures to increase the resilience of production, sales, and operational infrastructure
- Increased energy security by promoting alternative/energy efficient technologies to increase resilience to the impacts of climate change

Business/Industry/Trade

Objective: Increasing the resilience of production and trade by minimizing climate change-related risks and developing climate-friendly and adaptation-promoting products.

- Development of climate-friendly and adaptive products, technical processes and services
- Promotion of appropriate future scenario-based risk assessments, cooperation with R & D, and monitoring of scientific results
- Raising public awareness about preventing damage and reinforcing the individual responsibility of insured people
- Better risk diversification for insurers, with resulting increase in the insurability of climate- and weather-induced damage
- Providing services to customers after claims

Cities – Urban Green and Open Spaces

Objective: Securing the quality of urban life in changing climatic conditions by preserving and improving the diverse functions of urban open spaces and green spaces.

- Adaptation of the water management strategy for green and open spaces
- Adaptation of soil management in urban green and open spaces
- Conservation and promotion of biodiversity in urban green and open spaces
- Adaptation of planning strategies for urban green and open spaces
- Adaptation of open space planning and maintenance
- Promotion and adaptation of green and open spaces for recreation and leisure uses under changing climatic conditions
- Raising awareness, improved networking, and adaptation of the training and further education of actors (public and private)
- Improvement of the knowledge base through inter- and transdisciplinary research on urban green and open spaces

INTRODUCTION

1 INTRODUCTION

Climate change poses one of the greatest environmental challenges of the twenty-first century. The IPCC's Fifth Assessment Report (IPCC 2014a) confirms more clearly than ever before, that climate change is due to human influence and is progressing steadily. Because of the inertia of the climate system and the longevity of greenhouse gases, a further increase in temperature is inevitable until the middle of the century. Climate change will thus be determined by the greenhouse gas emissions caused in the coming years (APCC 2014). For Europe – especially the Alpine region – adverse effects are expected that will cause significant problems for many socio-economic and natural systems.

For the first time, the Paris Agreement (UNFCCC 2015) adopted a legally binding global climate change agreement with commitments for industrialized and developing countries. Global warming should be limited to well below two degrees Celsius, ideally to 1.5 degrees, compared with the pre-industrial level. For the first time, the International Climate Change Agreement clearly states that strengthening climate change adaptation and resilience and reducing vulnerability to the effects of climate change is becoming a global goal. Thus, adaptation to climate change is now being given the same priority as mitigation. Speedy implementation of the agreement can limit global warming, and thus limit future need for adjustment – especially for the second half of the century.

Extensive climate changes can already be observed today. In order to reduce or avoid the consequences of climate change, appropriate measures must be implemented in a timely manner. If this fails, considerable damage and costs can be expected (IPCC 2014a, b, Steininger et al., 2015).

Therefore, in addition to essential measures to reduce greenhouse gas emissions, adaptation strategies must be developed and implemented. Adaptation as the second pillar in climate policy represents a necessary and indispensable complement to climate mitigation. The causal fight against climate change, i.e., the further reduction of greenhouse gases, remains the top priority. A critical element of prevention in the coming years is thus the achievement of climate change mitigation objectives.

Austria is particularly affected by climate change due to its location within the Alpine region. The temperature in Austria has risen by about 2°C since 1880, and is thus considerably above the global temperature increase of about 0.9°C. The effects are already evident, among other things in the shrinking of glaciers, longer vegetation periods and the increase in temperature extremes.

There is no doubt that global warming will continue, with average temperatures in the Alpine region increasing at a particularly rapid rate compared with the global increase. For this reason, the forward-looking planning and implementation of flexible adaptation measures on the basis of current knowledge is crucial.

In response to the effects of climate change that are already observable today, Austria started developing an adaptation strategy at an early stage. In October 2012, the Austrian Strategy for Adaptation to Climate Change (BMNT, formerly BMLFUW 2012a, b) was adopted. It forms a comprehensive framework for successively taking the steps necessary for adaptation. It offers concrete starting points for all those involved in its implementation.

The first progress report (BMNT, formerly BMLFUW 2015, see Chapter 4: Activities for implementing the adaptation strategy) showed that a number of actions have already been adopted and implemented. These activities should be maintained and further developed.

Adapting to climate change is a long-term, ongoing task that will stretch over longer time horizons. The goal is to integrate adaptation-relevant aspects in all political decision-making processes.

POLITICAL ENVIRONMENT

2 POLITICAL ENVIRONMENT

In recent years, at both the international and European level, the issue of climate change adaptation has become a major focus of attention. The obligation to develop a national adaptation strategy can be found in the United Nations Framework Convention on Climate Change [1] (UNFCCC 2007, ratified by Austria), as well as in Art. 10 (b) of the Kyoto Protocol, which came into force in 2005.

Article 7 of the Paris Agreement (UNFCCC 2015), adopted in December 2015, highlights climate change adaptation as an important second pillar of climate policy, in particular through the introduction of a global adaptation target focusing on the following three elements: (1) improving adaptive capacity, (2) strengthening resilience and (3) reducing vulnerability to climate change. Furthermore, the article clearly states that contracting states should develop, implement and update national and, where necessary, regional programs. In addition, an obligation to report on adaptation has been specified, the modalities for which must be worked out until the Climate Change Conference in 2018.

In March 2015, the United Nations Third World Conference on Disaster Risk Reduction adopted the "Sendai Framework for Disaster Risk Reduction 2015–2030" (UNISDR 2015). It aims at reducing risks arising from natural disasters, avoiding the emergence of new risks, and strengthening the resilience of populations and institutions to disasters. Climate change is explicitly anchored in it, and thus forms the international link to the Framework Convention on Climate Change.

In pursuing the Sustainable Development Goals (SDGs, UN 2015[1]) adopted by the United Nations in September 2015, sustainable economic, social and environmental development is to be achieved by 2030 worldwide. Of the 17 key goals, Sustainability Goal 13 specifically refers to climate change and its consequences. In addition to increasing resilience to climate risks, concrete measures should also be integrated into planning and policy processes. The SDGs have an overarching and interconnected character. This includes the Paris Agreement (UNFCCC 2015) and the Sendai Framework for Disaster Risk Reduction 2015–2030 (UNISDR 2015).

In Austria, the implementation of the SDGs in the specific ministries will be carried out through integration into sector-specific strategies and programs. If necessary, new action plans and measures involving all relevant actors will be developed. An inter-ministry working group will be set up under the direction of the BKA (Austrian Federal Chancellery) and the BMEIA (Federal Ministry of Europe, Integration and Foreign Affairs) to prepare regular progress reports.

On April 16, 2013, the European Commission presented the EU Strategy for Adaptation to Climate Change (EC 2013a[2]) together with other documents such as technical reports on different sectors (e.g., insurance, health) and guidelines. The strategy builds on the Green Paper on Adapting to Climate Change in Europe (EC 2007b) and the White Paper on Adaptation (EC 2009a [3]).

The "EU Strategy for Adaptation to Climate Change" focuses on three main goals:

1. Promoting adaptation activities in EU Member States so that all EU Member States draw up comprehensive national adaptation strategies.

[1] *Link: https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals*
[2] *Link: http://ec.europa.eu/clima/policies/adaptation/what/documentation_en.htm*
[3] *Link: http://ec.europa.eu/clima/policies/adaptation/documentation_en.htm*

2. Integrating climate change issues at EU level in the key sectors of agriculture, fisheries, cohesion policy and infrastructure, and increasing the use of insurance in risk management.

3. Sound decision-making in the selection of measures for climate change adaptation by addressing knowledge gaps and further developing the European knowledge platform Climate-ADAPT.

The European internet platform for climate change adaptation –Climate-ADAPT (European Climate Adaptation Platform)[4] is a core activity for the implementation of the EU adaptation strategy. This platform provides users with information in the following areas:

- Climate change scenarios in Europe;
- Climate change vulnerability of regions and sectors;
- Information on national, regional and transnational adaptation strategies;
- Information and support materials for urban adaptation, in particular in the context of the European initiative "Mayors Adapt";[5]
- Adaptation case studies on adaptation measures and potential further adaptation options;
- Web tools to support the adaptation process (e.g., search engines for examples of good practice);
- Information on mainstreaming at the European level in sectors relevant to the EU (e.g., environmental protection, agriculture, infrastructure);
- Posters on adaptation-related research projects, and guidelines (e.g. on the management of uncertainty), reports, additional information sources, links, and announcements of events.

An important milestone in implementing adaptation activities has been laid by the EU financial framework for 2014–2020. It provides for 20% of the funds to be spent on climate change mitigation and adaptation measures (EC 2012, DG CLIMA 2016[6]).

In addition, the European Commission has established "Working Group 6 on Adaptation" within the so-called "Climate Change Committee" to implement the EU adaptation strategy. Austria is represented by the Federal Ministry for Sustainability and Tourism, BMNT (formerly BMLFUW).

The evaluation of the EU Adaptation Strategy is scheduled for 2017, with the plan to present the results in the second half of 2018 in the form of a Communication. In order to verify the achievement of the first objective, a so-called preparedness scoreboard was prepared by the Director General Climate (DG CLIMA). On the basis of selected indicators national processes for adaptation to climate change are described and evaluated (from very good progress to no progress). All EU Member States are involved in this process, and have the opportunity to provide feedback. If progress is insufficient, the possibility exists for the Commission to consider legally binding instruments.

Article 15 of the Monitoring Regulations for the EU Member States (Regulation (EU) No 525/2013[7]) requires, initially by March 15, 2015 and every 4 years thereafter, the provision of information on national adaptation plans and strategies in which measures implemented or planned for the facilitation of adaptation

[4] *Link: http://climate-adapt.eea.europa.eu/*
[5] *Link: http://mayors-adapt.eu/*
[6] *Link: http://ec.europa.eu/clima/policies/adaptation/financing/index_en.htm*
[7] *Link: http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32013R0525&from=DE*

to climate change are sketched out. The EU guidelines have been adopted for the presentation of the progress in adaptation.

In order to identify possible ways to improve Europe's resilience to the effects of climate change, a separate working group (Working Group II, "Impacts and Adaptation") has been established within the framework of the European Climate Change Program.[8]

In addition to the European Commission, the European Environment Agency (EEA) is also strongly focused on climate change and climate change adaptation. For example, the European Environment Agency regularly publishes reports on relevant topics, such as, for example, the monitoring and evaluation of adaptation in Europe (EEA 2015[9]). In a report from 2014[10] the EEA examines national adaptation policy processes in 30 European countries. The study shows that adaptation to climate change is on the political agenda in more than three quarters of countries.

The development of adaptation strategies is often the first step for a coordinated adaptation approach at the national level and represents the first milestone in a long-term process. As of December 2016, 22 nations in Europe had adopted a national adaptation strategy (see Figure 1) and 18 had an action plan.

Figure 1: Countries with adaptation strategies, as of 2016 (in green). Source: CLIMATE-ADAPT http://climate-adapt.eea.europa.eu/countries-regions/countries

[8] *Link: ECCP (European Climate Change Programme): http://ec.europa.eu/clima/policies/eccp/index_en.htm*
[9] *Link: http://www.eea.europa.eu/publications/national-monitoring-reporting-and-evaluation*
[10] *Link: http://www.eea.europa.eu/publications/national-adaptation-policy-processes*

In the Alps, the signatories of the Alpine Convention (BGBl. No. 477/1995) have become active and adopted the Action Plan on Climate Change in the Alps in 2009. Its aim is to make the Alpine region a role model in preventing and adapting to climate change. The Alpine countries have committed themselves to implementing the climate action plan by adopting concrete measures to fight climate change and providing the necessary resources for this purpose. Acting on a request by the European Council, a macro-regional strategy for the Alps has been in preparation since 2013, and this also has the task of addressing climate change (EUSALP Process[11]). Together with six other Alpine countries, Austria is actively involved in its development.

The **process of development of an Austrian Adaptation Strategy** commenced at the national level in 2007 (see Chapter 4: Activities for implementing the adaptation strategy). The government program of the Austrian government for the 24th legislative period (Republic of Austria 2008) has provided for the formulation of a national adaptation strategy with the involvement of all relevant stakeholders and the consideration of international good practices. The objective is to prepare for the population and the options for protection against negative consequences.

The Austrian Strategy for Adaptation to Climate Change was adopted by the Council of Ministers on October 23, 2012 (BMNT 2012a,b (formerly BMLFUW 2012a, b)) and endorsed by the Provincial Governors' Conference on May 16, 2013. It forms a comprehensive framework for the gradual implementation of the adaptation. The adaptation strategy contains concrete starting points for all those who are involved in the implementation. The adaptation strategy consists of the present context document, which contains strategic considerations and basic information, and an action plan with detailed recommendations for 14 areas of action. The current government program 2013–2018 (REPUBLIC OF AUSTRIA 2013) provides for the implementation and evaluation of the adaptation strategy.

[11] *Link: https://www.alpine-region.eu/*

OBJECTIVES

3 OBJECTIVES

The Austrian Adaptation Strategy aims at avoiding adverse effects of climate change on the environment, society and economy, and taking advantage of opportunities which arise. The adaptation strategy aims at strengthening the natural, social and technical capacity to adapt. Adaptation measures should thus involve no social downsides; rather, they should minimize risks to democracy, health, security, and social justice.

The need for adaptation affects a wide variety of decision-making levels, from public administration units with their various responsibilities over different economic sectors to individual people. Adaptation is a challenge that involves the entire society, requiring a well-coordinated approach that mediates between both the areas affected and the actors involved.

As a nationwide framework the strategy contributes to networking of the relevant actors, supporting cooperative action and capitalizing on synergies through cooperation whenever possible. It seeks to provide recommendations for each of the various areas and to identify linkages for all the actors challenged with implementation. In accordance with the precautionary principle, the strategy attempts to lay a foundation for forward-looking action with regard to future climate change impacts and to foster successful implementation. A proactive approach is recommended, because as climate change progresses, the opportunities for successful adaptation diminish and the associated costs increase. Another key objective is to increase awareness at all levels in order to sensitize actors and make the complex issue of adaptation to climate change more tangible.

Despite considerable scientific knowledge, the effects of climate change in many areas are still subject to uncertainty. A primary focus in the design of the strategy was therefore the development of flexible and robust recommendations for action that can easily be adjusted to various requirements and bring secondary benefits. No-regrets and win-win measures are worthwhile in any case, as they provide further social, ecological, or economic benefits regardless of the extent to which climate change is accelerating.

Another important objective is to identify linkages between the areas of action and related recommendations, in order to avoid negative impacts in other areas and possible conflicts in the implementation process. Adaptation activities that conflict with other key objectives – such as environmental protection or climate change mitigation – or that disadvantage social groups should also be precluded.

Of great importance is the avoidance of maladaptations. These are measures that are predominantly reactive and, as mere symptom control, are only promising in the near term, but prove counterproductive in the long term. Maladaptation can increase the vulnerability of other people, regions or sectors to the effects of climate change, have negative (side) effects on other areas, act against mitigation, be difficult to correct or redirect, or be ineffective (IPCC 2014b). This must be taken into account when planning and implementing recommendations for action in terms of quality assurance. The aim is to ensure maintaining a well-defined standard of “good adaptation” (see Chapter 6: Challenges to Adaptation).

In this sense, the Paris Agreement (UNFCCC 2015) also seeks to establish a degree of quality assurance. Both the adaptation article (Article 7) and Article 2, which sets out long-term objectives for mitigation, adaptation and financing, emphasize that all activities undertaken in the context of the climate change threat must contribute to sustainable development and conform with the stated global temperature target. Article 2 also notes that, in the future, cash flows must be reconciled “with a path towards low emission of greenhouse gases and climate-resilient development.” In this context, Article 2 of the Paris Agreement should also provide essential guidance in the implementation of climate change adaptation measures.

WHAT DO WE MEAN BY ADAPTATION?

The term adaptation refers to initiatives and measures enacted to "decrease the sensitivity of natural or human systems to the actual or expected effects of climate change" (IPPC 2007).

Adaptation activities seek to reduce vulnerability to climate change, to increase resilience, and to take advantage of potential opportunities presented by changing climatic conditions. Adaptation can be brought about in many ways and at various levels of action: forward-looking (proactive) or in response to specific climatic effects (reactive), on the public or private level, autonomously or planned.

Generally speaking, a wide range of adaptation options are available. They can be broadly classified into three categories (EC 2009c):

1. "**Gray**" measures are strictly technical in nature (such as technological systems for flood protection or slope stabilization);

2. "**Green**" measures directed at retaining or improving natural functions of ecological systems and thus creating "resilience" which serve as a buffer to climate consequences (e.g., the creation of landscape elements and hedges), and

3. "**Soft**" or "**smart**" measures. These include activities that focus on increasing awareness and knowledge, creating economic incentives and enabling institutional frameworks for adaptation (e.g., information leaflets on heat or natural hazards).

Although the definition of adaptation seems clear, in practice there are often difficulties in drawing distinctions. For example, measures aimed at the sustainable use of land and water are sensible and necessary even without explicit consideration of the effects of climate change. However, climate change will increase the pressure on natural resources, such that these types of measures will also contribute to adaptation to climate change. Therefore, it is not always possible, nor is it expedient, to differentiate adaptation to climate change from measures that serve to protect the climate, the environment, or sustainable development.

INTERFACES WITH RELEVANT NATIONAL STRATEGIES

Climate change adaptation is a cross-cutting issue related to a wide range of policy fields, from flood protection to the security of agricultural production to public health. Due to the cross-cutting nature of adaptation, a number of interfaces exist between the adaptation strategy and other relevant national strategies, processes, and programs. Sustainable development and adaptation are particularly closely related and complementary. The Austrian Adaptation Strategy is to be looked at in the context of sustainable development aimed at ensuring the country's economically efficient, socially equitable, and ecologically sound future development.

In addition, certain areas of action have already created their own strategies, offering important points of linkage; here, close cooperation and coordination in order to take advantage of synergies is advisable. The graphic below shows an example of interfaces concerning the adaptation strategy and other strategies and programs.

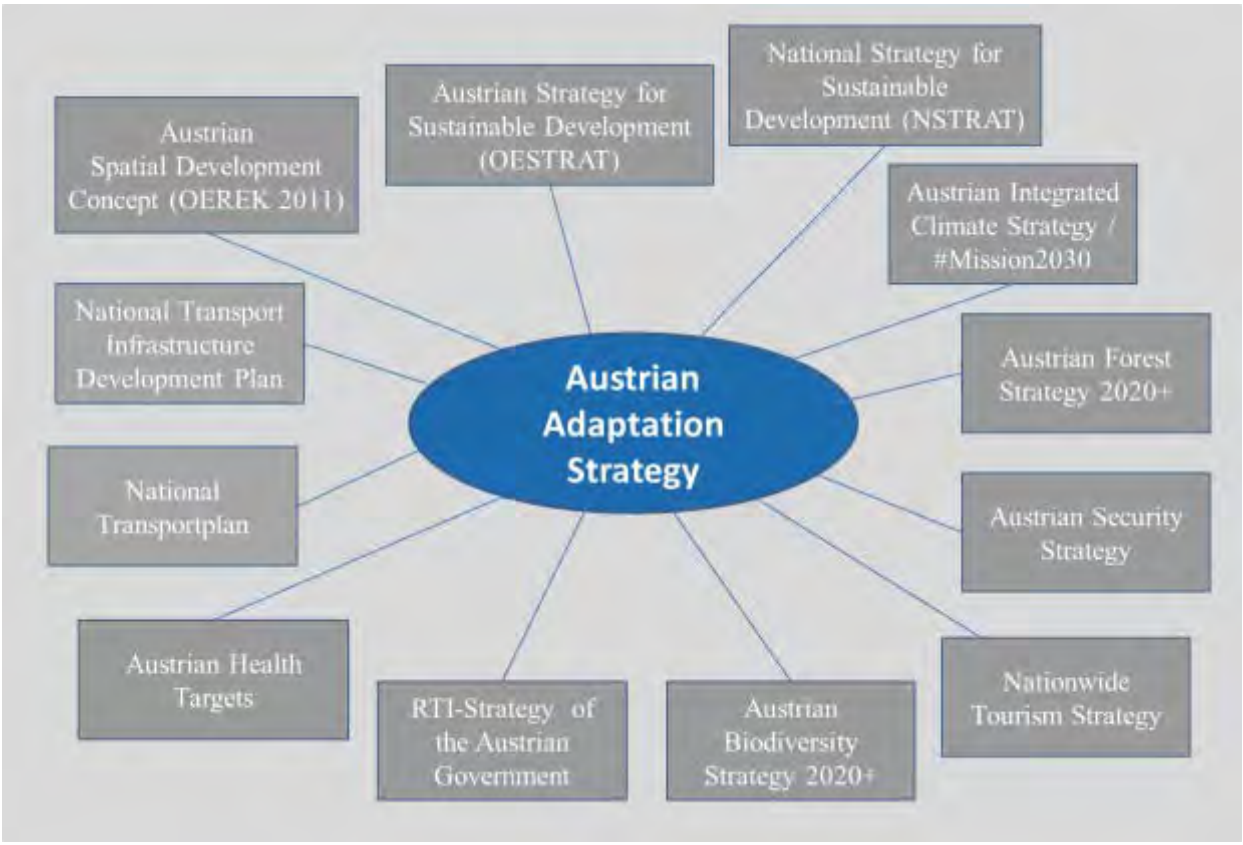


Figure 2: Adaptation to climate change as a cross-sectional issue, Source: Environment Agency Austria

CONNECTING FACTORS TO THE INTEGRATED ENERGY AND CLIMATE STRATEGY

At present, an integrated energy and climate strategy is being prepared in a cooperation between the Federal Ministry for Education, Science and Research, BMBWF (formerly BMWFW), the Federal Ministry for Traffic, Innovation and Technology, BMVIT, the Federal Ministry for Labour, Social Affairs, Health and Consumer Protection, BMASGK (formerly BMASK) and Federal Ministry for Sustainability and Tourism, BMNT (formerly BMLFUW), in which climate and energy policy principles for the coming years will be jointly examined, mutually considered and linked together. Austrian energy and climate policy is strongly influenced by requirements at EU level. It involves reducing greenhouse gas emissions, increasing the share of renewable energy sources in energy consumption, and further increasing energy efficiency.

According to the Paris Agreement, which entered into force on November 4, 2016, the long-term objective is to achieve a decarbonization of the economy.

In contrast, the climate change adaptation strategy is different concerning its primary orientation. It is complementary to the reduction of greenhouse gases and starts elsewhere in the overall structure. It is based on the scientifically based fact that even if greenhouse gas emissions are significantly reduced, climate change will continue to progress due to the inertia of the climate system. The challenges of adapting to climate change will therefore increase in the coming decades – despite all efforts and successes in mitigation. In addition to the indispensable measures for mitigation, already now and in the future even more significant measures are needed to adapt to the unavoidable consequences of climate change.

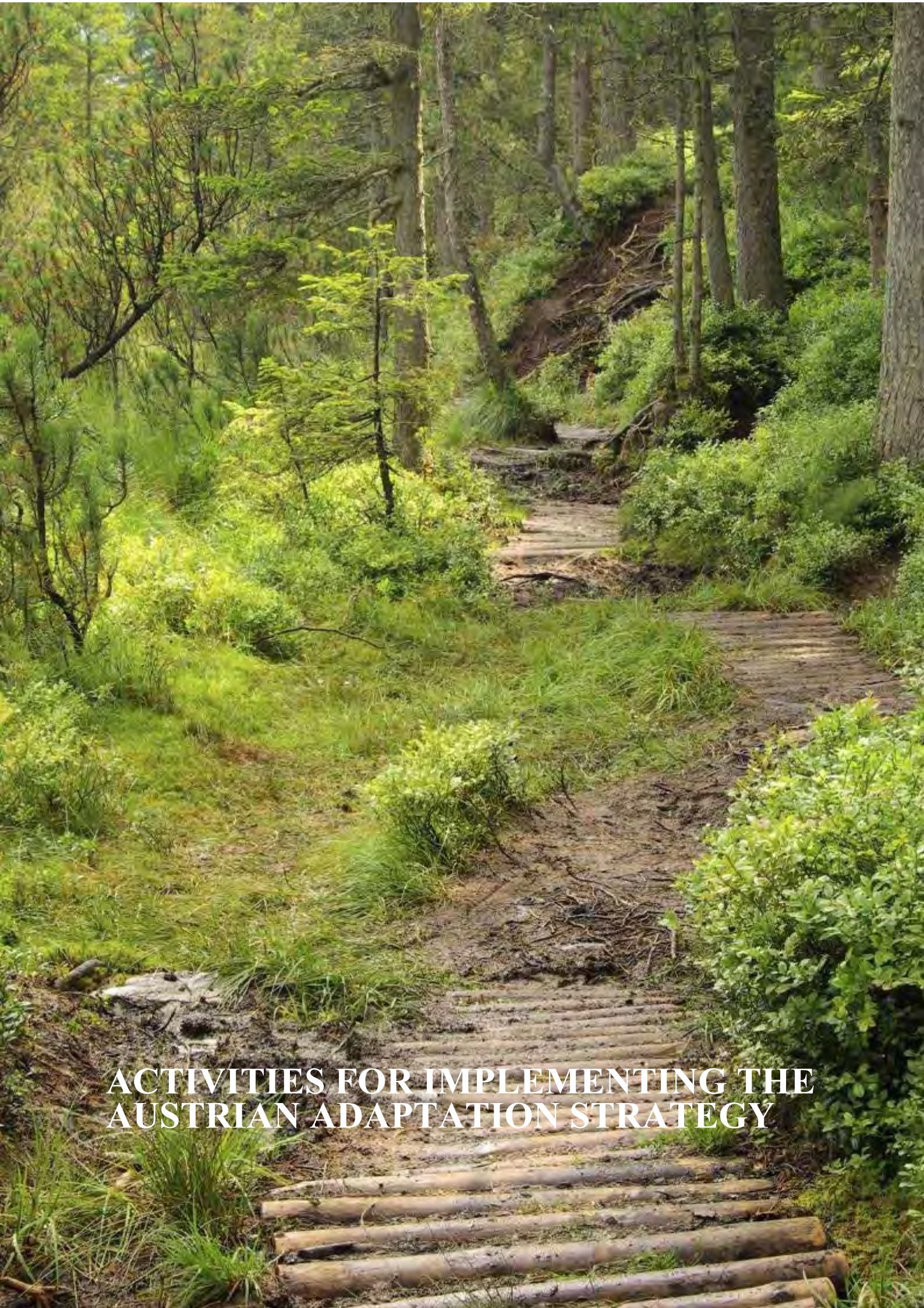
The adaptation strategy incorporates all sectors affected by climate change and provides recommendations for each of these sectors in order to avoid or minimize possible damage and to make the best possible use of any opportunities. The area of action Energy – Focus Electricity Industry, for example, is one of many areas covered by this strategy. Thus, an adaptation strategy is even more complex and more multi-layered in its

dimensions than a mitigation strategy. The overarching goals of the adaptation strategy form the basis of each individual task area. These are qualitative provisions/determinations. They aim at making the best preparation in each area of action for the new challenges posed by climate change.

The overlaps between climate change adaptation and mitigation are particularly pronounced in the areas of action Energy – Focus Electricity Industry as well as Construction and Housing, and their effects are closely linked. Here, there are a number of recommendations for action that are both emissions-reducing and positive in the sense of climate change adaptation. Thus, the thermal renovation of buildings not only reduces the energy requirements for room heating in winter (mitigation) but also helps to prevent summer overheating (adaptation).

The close links in the energy sector thus make it necessary to take into account both aspects in strategic orientations on mitigation and adaptation, to capitalize on synergies and to avoid conflicting activities as far as possible.

In principle, it must be ensured that climate change adaptation measures and mitigation policies do not conflict with each other. If this happened, it would be maladaptation, which is clearly rejected in the Austrian Strategy for Adaptation to Climate Change. All recommendations for action listed here have already been subjected to such a “cross check” in advance by experts, so that they have already been subjected to quality assurance in this regard, and have stood up to this review



ACTIVITIES FOR IMPLEMENTING THE AUSTRIAN ADAPTATION STRATEGY

4 ACTIVITIES FOR IMPLEMENTING THE ADAPTATION STRATEGY

The Austrian Strategy for Adaptation to Climate Change (BMNT 2012a, b (formerly BMLFUW 2012a, b)) has been gradually developed since September 2007. Development of the strategic elements and the action plan took place in parallel. The first recommendations, based on scientific findings (Haas et al., 2008, 2010a, b, Schweiger et al., 2011, Meinharter & Balas 2011, Bachner et al., 2011, Balas et al., 2011), were used in a broad participatory process involving around 100 organizations (ministries, federal states, interest groups, environmental and other organizations) to formulate concrete recommendations in 14 areas of action.

1. Agriculture
2. Forestry
3. Water Resources and Water Management
4. Tourism
5. Energy – Focus on the Electrical Industry
6. Construction and Housing
7. Protection from Natural Hazards
8. Disaster Management
9. Health
10. Ecosystem/Biodiversity
11. Transport Infrastructure Including Aspects of Mobility
12. Spatial Planning
13. Business/Industry/Trade
14. Cities – Urban Green and Open Spaces

The strategy is divided into two parts: the "Context" (BMNT 2012a (formerly BMLFUW 2012a)) with strategic considerations and basic information, and the "Action Plan" (BMNT 2012b (formerly BMLFUW 2012b)), which provides detailed recommendations in 14 areas of action. The Austrian Adaptation Strategy is the only strategy in Europe which considers social aspects, and includes a cross-sectional analysis in order to accelerate synergies between areas of action and recommendations for action while avoiding negative interactions.

The adoption of the strategy was the starting point for extensive implementation activities:

- In order to increase visibility at the European and international level, an English version of the context has been prepared.
- In order to draw attention to the links to a wider circle of actors in the federal states, interactive dialogues were held in five provincial capitals (BMNT (formerly BMLFUW), Climate and Energy Fund, Federal Environment Agency).
- In order to make the complex subject of adaptation more tangible and to present it to the general public, a brochure (Climate change – What to do?) with tips and advice for the public was published (BMNT2014c (formerly BMLFUW 2014c)) in January 2014. The brochure was sent to all Austrian municipalities. In addition, the contents of the adaptation strategy were integrated within the website ***www.klimawandelanpassung.at***.

- The **Newsletter Climate Change Adaptation** (Cooperation BMNT -formerly BMLFUW), Climate and Energy Fund, Environment Agency Austria) provides regular updates on current developments in politics and current research findings, and presents examples of adaptation practice.
- The **research needs** identified in the Action Plan have been and are being used in calls for tenders for research programs, for example in ACRP, in StartClim[12] or in PFEIL 20 (BMNT 2016 (formerly BMLFUW 2016)).
- In the context of the Austrian Adaptation Strategy, the preparation of a **concept for the presentation of progress**[13] is envisaged as part of the implementation. Based on the task of the adaptation strategy, a methodological approach (monitoring and evaluation) was developed with the involvement of specialist expertise and persons from the administration in order to systematically record progress in the implementation of the Austrian Adaptation Strategy. The concept has two strands: A survey of the state of implementation of the 132 recommendations for action and a list of criteria with three to five key criteria for each area of action. The synopsis of these two elements yields a comprehensive picture of the evolution and trend of adaptation in the respective areas of action. The concept for the presentation of progress sees it as a learning system that can adapt to changing conditions. It is designed to be flexible in order to integrate new findings in the rapidly changing field of climate change adaptation. It will be revised as required. The concept was published in June 2014 (BMNT 2014a (formerly BMLFUW 2014a)).
- Based on the task commissioned in the adaptation strategy passed in 2012 and as planned in the current government program for 2013–2018, the status quo for adaptation in Austria was investigated in the **Progress Report**[14] (BMNT 2015 (formerly BMLFUW 2015)). The report was adopted in the Council of Ministers on September 29, 2015 and noted on May 11, 2016 by the Provincial Governors' Conference. It can be described as a pioneering achievement, since comparably comprehensive reports on the state of implementation at European level are scarce. As a first step, in the period from March to May 2014 a survey was carried out among the federal ministries and the federal states, as well as other relevant actors, to assess the implementation status of the recommendations in the action plan. Subsequently, the survey on the 45 qualitative and quantitative criteria and data collection started. The special challenge is among other things, that, unlike mitigation, no quantified goals are available for adaptation. Consequently, in many cases qualitative descriptions are necessary. The progress report provides a first important basis/basis for comparison in order to be able to monitor the status of implementation at regular intervals. Future reports will show how the evolution of adaptation is progressing. The findings of the progress report formed an integral part of the further development of the strategy. Essential contents have been integrated into the action plan.
- A study on the rough initial estimation of the "**cost of inaction**" which can be expected as a result of climate change in Austria was completed. The purpose of the study was to estimate potential damage costs and possibly also the economically quantifiable benefits resulting from climate change, which will result without further consistent and active adaptation to climate change. The results of this project, COIN (Cost of Inaction – Assessing Costs of Climate Change for Austria, Steininger et al., 2015),[15] funded by the Climate and Energy Fund, were presented to the public in January 2015. The information is easy to understand and has been published in various formats. An eight-page abstract and fact sheets for ten areas summarize the key findings in a compact and clear manner. The publication series "ACRP in Essence," published by the Climate and Energy

[12] *Link: www.startclim.at*
[13] *Link: https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie/fortschrittsbericht.html*
[14] *Link: https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie/Fortschrittsbericht.html*
[15] *Link: http://coin.ccca.at/*

Fund, presents the key messages in the form of short stories in the booklet "The consequences of climate change."[16] The results have been published as a detailed book by Springer in English as "Economic evaluation of climate change impacts." The results from COIN have been integrated into the enhanced action plan.

- At present, knowledge concerning the costs of adaptation is still insufficient. The commissioning of a study which would make an initial estimate of the resource requirements for the adaptation on the basis of a scientifically founded evaluation was planned. The PACINAS (Public Adaptation to Climate Change) project funded by the Climate and Energy Fund (see also Chapter 16: Resource Requirements in the Course of Adaptation to Climate Change)[17] addresses the question of the costs and benefits of public climate change adaptation. Case studies at the city, state and federal levels serve to estimate both the existing adjustment deficit and future adjustment costs. The focus is on adaptation costs due to extreme events such as flooding, gravitational processes and heat as well as selected other climate-sensitive areas (public infrastructure, etc.). Results are expected in mid-2017.
- Adaptation affects everyone, politics, administration, business and every individual. To date there has been hardly any investigation of the potentials and possible dangers private adaptation to climate change entails. The project PATCH: ES (Private Adaptation Threats and CHances: Enhancing Synergies with the Austrian NAS implementation; see also chapter 16: Resource Requirements in the Course of Adaptation to Climate Change)[18] deals with the status, extent, motivation and mechanisms of private adaptation. Particular attention is paid to possible risks of maladaptation. The project will develop criteria for avoiding maladaptation, and concrete recommendations for promoting private adaptation will be developed. Private adaptation in agriculture, tourism and private households will be examined more closely. Results are expected to be available at the beginning of 2017.
- A decision of the State Environmental Conference in agreement with the Federal Minister of Sustainability and Tourism (BMNT, formerly BMLFUW) of May 29, 2015 in order to further strengthen and expand the existing **cooperation between the Federal Government and the states** under the auspices of the Austrian Adaptation Strategy already exists. It provides for cross-sectoral areas of action, the successful implementation of which, due to their complexity, can only be achieved through close cooperation between the federal government and the federal states in thematic workshops. The first preparatory work for the establishment of a working group on self-provision is in progress. Strengthening self-provision for protection against natural hazards is considered a central element in adaptation. At the regional level, dialogue sessions will be held from autumn 2016. This gets decision-makers more closely involved at the local level and positions the topic at the regional level. Furthermore, a good-practice brochure "Our Municipalities in Climate Change"[19] was created together. Preliminary talks on a program on climate change adaptation in local municipalities (CARMA+) are in progress.
- Austria, and thus also Austria's regions and municipalities are massively affected by the effects of climate change. Climate change adaptation is only positioned to a limited extent at regional and local levels. Currently, there are only a few isolated activities for adapting to the challenges posed by climate change at the local level. On the one hand, forward-looking adaptation increases the scope of action and is preferable from an economic point of view. For this reason, the funding program KLAR! was launched in September 2016 by the Climate and Energy Fund. 2016 climate

[16] *Link: http://www.klimawandelanpassung.at/fileadmin/site/links/ACRPBodenbodenforschungweb.pdf*
[17] *Link: http://anpassung.ccca.at/pacinas/*
[18] *Link: http://anpassung.ccca.at/patches/*
[19] *Link: https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie/goodpractice-broschuere.html*

change adaptation model regions launched.[20] The program was designed by the Climate and Energy Fund and the BMNT (formerly BMLFUW) with the involvement of the federal states and other relevant institutions. The implementation will be carried out in close cooperation with the BMNT (formerly BMLFUW) and the federal states.

[20] *Link: www.klar-anpassungsregionen.at*

CLIMATE CHANGE IN AUSTRIA

5 CLIMATE CHANGE IN AUSTRIA

The results of numerous studies suggest that climate change has been influenced by human activities since the beginning of industrialization and that the process is already underway.

Since 1880, an approx. 2°C increase in the average air temperature in Austria (APCC 2014) has been recorded. This increase is significantly above the global temperature rise of 0.9°C (IPCC 2013). In the last 25 years alone the air temperature in Austria has increased by 1°C (ÖKS15). With the exception of southeastern Austria, annual precipitation has increased by 10–15% (BMNT 2010c (formerly BMLFUW 2010c)).

The effects of climate change have been demonstrated in many places, including Austria: rapid melting of glaciers, thawing of permafrost, an increasing number of hot days, longer vegetation periods, etc. In order to analyze the climate of the past, researchers conducting the ÖKS15 study have used grid datasets for all of Austria with a spatial resolution of 1 kilometer. The following statements have emerged from the analysis of the climate of the past decades.

MEASURED TEMPERATURE CHANGES (1961–1985 COMPARED TO 1986–2010):

- The average numbers of summer days (days with temperatures of >25°C) and heat days (days with temperatures of > 30°C) have increased significantly in Austria: summer days by +8.2 to 15 days and heat days by +2.8 to 9 days. In addition, an increased occurrence of summer and extremely hot days was observed in the transitional seasons.
- The average duration of the vegetation period has increased by +13.5 to 212 days in Austria. The strongest increase was recorded in the lowlands of northern and eastern Austria as well as in higher mountain and valley regions in the direction of northern Italy.
- The number of cooling degree-days has increased significantly, especially in the summer and below an elevation of 1,000m. By contrast, the number of heating degree days has fallen sharply throughout Austria.
- The number of frost days across Austria also fell by 13.8 to 135 days. Days with thawing frosts have become more frequent in the winter months in Vorarlberg, Tyrol, Salzburg, Carinthia and Styria by up to +10 days (especially in locations over 1,500m). In low altitudes, however, they decreased by about 12 days in the months of October/November and March/April.

CHANGES MEASURED IN PRECIPITATION (1961–1985 COMPARED TO 1986–2010):

- Total annual precipitation increased by +11% in Austria. However, the current level is the same as the long-term average. The increase just mentioned is explained much more by a pronounced long-term minimum in the 1970s.
- Precipitation development shows clear regional differences. On the northern side of the Alps, the increase in precipitation was strongest, in the southeast of the Alpine arc the lowest.
- The frequency of weak or moderate rainfall days has decreased in Austria, while that of severe to extreme precipitation events has increased.

5.1 GLOBAL CLIMATE DEVELOPMENT

Climate projections provide information on the effects of current and future human activities on global and regional climate. Such projections on the climate of the future are based on global climate models and different scenarios for the evolution of greenhouse gases. In order to capture the complexity of the climate system and to estimate past and future climatic trends, complex climate models have been developed. These models describe the most important climate-related physical processes in the atmosphere, the oceans, and on the earth's surface, along with their mutual interactions.

To create climate projections, the climate models are coupled with different scenarios of the future development of society. Since 2013 new representative concentration pathways (RCPs), which replace the previous SRCC scenarios (IPCC 2007 Special Report on Emission Scenarios), have been used. The focus of the new IPCC scenarios as of 2013 is on the concentration of greenhouse gases and the radiative forcing (additional energy content of the atmosphere). The RCP scenarios initially define a concentration course up to 2100. In order to maintain this course, there are different pathways through different mitigation measures (e.g., increasing energy efficiency, reducing fossil energy production, slowing down deforestation). The new RCP scenarios integrate climate policy objectives and provide "if-then" options for future development.

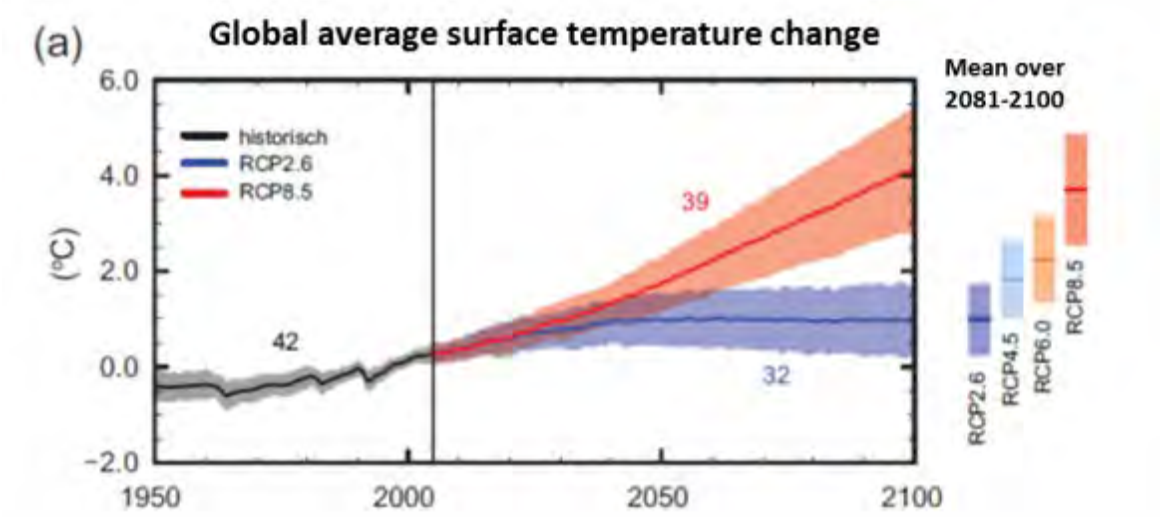


Figure 3: Temperature development until 2100 (source: IPCC 2014a)

The new status report of the IPCC has increased scientific understanding of climate change and can say with unprecedented certainty that humans are changing the climate. The 2014 IPCC Report estimates a global increase of 3–5°C by the end of the 21st century, unless additional mitigation measures are implemented. Limiting global warming to 2°C (equivalent to the RCP2.6 path) requires significant efforts to reduce greenhouse gas emissions (APCC 2014).

Models will only ever be approximations of reality and can never take into account all influencing factors. Model calculations for the global climate – and (especially) for regional climates – thus involve high levels of uncertainty; in addition, feedback effects have not yet been considered. Uncertainty in the assumptions also rises as the scenarios project further into the future. Nevertheless, the various models clearly indicate a potential range of climatic changes to be expected. Within this range, appropriate adaptation measures are needed that allow flexible readjustments and take existing uncertainties into account.

Despite existing uncertainties, climate models and scenarios constitute a crucial basis for the understanding of climate change and its potential impacts. However, for judging the projections for concrete measures it will be essential in the future to differentiate among factors with varying levels of accuracy (e.g., estimated

changes in air temperature are more reliable than estimates of changes in precipitation), and to show the whole spectrum of results.

TIPPING POINTS IN THE CLIMATE SYSTEM

The climate system of the earth is a complex non-linear system. Within the climate system there are regimes and processes which are especially sensitive in their reaction to climate changes. These so-called "tipping points" could be disrupted by climate change in such a way that they exceed a certain temperature threshold and subsequently "tip" into a fundamentally different state. An irreversible process that human actions could neither halt nor mitigate would be set in motion, accelerating the greenhouse effect. In addition, many of these processes are self-reinforcing, and therefore the effects are even more difficult to predict (Formayer 2009, Germanwatch 2010).

Science assumes that many of these tipping processes will be set in motion when the global average temperature rises by more than 2°C above pre-industrial levels.

So far, eleven potential tipping points have been identified (see Figure 4). One example of a self-reinforcing tipping point is the Arctic sea ice and the associated shrinking of the albedo (reflected radiation vs. total incident radiation). The smaller the ice surface, the more dark water surface becomes visible. This absorbs more of the sun's rays than the bright ice surface. This effect in turn fosters warming and simultaneously retards the process of new ice formation in winter.

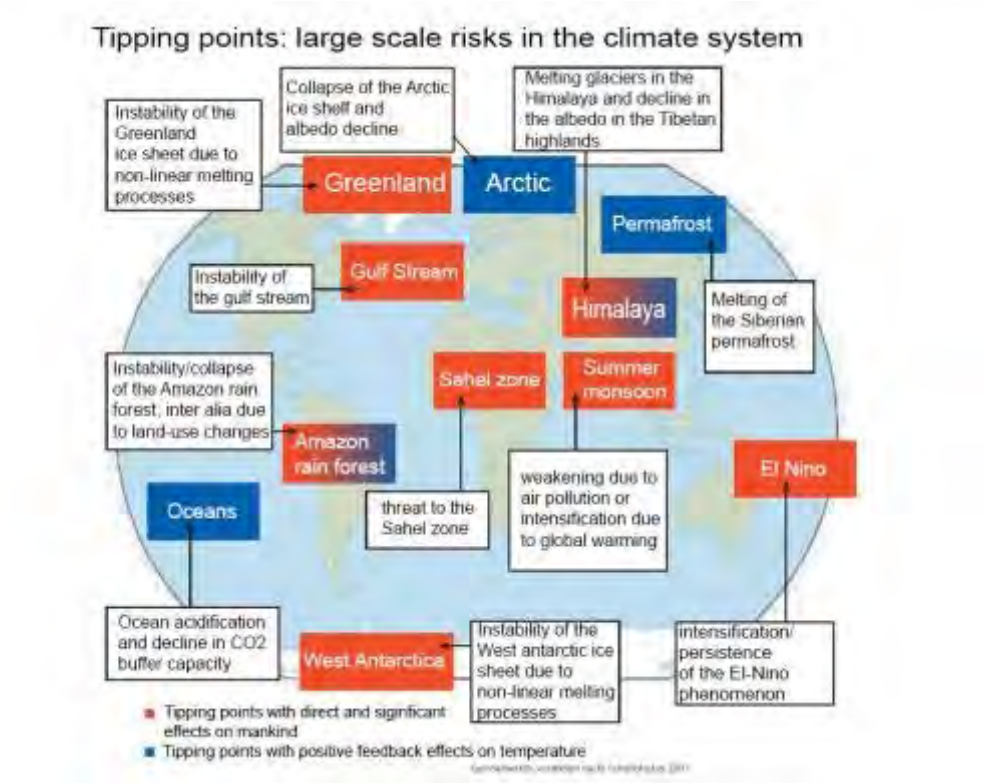


Figure 4: Tipping points in the climate system and their consequences (Source: German watch 2007)
https://germanwatch.org/de/download/3761.pdf

Another influence on Europe's climate is the Gulf Stream and the extended North Atlantic currents. This Atlantic Ocean current is controlled by water temperature and salt concentration. With increasing ocean temperatures and freshwater dilution (due to the melting of ice sheets in Greenland), this system of currents could change abruptly. The climatic consequences for Europe are not yet known; however, northwestern Europe could become significantly colder.

5.2 REGIONAL CLIMATE SCENARIOS FOR AUSTRIA

For Austria, the ÖKS15 data provide comprehensive, high-resolution and error-corrected information on climate change for the first time. The Ministry for Sustainability and Tourism (former BMLFUW) and all federal states have commissioned a consortium involving the Central Institute for Meteorology and Geodynamics (ZAMG), the Wegener Center for Climate and Global Change (WEGC) and the Interfaculty Department of Geoinformatics of the University of Salzburg (Z_GIS).

Their analysis delivers climate projections until the end of the 21st century and provides good insights into the expected effects of climate change in Austria. The ÖKS15 projections are based on 13 regional climate models and two different greenhouse gas scenarios (RCP8.5 and RCP4.5). The use of these two greenhouse gas scenarios clearly shows that the climate future is in our own hands:

- Scenario RCP8.5 reflects "business as usual" – i.e. unchecked greenhouse gas emission, so that by 2100 there is a 3 times higher concentration than today.
- Scenario RCP4.5 shows a future in which, after 2040, global greenhouse gas emissions have successfully been reduced and by 2080 have diminished to about half today's level. In order to fulfill the obligations of the world climate agreement, however, even the RCP4.5 path would still have to be significantly undercut.

The climate projections now provide information for the near future (2021–2050) and for the distant future (2071–2100) compared to the 1971–2000 period.

The following key statements can be inferred from the calculations:

POSSIBLE TEMPERATURE-RELATED CHANGES

- All models consistently show significant increases in annual and seasonal mean temperatures throughout Austria. Both scenarios show a similar increase in the annual average temperature of about +1.3°C to +1.4°C by 2050. By the end of the 21st century, with +4.0°C throughout Austria, RCP8.5 predicts a much more pronounced increase in temperature than RCP4.5 at +2.3 ° C (see Figure 5).
- In both scenarios average warming is strongest in the winter and weakest in the spring, both in the near and in the distant future.

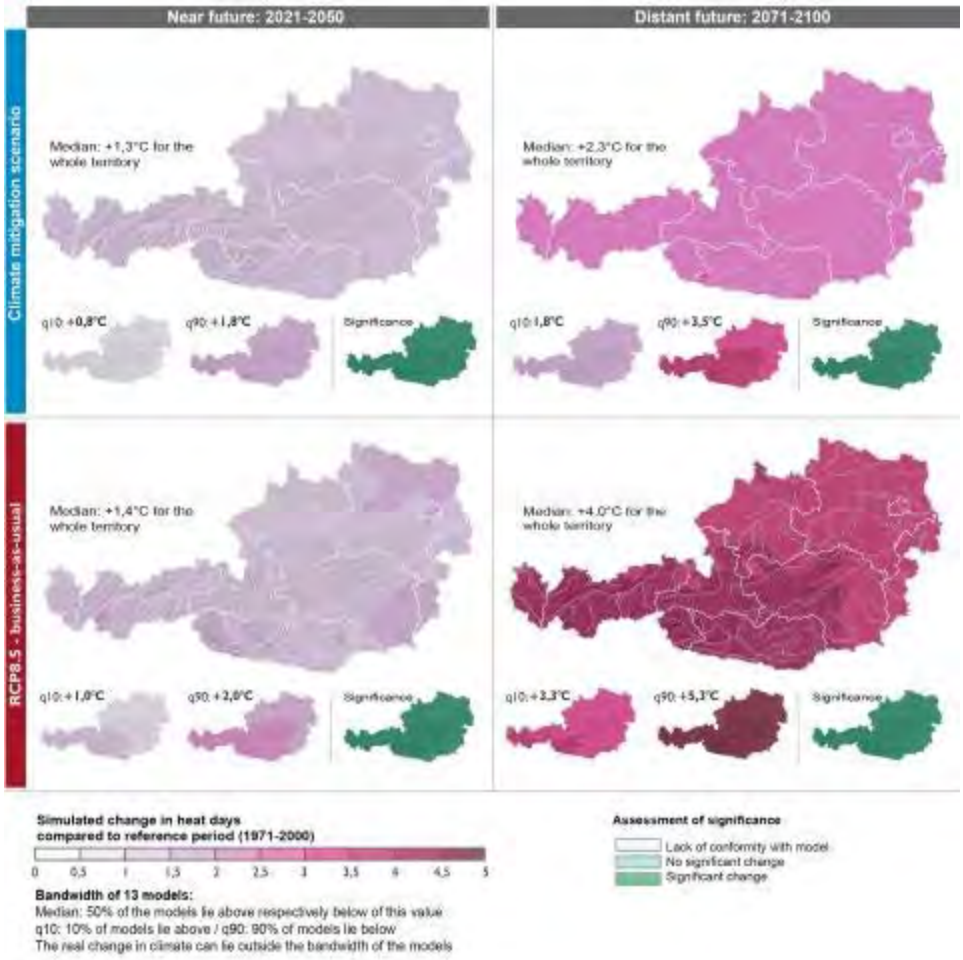


Figure 5: Simulated change in mean temperature [°C] compared with the reference period (1971–2000) (ÖKS15)

– By 2050, there will be a widespread increase of 4 heat days on average across Austria in both scenarios. By 2100, a significantly higher increase of an average of 17.4 heat days is expected in RCP8.5, compared with 7 such days in RCP4.5. The largest increase in heat days will occur in the foothills of the Alps, the flat and hilly country and the Klagenfurt Basin (see Figure 6).

– A significant lengthening of the vegetation period by 2050 is predicted only in the more extreme RCP8.5 scenario, with an average value of 20 days throughout Austria. In the distant future there will be significant prolongations from 32.7 days (RCP4.5) to 61.1 days (RCP8.5). The extension of the vegetation period along the main Alpine ridge and in the northern Alpine foothills is particularly evident.

– For the full year, until 2050 the number of frost days will continue to drop significantly by 20.5 to 24.5 days in both scenarios. By 2100, frost days will decrease by 42 (RCP4.5) to 70 days (RCP8.5). As with the days with subzero temperatures, the number of days of subzero temperature (continuous frost) will also decrease significantly. A change in the frost-thaw transition days from October to November will not be apparent until 2100.

– In the future, these trends will continue, and heating degree days will decrease throughout Austria, whereas cooling degree days will increase. This tendency will intensify in the second half of the century, being in the RCP8.5. the increase or decrease will be significantly higher.

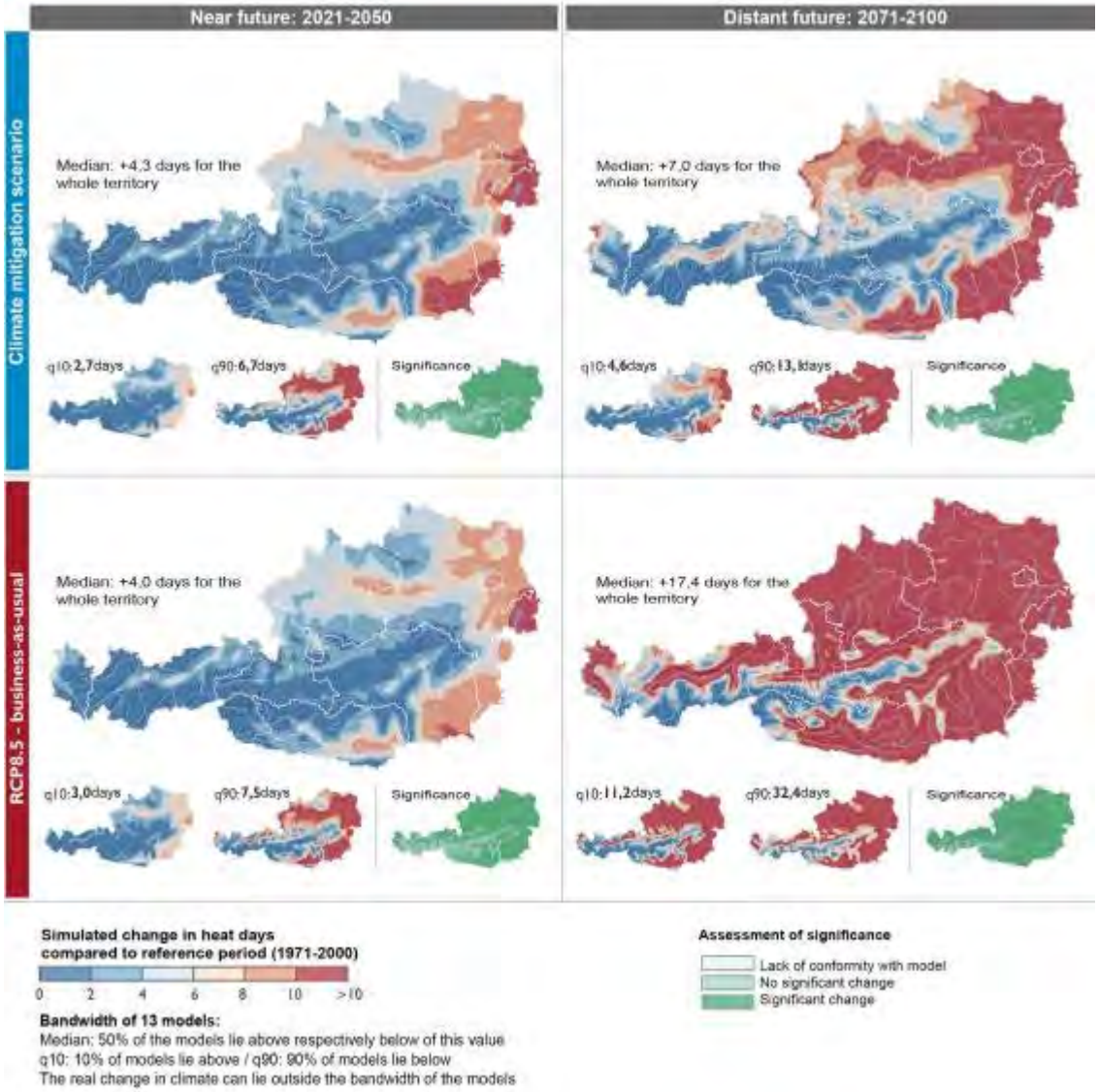


Figure 6: Simulated change of heating days [days] compared with the reference period (1971–2000) (ÖKS15)

POSSIBLE CHANGES IN PRECIPITATION

- Precipitation scenarios are associated with greater uncertainties. In Austria, a clear change in annual total precipitation is only expected in the distant future. In the case of RCP8.5, average Austrian rainfall will increase by +8.7% by 2100. Particularly significant changes will be seen along the main Alpine Ridge and in the highlands north of the Danube (Bohemian Massif, Lower Austria and Upper Austria).
- In seasonal comparisons, significant changes for larger contiguous areas appear only in the RCP8.5 scenario for the distant future. This is especially true in northeastern Austria with an increase of +30% on average, and in spring in the northern Limestone Alps and the northern Alpine foothills with an increase of around +18%.
- The change in maximum daily precipitation will only become apparent for larger contiguous areas in the distant future in both scenarios, and will increase. The climate scenarios do not yet indicate any interpretable changes in dry spells or precipitation episodes.

5.3 ANTICIPATED FUTURE EFFECTS OF CLIMATE CHANGE BASED ON CLIMATE SCENARIOS FOR AUSTRIA

In addition to the previously described regional and seasonal changes in temperature and precipitation, the direct and indirect effects of these changes will also be significant. The following section will briefly present the expected future temperature- and precipitation-induced effects with respect to their importance for the 14 areas of action under consideration.

Within Austria, differing regional effects are expected.

AREA OF ACTION: AGRICULTURE AND FORESTRY

- Prolongation of the growing season;
- Shift in precipitation from the growing season to the winter (regional differentiation is necessary here);
- Long-term decrease in precipitation during the summer months, with the south more affected;
- Increase in the variability of precipitation in the summer from year to year;
- Increase in the frequency of droughts;
- Heat stress in plants, especially in combination with droughts;
- Probable decrease in groundwater supply and thereby increased drought stress in southern and eastern Austria;
- Increase in potential evapotranspiration[21] due to higher temperatures and longer growing seasons;
- Heat damage to plants and the increase in evapotranspiration can result in specific crops being abandoned in certain regions or overall. Increased risk of a decrease in biodiversity;
- Changes in species composition, including new invasive species;
- Emergence of mutated and new invasive pests causing damage to plants and plant products;
- Increase in damage to forest ecosystems;
- Emergence of new pathogens in animal husbandry;

[21] *Evapotranspiration: Total soil evaporation, plant transpiration, and evaporation from interception (retention of rainfall on the "surface").*

- Reduction in the productivity of farm animals in heat waves, as well as increased risk of sickness;
- No authoritative conclusions as yet regarding the effects of extreme weather events, such as increased frequency of storms and hail or erosion due to heavy rainfall; for effects of flooding, see the area of action Water Resources and Water Management (further research needed);
- Changes in physiological parameters of performance and quality for cultivated plants and crops due to changing patterns of precipitation and temperature conditions.

AREA OF ACTION: WATER RESOURCES AND WATER MANAGEMENT

- Tendency for a shift in the risk of flooding into winter and spring in northern Austria; increase in heavy rainfall possible (so far, not clearly documented); a possible increase in short bursts of local heavy precipitation is possible;
- Increase in evaporation;
- Decrease in snowfall, early beginning of thawing; increase in the limits of snowfall and decrease in extremely deep snow;
- Increase in precipitation in winter (especially in the north), decrease in summer rainfall;
- Increased runoff in winter (with the exception of the south), decreased runoff in the summer (variable by region);
- Continuation of glacial retreat. Runoff from glacier melt should peak in 2040–2050;
- Increase in low-water discharge in the Alps in winter, possible reduction in the lowlands in late summer/autumn;
- General increase in low-water discharge in the winter, decrease in the summer;
- Increase in water temperatures (surface water – especially in the summer – as well as groundwater);
- Locally, the bedload potential in areas of permafrost may increase; from a regional perspective, the increase could be rather small for large discharge systems;
- In southern and eastern Austria a decrease in groundwater recharge is likely; in northern and western Austria groundwater recharge could increase;
- Due to the potential increase in evaporation and the decrease in summer precipitation, a reduction in spring discharges from near-surface springs cannot be excluded;
- Possible reduced dilution potential in surface waters in southeastern Austria could lead to higher concentrations of some substances;
- Higher temperatures will lead to changes in aquatic biocenoses, altering the bioregions;
- Increase in water needs in agriculture;
- On a small scale, existing bottlenecks in water supply in areas with unfavorable water resources could worsen.

AREA OF ACTION: TOURISM

- Increase in average annual temperature (year-round tourism);
- Changes in the amount of precipitation and its seasonal distribution: a decrease in the frequency of precipitation during summer months and an increase in winter months;
- Decrease in the amount of snow in lower and middle elevations; reduced certainty of snow;
- Decrease in days with continuous frost and with subzero temperatures;
- Increase in the number of days without continuous snow cover in the mountains;
- Thawing of permafrost can lead to instability in infrastructural facilities and to risk of rock falls;
- Glacial retreat affects the landscape;
- Increased pressure on glaciers due to worsening conditions in ski areas at lower elevations;
- Increase in water temperatures (longer season for swimming outdoors);
- Possible adverse effects on water quality in lakes (e.g., due to algae) at higher temperatures;
- Relative climatic advantage of Alpine region in the summer in comparison with Mediterranean destinations;
- More severe heat waves and an increase in the number of hot days (over 30°C) in the summer (e.g., city tourism – flight from urban regions into the surrounding areas);
- Loss of biodiversity (flora and fauna) resulting in a change in the natural scenery.

AREA OF ACTION: ENERGY – FOCUS ON THE ELECTRICITY INDUSTRY

- Increase in low-water discharge in winter and earlier beginning of snow thaw;
- In Prealps waters: increased occurrence of low-water periods in the summer and fall;
- In Alpine waters: potentially longer low-water periods in late summer; in glacial areas, summer and autumn flows could even increase in the short to medium term, as glacial melting contributes to the runoff. In the long term, however, the accelerated retreat of the glaciers is expected to result in decreasing water supply;
- Increase in water temperatures, above all during summer droughts;
- Locally, the potential for bedload in the area of the permafrost boundary may increase; from a regional point of view, the increase is likely to be rather small with large flood waters; a slight decrease in hydropower production in the summer due to hydrological changes, a slight increase in the winter;
- Potential changes in wind conditions;
- Potential changes in solar radiation;
- Potential changes in the supply of biogenic materials for energy production;
- Decrease in energy consumption for heating and increase in energy demand for cooling; changes in the number of heating and cooling days;
- Possible changes in availability of renewable energy (e.g., wind energy, solar power biomass).

AREA OF ACTION: CONSTRUCTION AND HOUSING:

- Increasing average temperatures and maximum temperatures;

- Greater incidence of heat waves leading to an increase in heat stress; especially in urban areas, the intensification of the heat-island effect is to be expected;
- Increase in temperature-related physical demands on buildings;
- Increase in night-time minimum temperatures of over 20°C;
- Decrease in heating needs and increase in cooling needs in buildings;
- Regional differences in increases in intensity of precipitation;
- Shift of flood risk to winter and spring (more general predictions regarding changes in flood risk for all of Austria are currently not possible);
- Increased snow loads are to be expected at higher elevations and, due to increasing climate variability, cannot be excluded for lower and middle elevations;
- Currently, no robust conclusions can be drawn regarding extreme weather events such as storm and hail frequency (further research needed);
- Regionally variable increases in heavy precipitation and the thawing of permafrost in Alpine regions can lead to increased mud flow, rock slides, rock falls, landslides, and (in winter) avalanches;
- Increased risk of forest fires and wildfires due to heat waves.

AREA OF ACTION: HEALTH

- Larger number of heat days and greater incidence of heat waves leading to an increase in heat stress; especially in urban areas, the intensification of the heat-island effect is to be expected;
- New record high temperatures in low-lying areas of Austria;
- Increase in overnight minimum temperatures of more than 20°C, especially during hot spells.
- Increase in thermophysical load on heat days and during hot spells;
- Increase in the mortality rate during heat waves, especially for high-risk groups;
- Possible impairment of performance on heat days and during hot spells;
- Changes in the dispersion and transmission conditions of vectors and pathogens;
- Potentially wider dispersion of allergenic plants and animals;
- Robust predictions of increases in extreme weather events such as storms and hail, heavy rainfall, and flooding are currently not possible. Higher frequency of extreme events would increase the risk of avalanches, injuries, permanent disabilities, and fatal casualties;
- Secondary health effects of extreme weather events potentially include stress and psychological disorders, as well as mold and mildew in living spaces due to water damage;
- Summertime high-pressure fronts can contribute to the accumulation of air pollutants;
- Higher temperatures can favor the growth of microorganisms in food and lead to an increase in food-borne infections (e.g., salmonella);
- Possible bacteriological contamination of drinking water due to an increase in water temperatures.

AREA OF ACTION: ECOSYSTEM/BIODIVERSITY

- Increase in annual mean temperatures;

- Higher temperatures lead directly to a lengthened growing season and thus to an earlier beginning and a later end of plant transpiration;
- Increase in the frequency of droughts;
- Changes in the amount of precipitation and its seasonal distribution – decrease in the frequency of precipitation during summer months and an increase in winter months (regional differentiation is required);
- Heat stress in plants, especially in combination with droughts;
- Probable decrease in groundwater supply and thereby increased drought stress in southern and eastern Austria;
- Increased risk of a decrease in biodiversity;
- Changes in species composition;
- Decrease in the amount of snow in lower and middle elevations; reduced certainty of snow;
- Decrease in days with continuous frost and with subzero temperatures;
- Increase in water temperatures, above all during summer droughts;
- Shifts in area boundaries along elevation and moisture gradients;
- Changes in species composition in biotic communities and biotopes;
- Loss of habitats and species;
- Spread of new invasive species (alien species).

AREA OF ACTION: TRANSPORTATION INFRASTRUCTURE INLCUDING ASPECTS OF MOBILITY

- Increased heat stress can result in damage to materials and structures, as well as the deformation of pavement and rail infrastructure (road and rail buckling);
- During heat waves, there is a higher risk of failure of electronic equipment (signal systems);
- Longer periods of heat can lead to additional physical strain on road users, passengers and staff;
- Changes in the amount of precipitation and its seasonal distribution – decrease in the frequency of precipitation during summer months and an increase in winter months;
- Tendency for flood risk to shift to winter and spring in northern Austria;
- Increased discharge in winter (with the exception of the south), reduction in the summer (variable by region);
- Potential increase in heavy precipitation (so far not clearly documented); a possible increase in local heavy precipitation of short duration is also being discussed;
- Heavy precipitation can result in drainage system overloads and the flooding of underpasses;
- Erosion and scouring can endanger the stability of railway embankments and trackbeds;
- Increasing risk of mass movements (landslides, mud flows);
- Decrease in precipitation in the form of snow and in the duration of snow cover; earlier onset of snow melt;
- Decreases in the proportion of snow in low-lying and medium altitude areas;
- Increase in the amount of snow at elevations above 1,800m, potentially accompanied by a higher risk of avalanches in certain regions;

- Increase in the number of days without continuous snow cover in the mountains;
- Decrease in days with continuous frost and with subzero temperatures;
- Thawing of permafrost can lead to instability in infrastructure facilities and to risk of rock falls;
- Increased need for maintenance of transport infrastructure through extended vegetation periods and spreading invasive neophytes;
- Accumulation of icefall events leading to operational problems;
- Reliable statements regarding storms are currently not possible; storms can cause damage to the electronic infrastructure and lead to disruption of road and rail sections due to falling trees.

AREA OF ACTION: BUSINESS/INDUSTRY/TRADE

- Higher temperatures and heat waves will increase cooling requirements for the storage and transport of various products;
- Higher temperatures and heat waves will affect working conditions (decline in productivity, endangerment of worker health and safety);
- Changes in consumer behavior due to rising temperatures and longer hot spells (e.g., beverage consumption);
- Decrease in the availability of cooling water during heat waves/droughts can affect cooling-intensive production as well as power generation;
- Potential changes in the availability of raw materials and intermediate products due to changes in temperature and precipitation conditions can have an impact on the entire value chain;
- Regional differences in water supply resulting from changes in the amount of precipitation and its seasonal distribution: a decrease in the frequency of precipitation during summer months and an increase in winter months;
- Potential increases in extreme events and extreme weather conditions can cause massive damage to operational infrastructure and production processes (risk of liquidity crises for enterprises and insurers);
- Precipitation- and temperature-induced extreme weather events (storms, hail, floods and landslides, heat waves in combination with droughts) can lead to bottlenecks in power generation and interfere with production or result in production downtime;
- Impacts on internal logistics due to more frequent extreme weather events, impairment of transportation and storage infrastructure;
- Through globalized networks, supplies for production in Austria as well as sales of Austrian products will be influenced by climate effects in other regions of the world;
- Both mitigation requirements and climate change can result in innovations in products and processes – for example, innovations in the insulation industry, in the development of coolants and new building materials, in renewable energy, or in terms of flood protection, slope stability measures, and other forms of adaptation.

AREA OF ACTION: CITIES – URBAN GREEN AND OPEN SPACES

- Greater incidence of heat waves leading to an increase in heat stress; especially in urban areas, the intensification of the heat-island effect is to be expected;
- Increase in thermal extremes and new maximum temperatures in lowland areas of Austria;
- Increase in night-time minimum temperatures of over 20°C, particularly during hot spells;
- Increase in thermophysical load on hot days and during hot spells;
- Increase in the mortality rate during heat waves, especially for high-risk groups;
- Possible impairment of performance on hot days and during hot spells;
- Reinforcement of the thermal urban climate effect resulting from increased power demand during hot spells (increased use of air conditioning in buildings);
- Summertime high-pressure fronts can contribute to the accumulation of air pollutants;
- Shift of flood risk to winter and spring (more general predictions regarding changes in flood risk for all of Austria are currently not possible);
- Changes in the amount of precipitation and its seasonal distribution – decrease in the frequency of precipitation during summer months and an increase in winter months;
- More frequent summer thunderstorms and heavy rainfalls with heavy peak rainfall flows;
- Making robust predictions regarding storms is currently impossible; storms can cause damage to electronic infrastructure;
- Changes in urban flora and fauna and the spread of thermophile plant and animal species, especially invasive alien species;
- Decrease in the evaporation capacity of vegetation;
- Prolongation of the growing season;
- Increased vulnerability of vegetation during dry periods or droughts.

CHALLENGES TO ADAPTATION

6 CHALLENGES TO ADAPTATION

The planning and implementation of adaptation is a dynamic process that must allow for flexible adjustment to new conditions (e.g., further consequences of climate change, new research results). Adaptation to climate change is a complex task characterized by a wide range of challenges.

Finding a proper **way of dealing with uncertainties** is undoubtedly a key challenge for the planning and implementation of any adaptation measure. Uncertainties result above all from the global and regional projections for the future development of the climate. Future projections are always based on model calculations and never fully reflect nature or reality. Only partial aspects can ever be simulated. On the other hand, models are the only way to work out quantitative statements about complex relationships. They are therefore indispensable tools (APCC 2014, see also chapter 5.1: Global climate development).

In addition to uncertainties linked to climate models, there are also uncertainties with regard to future developments in greenhouse gas emissions. These depend on many factors, such as the level of willingness to take action and the success of mitigation measures, population growth, economic growth, energy price development, change in land use, and the extent to which global low carbon technologies will be successful. In turn, in the planning of mitigation measures, those that would be robust in a wide range of plausible future developments should be favored.

Another challenge in adaptation results from the fact that adaptation is a classic **cross-cutting topic**: a multitude of areas for action (e.g., infrastructure, energy supply, water management, protection from natural hazards) and stakeholders from various fields all play a role. In addition, different levels and areas of responsibility are affected by actions on adaptation, from public administration agencies (local up to national) to various economic sectors to individual people. Interdependencies also arise between the various levels and areas of action, so that benefits in one area can lead to undesirable consequences in another. A **lack of cooperation and coordination** between the different areas for action, decision-making levels, and the people involved in implementation can cause conflicts with the result that potential synergies (including those of a financial nature) may not be utilized. Consequently, a cross-sectoral perspective and, where necessary, integration of adaptation in diverse policy areas should be pursued.

The third challenge arises from the inevitably close relationship between **climate change mitigation and adaptation**; the two issues should thus be considered together. Adaptation cannot replace mitigation. Successful mitigation contributes to reduction of the costs of adaptation. In the planning of adaptation measures, actions that simultaneously pursue the objectives of mitigating climate change should be prioritized. However, scientists agree (IPCC 2014, APCC 2014) that more than gradually improved mitigation and adaptation measures are needed. The goal of keeping the increase in the Earth's surface temperature well below 2°C requires a rapid **transformation** of the economy and of society. This requires new kinds of institutional cooperation, changes in the economic system, changes in prevailing patterns of consumption and behavior, participatory processes and long-term policy measures and decisions. What is needed is a conscious reorientation towards environment- and climate-friendly habits and a sustainable lifestyle.

For successful and effective adaptation, the avoidance of **maladaptation** is an essential objective (see also Chapter 23 Objectives). For example, to avoid spontaneous maladaptation as an immediate reactive response to the effects of climate change, it is necessary to consider how to prevent it during the planning and

implementation of measures. In addition, long periods of use as is the case with infrastructure or forestry, emphasize the need to avoid maladaptation. Measures must already be designed and implemented today, in order to be prepared for the climatic conditions in 30, 50 or more years. As part of the Climate and Energy Fund funded project PATCH:ES (Private Adaptation Threats and CHances: Enhancing Synergies with the Austrian NAS implementation)[22] criteria for the prevention of maladaptation have been developed.

The following criteria support the avoidance of maladaptation:

- **Vulnerability increase or vulnerability shift**: Measures should not, directly or indirectly, increase vulnerability or increase vulnerability in other areas and regions.
- **Target conflict with climate change**: Measures must not increase greenhouse gas emissions or impede or reduce the implementation or effectiveness of mitigation measures.
- **Goals conflicting with environmental sustainability**: In particular, measures must not compromise the quality of the environment and ecosystem services, increase the non-sustainable use of natural resources, or increase conflicts over the use of resources.
- **Goals conflicting with social sustainability**: Measures must not lead to an unfair distribution of costs and benefits between social groups, or disproportionately burden vulnerable groups or disadvantaged regions.
- **Path dependency:** Measures that, simultaneously with uncertainty about climatic developments or the measures' effectiveness, are irreversible or inflexible, i.e. that are impossible or difficult to correct, re-direct or retract, must be avoided.
- **Ineffectiveness/inefficiency**: Measures with an unfavorable cost-benefit ratio and a lack of effectiveness, especially in comparison with alternatives, should be avoided.
- **Negative competition effects**: Measures should not lead to increased consumer prices, displace competitors from the market, or lead to not the best solutions but the strongest market participants winning out.

The effects of climate change will be associated with significant **costs**. Already today, weather and climate-related damage in Austria incurs costs of around €1 billion annually (Steininger et al., 2015). In order to improve the basis for the planning, implementation and cost-benefit balancing of measures, it is necessary to deal with the economic damage caused by climate change. The first results on the financial effects of climate change have been provided by work in the project COIN (Cost of Inaction) for Austria (Steininger et al., 2015[23]). There is insufficient knowledge about future financial damage caused by extreme events. Statements about the future intensity and frequency of (especially regional) extreme events are difficult to make. But, since these are to a considerable extent harmful, there is a particular need for further research.

However, none of these challenges can be used as an argument for inaction! It is essential that all the people involved in adaptation processes share a common understanding and the same level of knowledge, and are all willing to deal proactively with open questions regarding planning and implementation. Furthermore, a cooperative approach and close collaboration between science, practice, and decision-makers is a prerequisite for successful adaptation.

[22] *Link: http://anpassung.ccca.at/patches/*
[23] *Link: http://coin.ccca.at/node/3*

SOCIAL ASPECTS OF CLIMATE CHANGE

7 SOCIAL ASPECTS OF CLIMATE CHANGE

Mankind is on the one hand the main cause of climate change, but on the other hand is increasingly feeling its effects and investigating possibilities for adapting. Climate change mitigation and smart adaptation serve not only to protect ecosystems. In the best case, they also provide definite social advantages, as they anticipate potential social effects and seek to minimize risks to democracy, health, safety, and social justice, drawing upon social integration and cohesion, respecting fundamental rights and cultural diversity, guaranteeing the equality of men and women, and fighting against discrimination of any kind.

The treatment of the environment and the related risk perception is influenced by individual factors as well as by the social environment. How people confront climate change and whether and in what way they are capable of implementing appropriate strategies or dedicating available resources to adaptation depend largely on the specific social conditions of those affected, on individual prerequisites, and on the social-cultural environment.

At the global level, but also within Austrian society, there are inequalities in terms of lifestyle, income level, and resource consumption. There are those who consume more resources but nevertheless are less affected by adverse environmental impacts (such as the negative consequences of climate change), and there are others, generally the socially disadvantaged, who suffer both socially and as a result of increased environmental burdens.

In addition to a social discourse on how we deal with the environment and how much risk we are willing to accept in connection with climate change, the social aspects of climate change and adaptation to climate change include value systems that delve deep into the ideological and ethical thinking of all those affected. This includes issues such as social and ecological justice between those living today and future generations.

Currently, no detailed scientific assessments of the social consequences of climate change or the social effects of adaptation measures are available. However, the following questions should be considered:

- How are people in Austria affected by climate change and potential adaptation measures on the basis of their location and socio-economic situation?
- How will everyday life, especially working conditions and lifestyles, be altered through climate change?
- How are national aspects of adaptation to climate change connected to European and global aspects?
- What measures are required in order to minimize or prevent the vulnerability of social systems and the adverse effects of climate change?

More research is needed in particular on how the effects of climate change can or will affect communities (social justice, integration, cohesion, stability, character, security), political participation (democracy, opportunities for participation), everyday life (employment, lifestyles, and interactions), culture (cultural diversity, values, beliefs, education, cultural change), health and welfare (of physical, mental and social nature; safety), and individual rights (fundamental rights, economic concerns of individuals, gender equality, discrimination).

In addition, research should examine which sectors and regions in Austria are particularly affected by the social consequences of climate change, which population groups (the disabled, low-income households) are more likely to feel the effects of climate change, which measures from the point of view of both climate change mitigation and adaptation entail social and economic benefits, how the resilience of health and social policies can be improved, and how adaptation measures in all policy areas can be sensitized to the social dimension (see also EC 2009a). In the ACRP research program of the Climate and Energy Fund, the topic "Social Aspects of Climate Change" has been the subject of several calls for proposals. A few projects dealing with parts of this complex have either been completed or are in progress.

For example, the project **GIAKlim** (Gender Impact Assessment in the Context of Adaptation to Climate Change and Natural Hazards), completed in 2014 within the framework of StartClim, dealt with gender and group-specific aspects in dealing with natural hazards. The impact of heat on vulnerable groups was the subject of the projects funded by the Climate and Energy Fund **CC-Talk** (From change to action: Effective Communication on Climate Change and Adaptation) and **STOPHOT** (Cool Towns for the Elderly – Protecting the Health of Elderly Residents against Urban Heat). The project **Capital-Adapt** (KlimaNetz – The Role of Human and Social Capital in Dealing with and Adapting to Climate Change)[24] emphasized social structures for increasing the capacity for immediate and long-term adaptation to the consequences of climate change. Other currently ongoing projects focus on the effects of heat on persons with a migration background (**EthniCityHeat –** Vulnerability of and adaption strategies for migrant groups in urban heat environments)[25] and natural hazards (**CCCapMig** – Climate change adaptation and protection from natural hazards: capacity building for people with migration background in Austria).[26]

The SDGs (Sustainable Development Goals – SDGs, Un 2015) adopted in September 2015 aim at making global development socially, ecologically and economically sustainable, thus ensuring that future generations have the chance of a fulfilling life. Unlike the Millennium Development Goals (MDGs), the new goals are intended to stimulate major changes that also impose obligations on industrialized countries. This involves careful use of resources, responsibility for social standards, or the emission of climate-damaging gases. In addition, socio-political objectives such as gender equality, fair tax policies, reducing inequality within and between states, and access to legal assistance and inclusive institutions are also involved. Specifically, Sustainability Goal 13 refers to climate change. Resilience to climate risks is to be increased and concrete measures integrated into planning and policy processes. Another focus is to increase people's awareness of climate change mitigation and adaptation. With the ministerial report of January 7, 2016, all federal ministries were required to implement the SDGs. The global sustainability goals are to be integrated into relevant strategies and programs and, if necessary, appropriate action plans and measures are to be developed with the involvement of relevant actors from the various administrative levels as well as social partners, civil society and science. The status of implementation will be presented in regular progress reports on the basis of internationally defined specifications.

In Austria, the politically agreed upon common social objectives can be found in the National Strategy for Sustainable Development (NSTRAT, BMNT 2002 (formerly BMLFUW 2002)) and in the Austrian Strategy for Sustainable Development – Scope of action for the Federal Government and the States, adopted in July 2010 (ÖSTRAT, BMNT 2010b (formerly BMLFUW 2010b)), as well as in the ÖSTRAT Work Program 2011ff adopted in August 2011.

Taking into account European and international developments in the sustainability discourse, the federal government within its area of competence has complemented the thematic orientation included in the ÖSTRAT resolution of the regional governors, adopted on May 5, 2009, by adding social, economic, and

[24] *Link: http://www.klimanetz.at/*
[25] *Link: https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=10190*
[26] *Link: https://www.rali.boku.ac.at/ilap/projekte/cccapmig/*

socio-political concerns. These are presented in the ÖSTRAT Work Program 2011 under the new priority thematic areas "Public Health, Prevention and Aging" and "Work under Fair Conditions for All" and are implemented through targeted initiatives and measures at the federal level.

The potential impact of climate change and first general considerations on potential action will be investigated in accordance with the central guiding principles of NSTRAT.

QUALITY OF LIFE IN AUSTRIA – A SUSTAINABLE LIFESTYLE

The goal of a sustainable future lifestyle is shaped by the defining principles of "sustainable development": local identity, long-term applicability, diversity, naturalness, partnership, quality before quantity, and proximity. The so-called "Western lifestyle" is only possible through the above-average (on the global scale) consumption of energy and resources. The concept of an ecological footprint developed in the 1990s, which graphically represents the consequences of the Western lifestyle, demonstrates that three planets would be needed if all 7 billion people on Earth were to lead such a lifestyle.

Due to the increasing worldwide demand on resources (above all, energy and food), prices are beginning to rise. The global food price index peaked in 2011. Price increases or price fluctuations are caused by among other things extreme weather conditions due to climate change (such as floods, drought, dry spells and associated crop failures, etc.), higher energy costs, and scarcer resources. Without compensatory measures, these cause a deterioration in the living conditions of low-paid and poor people in particular. By contrast, because of their relatively lower spending on basic needs as a percentage of income, high earners will be less affected by higher prices. It is to be expected that price increases accelerated by climate change will exacerbate the already existing social disparities between the rich and the poor. Primarily for financial reasons, low-income groups have fewer opportunities of preventing or avoiding undesirable developments. The number and distribution of low-income people and the effects of climate change on them vary regionally. Furthermore, an increase in inequality and issues of distributive injustice can lead to conflicts.

Graphic illustrations of the consequences of a resource-intensive lifestyle (such as the ecological footprint) must therefore also take into account the fact that a reduction in resource consumption without appropriate accompanying measures can have negative social effects.

RECOMMENDATIONS

- Measures for adaptation to climate change in all areas of action should reflect the principles of sustainable development in order to consider and balance social, economic, and ethical aspects.
- Adaptive capacity and personal responsibility in the field should be reinforced and fostered through supporting programs and initiatives at the federal and state levels. As needed, these programs can vary from region to region and/or be socially differentiated.
- The social aspects and impacts of climate change and adaptation measures should be integrated more fully into the implementation of existing programs/initiatives and Klima**aktiv** and Climate Alliance.
- Research on the social consequences of climate change and adaptation measures should be generally promoted. Examples include topics such as "lifestyles or social milieus in relation to risk perception", "risk communication and adaptation to climate change", "climate change adaptation and ethical aspects" (distributive justice), "social cohesion and democracy development", "technological change and climate change adaptation", "scenario development with regard to impacts on different groups", etc.

QUALITY OF LIFE IN AUSTRIA – DEVELOPMENT OPPORTUNITIES FOR ALL GENERATIONS AND LIVING WITH DIGNITY

Socially weaker groups are generally more exposed to the effects of climate change. In most cases, various factors (low income, low education, low social capital, precarious work and housing conditions, unemployment, limited room for maneuver) combine to make underprivileged groups more vulnerable to the effects of climate change. Different social groups have different levels of ability to adapt and are more affected by climate policy measures, such as taxes and charges on energy (APCC 2014). People with disabilities are also faced with new challenges, which require appropriate provision in, for example, civil catastrophes.

In addition, comprehensive demographic changes are expected. Changes in population size, age distribution, number of single-person households, or other demographic characteristics have implications for handling the environment, but also for specific needs (e.g., increase in heat sensitivity with increasing age). Demographic changes thus also have consequences for the planning and implementation of climate change adaptation measures.

It can be assumed that the following Austrian population groups will be particularly affected by climate change and by potential adaptation measures due to their location and/or socio-economic situation:

- People at risk of poverty or marginalization;
- Chronically ill people, people with poor health (among other things during hot spells or vector-transmitted sicknesses);
- Children;
- The elderly;
- People living in areas threatened by natural hazards;
- People living in areas increasingly subject to heat waves;
- People who are occupationally exposed to extreme weather conditions;
- People whose income may be at least temporarily threatened by the effects of climate change.

According to the results of current analyses, the population of Austria will continue to grow in the future, reaching approximately 9.6 million in the year 2050. Parallel to this are changes in the age structure. The population of people older than 65 will increase both absolutely and in relative terms.

One measure of the material standard of living is the equivalized household income. When this lies below a certain threshold, those living in the household in question are regarded as being at risk of poverty. For 2015, the threshold for being at risk of poverty for a one-person household was €13,956 euros net disposable household income per year. In 2015, 13.9% of the population in Austria was considered at risk of poverty, or 18.3% as at risk of poverty or exclusion according to the broader definition of the Europe 2020 social target (Statistik Austria 2016). Already at present, population groups with low levels of education and income are often additionally affected by environmental stress. In cities, poor people and those at risk of poverty often live in areas exposed to heavy traffic noise and high levels of particulate pollution, and generally have little access to green spaces or recreation areas. The effects of climate change (such as heat waves, drought, and heavy rainfall) will represent an additional burden and could affect the health of the population. Presumably most affected will be those with neither the knowledge nor the financial resources for taking precautions. The hardest hit will be those low-income households that already spend more than 10% of their income on heating. In future, these will be even less able to finance cooling, even if heating demand and thus heating costs will – to some extent – decline. This is, among other things, because such households often use energy-

inefficient electrical appliances and heaters and thus have comparatively higher energy costs (APCC 2014). In addition, poorer people often live in tenancies and lack the legal means to persuade their landlords to adapt to climate change such as insulation or shading.

The potential of a community and the population living there to respond to climate-induced changes is determined not only by available technologies and resources but to a high degree by existing human and social capital as well.[27] People and their cohesion are the most important asset of every community. How to use and strengthen this in order to be forward-looking in terms of climate change and to approach the future with more confidence as a community was the focus of the Capital-Adapt project funded by the Climate and Energy Fund (KlimaNetz, The Role of Human Rights) and Social Capital in Dealing with and Adapting to Climate Change). How the process itself −from problem-finding to the formulation of solutions − can be progressively implemented in a community has been published in a compact handbook (Feiner et al., 2012). It describes in six steps the process through which a community can raise existing social and human capital, identify the areas affected by climate change, and then develop measures to tackle the challenges. In addition, there is information on indicators for human and social capital related to the impacts of climate change.[28]

Above all in densely populated residential areas increased heat load in the summer will lead to more unfavorable space and living environments and thus to negative consequences for health. This problem is compounded by the lack of nocturnal cooling. CC-Talk developed brochures on how to deal with heat for carers and relatives of elderly or dependent persons, and for kindergarten teachers and parents of small children (Grothmann et al., 2014a, b).[29] STOPHOT aimed at developing measures to improve living conditions for older persons (> 65 years) during hot periods in Vienna. The results of the project showed among other things that the heat stress and the risk for elderly people in urban areas are spatially and socially unevenly distributed. As part of the project, measures were developed that address older people directly, serve to inform and raise awareness, and that can be used in urban and open space planning (Arnberger 2014).

In the future, there will be high demands on public finances due to demographic shifts and the associated consequences for the health care, welfare, and pension systems. It is unclear whether climate change will simultaneously create significant additional burdens on public finances, creating a double load.

RECOMMENDATIONS

- In the planning and implementation of adaptation options – especially in the areas of action related to health, construction and housing, energy, spatial planning, transportation infrastructure, and cities – urban green and open spaces – the varying needs of different generations and particularly demographic shifts should be taken into consideration.
- Health status also influences how well people can cope with changes in the climate and how well they can adapt. These differences should be taken into account in climate change adaptation measures.
- In the selection and design of adaptation measures, special attention should be devoted to the perspective of distributive justice and the effects on those living in poverty or at risk of poverty.
- Measures focused on adaptation to climate change should be linked to existing social objectives, opportunities for social participation, or health-related objectives (such as the reduction of noise or particulate pollution).

[27] *Human capital involves the knowledge, abilities and skills of individual people which are essential for managing climate change, and social capital involves relationships, the density of networks and associations and their social cohesiveness, which is important for making use of human capital.*
[28] *Link: http://www.klimanetz.at/results/*
[29] *Link: http://www.klimawandelanpassung.at/ms/klimawandelanpassung/de/kwa_news/kwa_hitzevideos/*

- Appropriate intervention measures should be investigated and implemented. Care should be taken that such measures do not represent any additional burden on the factor of work.
- The costs and benefits of climate change adaptation should be presented stratified by the various population levels, with due regard paid to gender aspects. Here, the social advantages and disadvantages as well as conflicts in usage should be considered. (Adaptation measures can also increase the environmental footprint, such as air conditioning, technical protection measures).
- The social dimension of climate change adaptation, including social and price implications for different population groups, should be integrated into existing programs.
- A national action plan against energy poverty should be developed, taking the following aspects (among others) into account:
  - Information and advice for private households (free on-site energy consultation); studies on how consultation should be carried out in a target group-specific way already exist or are currently being conducted (e.g., by Caritas);
  - Promotion of research on issues of "energy poverty" and the social aspects of climate change (varying degrees to which people are affected, changes in energy consumption behavior);
  - Implementation of educational measures;
  - Identification of factors that increase energy consumption as a result of climate change, especially in poorer households (price trends: consumption trends), and the development of counter-strategies;
- Increased federal/state cooperation with regard to subsidies;
- Encouragement of the use of alternative energy sources.
- Research on employment effects in connection with climate change adaptation.
- Vulnerability assessment of the (qualitative and quantitative) workplace situation: Analysis of which changes are due to climate change; estimation of how technological changes have a negative or positive effect (including technological consequences).

QUALITY OF LIFE IN AUSTRIA – EQUALITY FOR WOMEN AND MEN

Men and women have different needs and attitudes to risks such as climate change and adaptation to climate change. In the areas of climate change adaptation and mitigation, women are generally more willing to make lifestyle changes, while men often rather rely on technological solutions.

In terms of perception and behavior, it makes a difference where people live, the extent of their knowledge of the risks related to climate change, and whether nature is perceived as unpredictable or fragile.

Income is also one of the factors that determine whether an individual is even in a position to implement measures for adaptation to climate change. There are still differences in income between men and women. Single older women and single mothers experience a higher than average risk of poverty.

It is important that in connection with measures for adaptation to climate change women have the same chances as men in terms of participation, design, and decision-making in social processes. Research has been conducted on the subject of gender and climate change, but it mainly involves development-policy contexts in which the different roles of men and women are addressed. In many areas, women assume an important role as "agents of change" for both climate change mitigation and adaptation.

The GIAKlim project (Gender Impact Assessment in the Context of Climate Change Adaptation and Natural Hazards) showed that gender and group-specific aspects of dealing with natural hazards have tended to receive little attention from either emergency services or the population, but that fostering awareness of the different needs and requirements makes sense and can contribute to improvement of disaster relief and promotion of self-dependence. People without a pronounced local social network are particularly affected by a natural disaster. The integration of gender-specific aspects can contribute to more comprehensive, more efficient disaster management. However, this requires a differentiated approach that takes account of different needs and allows equal involvement in decision-making processes. In addition, proposals for gender-sensitive methods of analysis of natural disasters in the Austrian context were developed at different levels. For the local and (small) regional level, a new form of gender-sensitive analysis − the Gender Analysis of Natural Disasters (GAND) − has been developed (Damyanovic et al., 2014).

RECOMMENDATIONS

- Gender-specific analyses of the subject of climate change in Austria and adaptation to climate change should be encouraged, in order to be able to take account of the different needs and concerns of women and men and align programs and strategies accordingly.
- Women and gender experts should be involved in the planning, development, and implementation of all climate-relevant strategies and measures.
- The participation of women in discussions related to adaptation to climate change should be promoted.

QUALITY OF LIFE IN AUSTRIA – EDUCATION AND RESEARCH CREATE SOLUTIONS

Climate change and the energy crisis are already perceived as a threat by the population. However, on the one hand these problems are not directly associated with personal lifestyles, and on the other hand there is a lack of knowledge regarding appropriate possibilities for action. Information alone is often insufficient to initiate necessary changes in behavior. Motivation and the creation of incentives and appropriate social framing conditions are considered crucial elements in increasing the capacity to act of each and every individual member of society.

Knowledge on the subject of climate change adaptation is limited by the perception of risk. The different perceptions and values influence decisions on whether and how to adapt to climate change, for adaptation measures are influenced by deeply rooted (but not unchangeable) cultural and social norms and values as well as individual perceptions.

Consideration of the cultural and social environment, as well as the individual level that influence both the perception of risk and the ability and knowledge to adapt, should always be included in communications on the subject of climate change adaptation. This can make the transfer of information in various social environments a challenging task.

In all of the areas of action addressed, there are topic-specific recommendations on measures for communication and education. Communication and educational efforts are relevant to all age groups, all social environments, and all levels of administration, and need to be prepared for specific target groups. The objective is to provide all individuals with sufficient knowledge to be able to act responsibly on their own within an appropriate framework.

RECOMMENDATIONS

- Advice on climate change adaptation should be oriented to specific target groups and be gender specific; it should also be accessible to the educationally disadvantaged.

- Whenever possible, adaptation to climate change and the resulting necessary lifestyle changes should be addressed in dialogue with those affected. Ethical issues should also be discussed.
- The responsibility of each and every individual with regard to climate change should be made clear; in this way, willingness to perceive individual opportunities for adaptation to climate change can be increased.
- Relatively little information is publicly available on the subject of risk communication and climate change adaptation and social environments. Research addressing these issues should be encouraged.
- In communication, information on the potential opportunities offered by climate change should also be compiled and effectively disseminated.

Balanced consideration of social aspects of climate change is a general principle of action that generally applies in all areas of action and to all recommendations for action (see Chapter 15.1: Overall principles). In addition, social aspects should be emphasized in, for example, the areas of action Energy – Focus Electricity Industry, Construction and Housing as well as Health. This concerns the recommended action 3.5.4.5 Optimizing the Interaction of Generation (from various sources) and Consumption in the Energy Supply System with Changing Supply and Demand, where another recommended step is *the creation of exchange programs (socially graduated) as an incentive to switch to efficient electrical appliances*. In the area of action Building and Housing, recommended action 3.6.4.1 Implementation of Structural Measures (in New Buildings and in Renovations) to Ensure Thermal Comfort *suggests promoting refurbishment rates through incentives, energy advice, accompanying restructuring advice and increased consideration of different social groups*. Particularly vulnerable population groups are given special consideration in specific areas of action, in particular 3.9.4.1 General Public Relations, the fields specifically concerned with preparation for extreme events or outbreaks of infectious diseases 3.9.4.2 Handling Heat and Drought, and 3.9.4.7 Linking and Further Development of Existing Monitoring and Early Warning Systems.

GUIDING PRINCIPLES FOR ADAPTATION

8 GUIDING PRINCIPLES FOR ADAPTATION

Adaptation to climate change is an ongoing process that will extend over a long time period and must be carried out by many actors. To support adaptation planning, guiding principles have been devised that can be independently applied by the participating sectors, levels, and stakeholders. Ten guiding principles (Prutsch et al., 2010) summarize the key factors for successful adaptation. This offers an orienting framework for adaptation, while still leaving sufficient room for situation-specific decisions.

THE GUIDING PRINCIPLES FOR ADAPTATION CAN BE SUMMARIZED AS FOLLOWS:

- **Assure responsibility**: Clear commitment of decision-makers to adaptation and willingness to accept management tasks in an organization or group of people must be present from the outset. In the long term, sufficient personnel and financial resources for adaptation must be available.
- **Share information**: Learning from other actors, continuous enhancement of knowledge, and communication of information are all essential for adaptation processes. Scientific information must be presented in a way that meets the requirements of the specific target audience. At the same time, all parties concerned must share a common understanding of concepts and terminology in order to facilitate communication and cooperation.
- **Foster cooperation**: Working in partnership with the relevant and affected parties throughout the entire adaptation process is an important prerequisite for successful adaptation. The following guidelines may be helpful for identifying relevant actors:
  - Who is affected by the consequences of climate change or by potential adaptation decisions?
  - Who is responsible for the implementation of potential adaptation measures?
  - Who can facilitate the success of adaptation measures?
  - From the outset, the objectives of cooperative efforts and the areas of influence of the participants must be clearly determined and communicated.
- **Work with uncertainties**: Uncertainties are an inherent part of all projections of climate change and its impacts. In accordance with the precautionary principle, adaptation measures must nevertheless be introduced. Adaptive management is characterized by a stepwise and iterative approach to the planning, implementation, and improvement of adaptation measures. For sectors with long-term planning horizons, it is crucial to maintain or enhance the resilience of natural and human systems.
- **Prioritize climate change impacts**: For the prioritization of climate change impacts at the regional level, both past weather events and scenarios of possible future climatic and socio-economic changes should be analyzed. In order to minimize the uncertainty in climate scenarios, several scenarios should always be drawn upon for the estimation of climate trends.
- **Employ a wide range of adaptation options:** In planning, the entire potential portfolio of technological, behavioral, informative, organizational, ecosystem-based, and socio-economic adaptation measures, both sector-specific and cross-cutting, should be considered. The available options should be described in the greatest detail possible, such as in terms of their objectives, direct, indirect, temporal, and spatial effects, as well as the actors and those affected.
- **Prioritize adaptation measures**: To prioritize the implementation of the identified adaptation measures, a set of selection criteria can be applied, such as efficiency, effectiveness, urgency,

flexibility, side effects, etc. Priority should be assigned to any measure that generates benefits independent of climate change ("win-win") or that entails no disadvantages in the event that the actual climate change does not correspond to projections ("no regrets").

– **Integrate adaptation into existing instruments and structures**: Existing instruments and decision-making processes, both in public administration and in the private sector, should be reviewed with regard to their suitability for addressing climate change, and modified as needed. Where necessary and appropriate, new instruments must be considered.

– **Avoid conflicts of objectives and interests**: In the planning of adaptation measures, anticipatory balancing of short- and (especially) long-term effects – also on other areas – is critical for the success of their implementation. Above all, it must be ensured that adaptation measures do not contradict the objectives of climate change mitigation and sustainability.

– **Establish a system for monitoring and evaluation**: Adaptation is a continuous process that requires regular review of the prioritized climate change impacts and the effectiveness of the selected adaptation measures. Monitoring should accompany the ongoing learning process of adaptation, while the evaluation system focuses on the assessment of results. Monitoring and evaluation in adaptation efforts should be considered in parallel with the design of the measures. The use of indicators can facilitate the monitoring and evaluation of adaptation measures.

CRITERIA FOR PRIORITIZING THE RECOMMENDATIONS FOR ACTION

9 CRITERIA FOR PRIORITIZING THE RECOMMENDATIONS FOR ACTION

The Action Plan for the Austrian Adaptation Strategy includes a number of recommendations in the various areas of action for both public and private actors. These recommendations are based on the most recent knowledge. When developing the recommendations for action, care was already taken that these do not contribute to maladaptation (see also Objectives chapter 3: Objectives).

Certain sectors of society and regions are affected by climate change in different ways and to varying degrees. The extent to which the people, the environment, and the economy of a region will be influenced by the consequences of climate change depends on both the natural vulnerability of the region and on its existing adaptive capacity to cope with climate change and extreme weather. This results in differing requirements for action.

In order to determine which recommendations should be assigned priority in a given area of action or region, a list of criteria is introduced. This list serves to support the actors concerned in setting their priorities in the adaptation process.

In general, however, it must be noted that measures that provide benefits independent of climate change ("win-win") or entail no disadvantages in the event that actual climate trends do not correspond to projections ("no regret") should be prioritized. Due to the inherent uncertainty about the effects of future climate warming, it is necessary to select and implement flexible measures that can be easily adjusted to changing conditions.

As already mentioned in the guiding principles for adaptation, a series of criteria for prioritizing adaptation measures is available (see below, based on Vetter and Schauser 2013). As these criteria can have different meanings depending on the objective and the context, weighting of the criteria is suggested. The selection of the prioritization criteria and their weighting should be undertaken with affected actors.

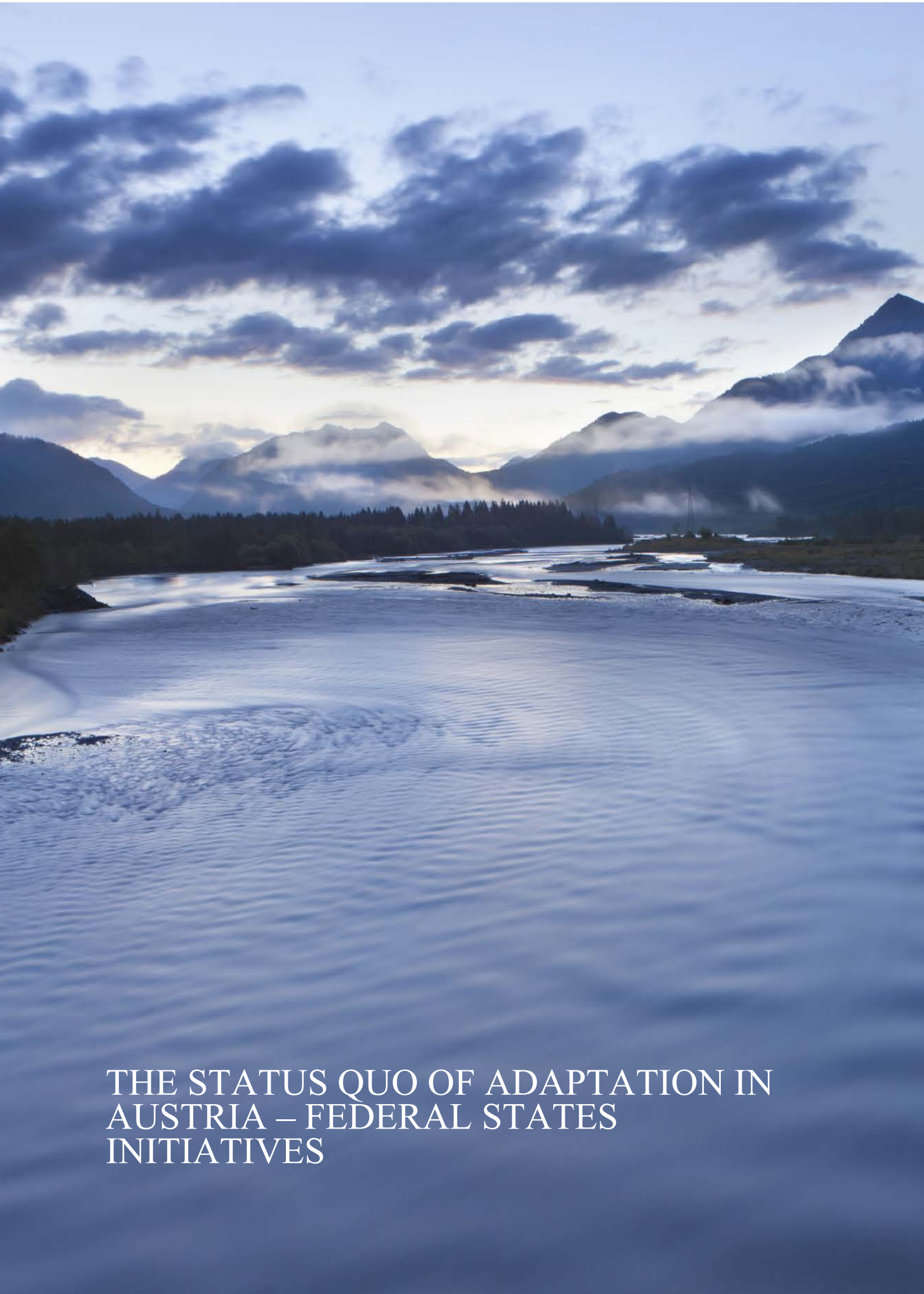
With a view to a comprehensive macroeconomic analysis, it is generally suggested that the prioritization of recommended actions take into account the "Europe 2020 – A strategy for intelligent, sustainable, and inclusive growth" (EC 2010), which is scheduled for 10 years.

- **Significance/Relevance:** The recommended actions have very great potential for reducing the risk of negative consequences of climate change, improving the resilience of the sector/system, and taking advantage of the positive effects of climate change. Aspects to be addressed: How significant is the measure in absolute terms? Is only a relatively small portion of the population and society affected, or a very large part? If this measure were not implemented, would the damage to society as a whole be large or quite small?
- **Urgency:** The recommendation requires rapid implementation because the effects are already being felt, long-term planning processes are necessary, or the recommended action will only become effective with a time lag (e.g., forestry, technical infrastructure). Consideration should also be given to whether areas are particularly fragile and/or critical uses are involved. For example, there is extremely urgent need for adaptation where there are already problems with

industrial cooling water discharge points, flooding damage in densely built up residual risk areas or with (major) coldwater fish species.

- **Robustness and ex ante quality assurance:** Recommendations will be given priority that yield an advantage independent of climate change ("win-win") or entail no disadvantage in the event that actual climate change does not correspond to projections ("no regrets"). In accordance with this criterion, those measures will be highly rated that create an environmental, economic, or other benefit for society independent of the extent of climate change. In this context, it should also be determined whether the risk of maladaptation is present and how severe this risk could be (see also Chapter 6: Challenges to Adaptation). During planning and implementation of measures, in keeping with quality assurance, special importance should be given to anticipated effectiveness.
- **Flexibility and Reversibility**: The recommendations take due account of uncertainties regarding future global warming. They are thus designed to be flexible, so that they can be easily adjusted or reversed based on changing conditions.
- **The Cost-Benefit or Budget Effectiveness:** Those measures should be favored which deliver a high degree of benefit at as low a cost as possible. However, it should be noted that in the framework of this Austrian Adaptation Strategy, quantification of the costs and benefits of adaptation measures is not foreseen. Consequently, it will only be possible to take into account qualitative estimates and values from the literature as available. The issue of potential loss in competitiveness in an international comparison is also to be considered in this context.
- **Additional benefits and synergies:** Implementing the recommended actions also has an additional positive effect on the environment (ecosystems, biodiversity, water resources, soil) and on socio-economic aspects. The measures should also be consistent with the objectives of other environmental policy processes, such as sustainability.
- **Simultaneous Mitigation Effects:** Specifically, recommendations for adaptation action will support the objectives of climate change mitigation and, in the best case, contribute to reductions in greenhouse gas emissions.
- **Interactions with Other Recommended Actions:** Climate change as a cross-cutting issue affects different levels and sectors and will present major challenges in the coming years and decades requiring substantial changes and investments. The question is to what extent proposed adaptation measures in one sector affect and influence measures from other sectors. In addition, there are also other developments, trends, and measures to consider. Priority should be assigned to recommended actions that involve synergies with other measures and developments.
- **Political Feasibility:** Prioritization should also take into account an estimation of political feasibility. Will consensus be achievable and can the implementation probability be rated as high, or will the measure be difficult to realize?

In the prioritization of recommended action, differentiation of assumptions on climate change and its effects on the basis of their robustness (e.g., in a classification of high/medium/low) is also suggested.



THE STATUS QUO OF ADAPTATION IN AUSTRIA – FEDERAL STATES INITIATIVES

10 THE STATUS QUO OF ADAPTATION IN AUSTRIA – FEDERAL STATE INITIATIVES

Austria has already been dealing with the issue of adaptation to climate change for a number of years.

At the level of the **federal states ("Bundesländer")**, a variety of initiatives have already been adopted, ranging from research projects to concrete measures in individual sectors. All nine federal states regard climate change adaptation as part of an integrated climate mitigation policy. In some federal states, state-specific strategies for adaptation already exist. The following section presents an overview of the adaptation activities of the Austrian federal states.

Regional climate projections for Austria (ÖKS15)[30] were prepared recently, commissioned by the BMNT (formerly BMLFUW) and all federal states. They constitute important groundwork for identifying particularly vulnerable areas and are the basis for further regional adaptation strategies and detailed plans.

In addition, in accordance with a decision by the State Environmental Conference in agreement with the Federal Minister of Sustainability and Tourism (BMNT, formerly BMLFUW), close cooperation on selected projects is taking place (see Chapter 4: Activities for implementing the adaptation strategy).

BURGENLAND

In 2006, **Burgenland** commissioned ARC Seibersdorf Research GmbH to conduct a study on "Lake Neusiedl – Tourism with a Future," in order to scientifically analyze the effects of the water level in Lake Neusiedl on the surrounding region.

In the course of the project EU-LAKES (2010 to 2013), guidelines were prepared for sustainable lake management for the Lake Neusiedl region in order to further promote water management measures with respect to preserving Lake Neusiedl and its environs. The purpose of the guideline is to support local decision-makers, especially when planning and implementing projects in the entire Lake Neusiedl region, and to highlight concrete options for action.

The project "Aqua Burgenland Sopron" was established to secure the drinking water supply long-term. The project is to ensure transboundary water supply in periods of drought in the "Pannonian Region Lake Neusiedl." This infrastructure project connects the public water supply systems of the Northern Burgenland, the city of Sopron, and the Central Burgenland for the purpose of reciprocal security of supply.

In the area of disaster management, the main focus was on preparing disaster management plans and implementing a heat warning plan. A digital plan showing water for firefighting, which includes the entire water supply network of Burgenland, was prepared in cooperation among the federal state Burgenland, its safety center, its firefighting association, its water suppliers, and Energy Burgenland. Another supporting

[30] *Link: https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie/klimaszenarien.html und https://data.ccca.ac.at/group/oks15*

instrument is currently in the planning and development phase. The project "Raab Flood 4cast" will create an early warning system for heavy rain events in the region East Styria, South to Central Burgenland and for neighboring Hungary.

Agricultural irrigation management was introduced for the Neusiedl district to better coordinate groundwater supply and demand. In practice, a shift in cultivation habits is already taking place; for example, increased installation of green cover for humus formation and protection from erosion, an increase in biological farming and viniculture, and the use of heat- and drought-resistant varieties. In the construction of livestock stables, Burgenland agriculture increasingly focuses investment on the use of open stables with improved ventilation.

Extensive and cross-sectoral activities involving climate adaptation were initiated in the context of spatial planning, mostly concerning the areas of transport, energy, and housing construction. The State Development Plan of Burgenland (LEP 2011), among other things, should be mentioned here; in addition to the principles of spatial development, it also deals with supra-local guidelines, including the areas of energy and resources, the economy, infrastructure and mobility, as well as nature and the environment. To minimize the extent of damage from heavy rainfall events in the longer term, it is not permissible to zone flood-prone areas (HQ 100) as land suitable for building. Zones suitable for wind power systems are designated in order to promote the expansion of climate-friendly electricity generation as enshrined in Burgenland's Energy Strategy 2020+.

CARINTHIA

In the federal state of Carinthia, the environmental officer (in the political domain) and the Environment Department of the Carinthian state government (regarding technical aspects) were commissioned to coordinate the adaptation agendas through a unanimous government decision (May 6, 2014, Zahl 08-ALLG-24/4-2014). Concrete adaptation measures are to be prepared, and the individual steps taken in the various affected fields are to be supervised on an ongoing basis. In this way, the political officers responsible for each area and all affected departments are included in active cooperation on climate adaptation for all relevant sectors; this also involves appropriate reporting.

The federal state of Carinthia is thus consolidating and expanding its working group on climate adaptation, whose first coordination session took place as early as January 2009. This working group includes the sectors agriculture and forestry, water resources and water management, tourism, energy, construction and housing, protection from natural hazards, disaster management, health, ecosystems and biodiversity, transport infrastructure, spatial planning and demographic change, the economy, industry and trade, urban green and open spaces, municipalities, and education. The task of this working group is to develop and implement strategies for adaptation to climate change specifically for Carinthia, as well as to identify sectors that specifically require initiatives. This approach also supports the further development and implementation of the Austrian Adaptation Strategy. An initial dialogue on climate adaptation took place as early as December 2012, including all affected actors from public administration, policy, science, research, and practice.

Carinthia's climatography[31] maps the current impacts of climate change in Carinthia, and is to be expanded to include a comparison with long-term averages. In addition, the findings from the project "ÖKS15 – Climate Scenarios for Austria" provide a basis for identifying vulnerability and climate change hot spots. Based on this as well as the national strategy, a regional implementation strategy for climate adaptation is to be prepared in the medium term. Consultation on this matter is planned in the municipalities affected,

[31] *Link: www.klimaatlas.ktn.gv.at*

involving both the existing e5 consultant network and the eight managers of Carinthia's climate and energy model regions. The participation of Carinthia's regions in the "Climate Adaptation Model Regions (KLAR)" planned by the Climate and Energy Fund is also under consideration.

Individual departments of the state government have already laid the groundwork for climate adaptation, for example the Environment Department with the ZAMG study "Long-term Climate Carinthia – Long-Term Time Series and Future Scenarios for the Federal State of Carinthia" from 2010[32], the literature review "Impacts of Climate Change on the Water Regime of Bodies of Standing Water"[33] by the Carinthian Institute for Lake Research from 2011, and the 2013 brochure "Climate and Health"[34] by the Carinthian State Health Agency.

In the area of research, knowledge about the impact of climate change at the regional level in the Alpine space, and specifically on the water regime, Alpine lakes, or the Alpine forest was deepened, and specific adaptation measures were developed in recent years in numerous Interreg and Alpine space projects (e.g., AdaptAlp[35], ClimChAlp[36], Alp-Water-Scarce[37], SILMAS[38], MANFRED[39]). Contributions were also made to the preparation of the handbook "Methods and Tools for Climate Adaptation"[40] for federal states, regions, and cities within the framework of the project FAMOUS, funded by the Climate and Energy Fund. Adaptation strategies and knowledge about climate change were summarized and recorded in an interactive tool in the project C3-Alps (Capitalising Climate Change Knowledge for Adaptation in the Alpine Space[41]). A total of 11 climate change and adaptation projects available as a basis for future activities were evaluated specifically from the perspective of Carinthia.

Carinthia is currently involved in the project CLIMA-Map[42] (Climate change impact maps for Austrian regions), which is financed by the Climate and Energy Fund and in which climate impact maps are being developed to support decision-makers in preparing for climate change at the municipal level, as well as in multiple cooperation arrangements with federal states (implementation of LURK decisions, good practice brochure, etc.).

LOWER AUSTRIA

As early as 2007, Lower Austria concerned itself with the impacts of climate change in five sub-studies (forestry, agriculture, energy demand for heating and cooling, river runoff behavior, and winter tourism) of the research project "Impacts of Climate Change in Lower Austria." Since then, Lower Austria has participated regularly in national and international projects on the topics of climate change and adaptation (FAMOUS[43], RIVAS[44], ÖKS-15, CLIMA-MAP[45] etc.).

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[32] *Link: http://www.wissenslandkarte.ktn.gv.at/177510p_DE-KIKS-Publikationen*
[33] *Link: http://www.wissenslandkarte.ktn.gv.at/177510p_DE-KIKS-Publikationen*
[34] *Link: https://www.ktn.gv.at/Themen-AZ/Details?thema=32&detail=473*
[35] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/AdaptAlp/show/index.html*
[36] *Link: http://www.alpine-space.org/2000-2006/climchalp3a6e.html?&L=yobycrvtmtp*
[37] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/Alp-Water-%20Scarce/show/index.html*
[38] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/SILMAS/show/index.html*
[39] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/MANFRED/show/index.html*
[40] *Link: http://klimawandelanpassung.at/index.php?id=25504*
[41] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/C3-Alps/show/index.html*
[42] *Link: http://www.alp-s.at/cms/de/land/aktuelle-projekte/clima-map/*
[43] *Link: http://klimawandelanpassung.at/index.php?id=25504*
[44] *Link: https://www.klimafonds.gv.at/wp-content/uploads/sites/6/20130502RIVASEndberichtWolfgang-Lexner.pdf*
[45] *Link: https://clima-map.com/projektbeschreibung/*

The project "Versatile Mostviertel" (2011–2014)[46], which was implemented in the framework of the EU project C3 Alps[47] in Lower Austria, should be particularly emphasized. Seven pilot municipalities in Lower Austria were prepared for the impacts of local climate change. Scientific facts were made usable for the municipalities and local knowledge and existing solutions to climate change were taken up, thus creating the basis for groundbreaking decisions.

The energy and climate goals of Lower Austria, which also include aspects of climate adaptation, are laid down in the "Lower Austria Energy Roadmap 2030" and in the "Climate and Energy Program 2020." The "Lower Austria Energy Roadmap 2030" sets out the restructuring of the energy system and the strategic guidelines for the transition to a new energy era: Since late 2015, 100% of Lower Austria's electricity demand has been met with renewables; by 2020, 50% of Lower Austria's total energy is to be produced regionally and with renewables.

The Lower Austria Climate and Energy Program 2020 and its meta-goals:

1. Increasing energy efficiency and the use of renewables
2. Climate mitigation as a motor for innovations and investments in the future of Lower Austria
3. Enhancing quality of life through a sustainable lifestyle

has created a platform for goal-driven development of Lower Austria. The program is directed toward public administration, businesses, organizations, educational institutions, and the general public.

The role of climate adaptation has been strengthened even more since 2017 as the "Climate and Energy Program 2020" has been adapted. To prepare for this, the existing instruments of all 15 fields of action in the six areas (buildings, mobility and spatial development, closed-loop economy, agriculture and forestry, the federal state as a role model, energy supply) were examined in terms of their contribution to climate adaptation and made more precise in some areas, and their relationship to climate adaptation was explained.

The Electromobility Strategy 2014–2020 with the targets of e-mobility reaching a 5% share of all automobiles in Lower Austria, individual automobile use being reduced by 25,000 people, and value creation and employment in the area of e-mobility being increased by above-average rates, compared with the entire country, also contributes to climate adaptation.

Agriculture

Many of the measures in the area of agriculture are included in various programs, especially in the Program Rural Development. The new Austrian Program for Environmentally Compatible Agriculture (ÖPUL) makes a significant contribution to climate mitigation, in Lower Austria too, and has reacted to climate change with relevant measures (e.g., Lower Austria Consulting Service on Organic Farming and Organic Food). In addition, support is being provided for various research projects connected to climate adaptation, e.g., ClimGrassEco, Efficient Cow, or Future Bee.

[46] *Link: http://www.klimabuendnis.at/wandelbares-mostviertel-fit-in-die-klimazukunft-das-projekt*
[47] *Link: http://www.alpine-space.org/2007-2013/projects/projects/detail/C3-Alps/show/index.html*

Water Management

In Lower Austria, the structure of the water supply to all municipalities was surveyed and a basis established for increasing the security of supply through the expansion of public networks, increased networking of existing facilities, and the development of additional water dispensers. Building on a study commissioned by the federal government and the states "Adaptation strategies to climate change for Austria's water management" (BMNT 2011 (formerly BMLFUW 2011)), concepts are now being developed for regions with projected future reductions in groundwater recharge that cannot be compensated for by the existing supra-regional supply structure. In light of the problems with water supply in some municipalities resulting from the drought in the summer of 2015, work is currently being performed on solutions to such problems.

Maps indicating areas at risk of flooding from water running off slopes because of potentially more frequent heavy rain events were designed and made available to the affected municipalities, accompanied by consultation. A regional water management program to maintain valuable retention volume covering the entire federal state is currently being prepared; the goal is to reduce flood peaks.

The expected temperature increase will also result in increasing water temperatures. These values have recently been made available online to improve knowledge about the current temperature of surface water bodies. Work on warning plans to avoid potential fish die-offs is under way.

Nature conservation

In connection with nature conservation measures, which also make a significant contribution to climate change adaptation, several projects have been initiated and implemented (e.g., the restoration of semi-natural ecosystems, inter alia, as carbon sinks and retention areas; the networking of existing protected zones/natural habitats in order to permit necessary migration or exchange of (partial) populations).

In addition, a project is being carried out that has brought out the value of semi-natural ecosystems and conveyed this information to the interested public. Notable examples are the projects AKK (Alpine-Carpathian Corridor 2009–2012) and RAMSAR-SKAT 2010–2012. Further projects aimed at renaturation of habitats are to be implemented with the support of the EU-LIFE Program.

Health

A heat warning system for Lower Austria was implemented in cooperation with the ZAMG in 2016. State government departments and institutions concerned with particularly vulnerable population groups were informed about upcoming heat waves via e-mail. Information material on dealing with heat was also made available. Extensive information on heat and UV radiation is available to the general public on the website of the federal state of Lower Austria.

UPPER AUSTRIA

Upper Austria was the first federal state to begin developing an adaptation strategy. Preparation of a climate adaptation strategy for Upper Austria, which was enshrined in the government program 2009–2015, began immediately after the national strategy had been finalized. Experts from Upper Austria in the areas of tourism, agriculture, forestry, nature conservation, health, transport, buildings, disaster management and insurance, energy, as well as water management contributed their know-how to the strategy. This network, branching out in all directions, was already involved in preparing the Austrian Adaptation Strategy.

The strategy was adopted on July 8, 2013 by the government of the federal state of Upper Austria.

The development of the strategy was supported by the handbook "Methods and Tools for Climate Adaptation" [48] (prepared within the framework of the project FAMOUS, funded by the Climate and Energy Fund).

The **Upper Austrian Climate Adaptation Strategy**[49] strengthens efforts across departments to take the unavoidable impacts of climate change into account in all planning procedures. Implementation of the measures is promoted by the relevant departments. The Department of Environmental Protection or the Climate Mitigation Ombudsperson coordinates implementation in collaboration with the responsible organizational units. In addition, the Department of Environmental Protection will regularly evaluate and update the Upper Austrian Strategy, in agreement with the reporting formats of the Austrian Climate Change Adaptation Strategy. An initial implementation report was published in the spring of 2016.

Further research will be initiated in the framework of the climate research program StartClim.

SALZBURG

The **Salzburg** climate and energy strategy SALZBURG 2050 was adopted in 2012. In agreement with the goals of the European Union, it plans and provides for a stepwise phase-out of fossil fuel use and for making the federal state of Salzburg climate-neutral and energy-autonomous by 2050. Interim goals for the years 2020, 2030 and 2040 were developed to this end. On 17 November 2015, the government of the federal state of Salzburg adopted the Master Plan Climate + Energy 2020; it includes measures and approaches for achieving the first interim goal 2020 of the climate and energy strategy SALZBURG 2050 (a reduction of greenhouse gas emissions by 30% and an expansion of renewables to 50% of Salzburg gross final consumption of energy compared with the year 2005).

Another important area of this long-term climate and energy strategy is adaptation to climate change. For this reason, a Salzburg climate change adaptation strategy is being prepared whose contents are closely intertwined with the Austrian Climate Adaptation Strategy and which is to cover those areas in operative terms where there is a specific need for action in Salzburg. The results of the project ÖKS15 will be an important basis for this climate adaptation strategy. In addition, Salzburg supports the project CLIMA-MAP[50], which is financially supported by the Climate and Energy Fund. Municipalities are to be presented with specific guidance and implementation support on the basis of the results.

STYRIA

The position of Climate Mitigation Coordinator within the federal government of Styria was established in May 2009. A concrete point of contact was thus instituted for key climate mitigation and adaptation agendas.

Climate Scenarios for Styria Through 2050

In order to provide a reliable information base for assessing the impacts of climate change and preparing adaptation options, the Wegener Center for Climate and Global Change was commissioned to prepare the first comprehensive climate scenarios for Styria (STMK12). Alongside the analysis of scenarios with various meteorological parameters, the dataset prepared also enables further usage in many application-oriented disciplines. In addition to temperature and precipitation, data on changes in heavy precipitation events,

[48] *Link: http://klimawandelanpassung.at/index.php?id=25504*
[49] *Link: http://www.land-oberoesterreich.gv.at/111202.htm*
[50] *Link: http://www.alp-s.at/cms/de/land/aktuelle-projekte/clima-map/*

certainty of snow, or dry periods are available at the district level. The results are available at Environmental Information Styria[51].

Climate Adaptation Strategy Styria 2050

In Styria and beyond, the impacts of climate change are already visible today. The results of the "Climate Scenarios for Styria Through 2050" show that Styria must reckon with an additional temperature increase of approximately 1.4°C by 2050.

The "Climate Adaptation Strategy Styria 2050" is to prepare Styria for the future climatic conditions as well as possible in order to reduce negative impacts of climate change and to make use of opportunities. Beside the existing climate mitigation plan, the adaptation strategy complements the federal state's work in the field of climate policy. The strategy deals with 13 relevant areas: spatial planning and urban spaces, construction and housing, transportation infrastructure, water resources and water management, energy supply, disaster management, agriculture, forestry, nature conservation and biodiversity, the economy, tourism, health and social affairs, as well as education and global responsibility. The strategy comprises a total of 97 measures.

Climate.Concrete.Styria

Climate change is confronting us with ever greater challenges. Answers from research and science are needed more than ever. Many areas have a major need for action and hope for concrete answers from research and science. Research, in turn, requires information about the users' needs in order to be able to include societally relevant questions in research activities. The Climate Change Centre Austria (CCCA) developed a participatory workshop format called CLIMATE.CONCRETE.STYRIA to do justice to these requirements. In these workshops, researchers and political decision-makers discuss all kinds of topics related to climate change and adaptation options (e.g., workshop on heat in December 2013) in Styria.

Water Supply Plan 2015

Following the General Plan for Water Supply Styria 1973 and the Water Supply Plan Styria 2002, the Water Supply Plan Styria 2015 is now continuing a successful instrument of overarching plans for water supply in Styria. The contents and focal areas of the Water Supply Plan mirror the genesis of public water supply in Styria. The Water Supply Plan Styria 2015 also serves to maintain the functioning and the assets of the existing water supply infrastructure long-term. Hydrogeological fundamentals were reviewed on the basis of current EU standards, and hydrographic fundamentals were newly worked out and evaluated because of climatic changes.

In addition to the topic of climate change, the analysis of the quality and quantity of groundwater bodies as well as the qualitative and quantitative resource protection that can be derived from it were defined as focal areas. The Water Supply Plan Styria 2015 deals intensively with the topics of drinking water demand and security of supply, and forms the basis for the further development of the Water Network Styria and the equalization of water supply within Styria. The topics of security against failure of supply and management of disruptions were given particular significance in order to maintain and improve security of supply.

Styrian Heat Protection Plan[52]

At our latitudes, heat waves are a regularly occurring natural phenomenon. In addition, frequent occurrence of prolonged, intensive heat waves because of climate change must be expected. There is a high level of risk

[51] *Link: http://www.umwelt.steiermark.at/*
[52] *Link: http://www.gesundheit.steiermark.at/cms/beitrag/11685019/72561200/*

when day and night temperatures reach levels that involve a massive threat to the health of individuals and at-risk groups. Experiences from the past show the effects prolonged extreme heat waves can have on segments of the population such as children, the sick, and the elderly. The Heat Protection Plan Styria (HSPL) was presented in 2011 and updated in 2015 in line with WHO recommendations.

TYROL

Commissioned by the **Tyrolean state government**, climate mitigation coordination developed a strategy which is to ensure that the legally mandated CO_2 emission goals are reached by 2020 and that the necessary steps to adapt the economy and society to climate change are initiated. The Tyrolean Climate Mitigation and Adaptation Strategy was adopted by the Tyrolean state government on May 26, 2015. The goal of the strategy is to make CO_2 emissions targets achievable by 2020 and to initiate the necessary steps towards climate adaptation.

The 15-page government decision highlights the challenges and the need for action on the basis of the Austrian Assessment Report Climate Change 2014 (APCC 2014). In the area of climate adaptation, the strategy encompasses a comprehensive bundle of measures for 13 subject areas. The state of implementation is summarized annually in a report. The strategy was prepared in the context of a comprehensive participatory process.

The technical fundamentals are synthesized in four volumes:

Volume 1: The "Assessment Report Climate Change in Tyrol" analyzes the impacts of climate change on Tyrol and presents the greenhouse gas and energy budget.

Volume 2: "Achieving Climate Mitigation Targets by 2020" analyzes and evaluates the existing measures and includes sector-specific concepts for action (action plans) as a basis for concrete climate mitigation measures and funding guidelines for achieving the climate targets by 2020 and beyond.

Volume 3: "Adaptation to Climate Change" is concerned with the challenges and opportunities for the federal state of Tyrol and includes measures for priority fields of action. This report also casts light on synergies and challenges arising between climate mitigation and adaptation as well as the topic of raising awareness.

Volume 4: "Monitoring and Evaluation of Climate Mitigation Measures and Climate Adaptation Measures" provides an overview discussion of possible monitoring and evaluation strategies for the areas of climate mitigation and adaptation.

VORARLBERG

Vorarlberg adopted its strategy for climate adaptation in December 2015.

Preparation of this strategy was initiated in March 2015. Points of connection to the Austrian Adaptation Strategy and the Austrian Assessment Report Climate Change 2014 (APCC 2014) were presented and discussed at an information event. Preparation of the strategy built on that, taking account of local specialized knowledge from experts in public administration, associations, the business community, and NGOs.

The work involved nine departments of the Office of the State Government of Vorarlberg, the Department of Energy and Climate Mitigation, the Institute for Environment and Food Safety of the State of Vorarlberg, the State Fire Department Association, and Torrent and Avalanche Control.

The strategy aims at preparing the general public and the business community for future changes due to climate change and offering options for protection from negative impacts, but also at early use of potential opportunities. The important tasks mentioned include informing the general public about changes caused by climate change as well as early planning and implementation of adaptation measures. Full details are presented in the form of 14 independent partial strategies for the 14 sectors affected.

Of the many and diverse challenges that climate change will entail for Vorarlberg, 66 areas of action with a pressing need for action were identified. The following ten areas of action were classified as especially important:

- Maintaining protective forests
- Compact settlement patterns with minimized potential for damage
- Integrated flood control
- Strengthening disaster relief and individual responsibility
- Securing buildings against the impacts of climate change
- Minimizing the health burden arising from climate change
- Securing sustainable winter and year-round tourism
- Maintaining biodiversity
- Independent, sustainable agriculture
- Research and information

Concrete implementation measures were prepared by the responsible departments through late 2016 in a joint action plan coordinated by the Department of Energy and Climate Mitigation and under the supervision of the existing steering committee. A coordination group will ensure the flow of information and consultation regarding all relevant questions within the administration of Vorarlberg.

Progress in adaptation will be presented on the basis of periodic action plans as well as selected indicators. The strategy will be reviewed for consistency and currency at least every five years.

VIENNA

Vienna has been active for years in climate adaptation in addition to its climate mitigation activities. In Vienna, the topic of climate adaptation has always been treated as a part of and as a necessary complement of equal value to the climate mitigation program. The advantage of this approach is that synergies between climate mitigation and climate adaptation can be used and that potentially conflicting overlaps, for example when meeting future cooling needs, can be identified early. Furthermore, climate change adaptation measures have been implemented as integral components of existing strategic plans, such as the Urban Development Plan and projects such as target area management.

In December 2009, the Vienna city council adopted an update to the Vienna Climate Protection Program (KLiP II) with a time horizon of 2020; this update includes a mandate to determine the extent to which additional adaptation measures are needed and to offer concrete suggestions to political decision-makers.

In October 2011, concrete work on climate adaptation in Vienna commenced in the form of a kick-off workshop with senior staff of the City of Vienna. Working groups were formed for the following fields of action: health, urban planning and infrastructure, energy, “green” (forestry, agriculture, and nature conservation), water resources and water management, as well as disaster management. These working

groups – whose members consist of staff from the entire municipal administration – have been preparing concrete climate adaptation measures since 2012.

Examples of projects and measures in climate adaptation in individual sectors are listed in the following:

- In the area of flood control, the Hazard Zone Plan Wienerwaldbäche as well as ongoing flood control measures on the Danube, Liesing, Wien, and other rivers should be mentioned.
- The topic of disaster management is covered well by the Disaster Management Plan, including emergency plans for natural and environmental disasters, supply crises, etc.
- An important activity in the area of energy supply was the preparation of a Security of Supply Plan.
- Urban Heat Islands – Strategy Plan (UHI-STRAT Vienna) describes in detail various ways of cooling urban heat islands. It includes precise information on the effectiveness of 37 individual measures for the climate in the city and in neighborhoods. Furthermore, the Strategy Plan provides information about the advantages and possible obstacles in implementing measures, as well as the expected costs of construction and maintenance.
- For years, the City of Vienna has been promoting roof and facade greening and supporting roof greening in built-up areas.
- The MA 49 farm and the Bio-Zentrum Lobau are jointly farming roughly 1,000 hectares organically; this is thus one of the largest domestic organic farms.
- The research program KATER was conducted in the Lower Austrian-Styrian Limestone Alps to secure the drinking water supply. The goal was to maintain the high standards of Vienna's water production and to gain more precise knowledge about the factors affecting the karst water.
- In 2015, the first "Vienna Heat Guide Booklet" was published, the first to provide comprehensive information about all topics related to heat in the city. The Heat Guide Booklet is also an important measure in the framework of the "Vienna Health Goals 2025."
- A preventive heat warning service has existed since 2010 which, in cooperation with the Central Institute for Meteorology and Geodynamics, informs relevant institutions and the population of Vienna about looming heat stress lasting at least three successive days.

The climate adaptation activities (results from the working groups, concrete measures and projects, etc.) are documented in the progress reports on the Climate Protection Program, which are periodically presented to the city council and others.

RESEARCH ENVIRONMENT AND RESEARCH NEEDS

11 RESEARCH ENVIRONMENT AND RESEARCH NEEDS

Science and research must assume substantial responsibility in connection with adaptation to and mitigation of climate change. Meaningful political, economic, ecological, and social solutions can only be designed and implemented when the causes of climate change and the consequences for people's lives can be estimated in a substantiated and integrative manner.

In recent years, climate change research in Austria has evolved rapidly. Questions concerning adaptation to climate change determine the strategic orientation of research programs and are integral components of climate research. This strategic orientation has already significantly improved the knowledge base of this relatively new topic. The findings of numerous research projects contribute to implementing the present strategy and were drawn on for its further development.

Some focal areas should be mentioned here:

The federal government's **FTI-Strategy**[53] (Research, Technology, & Innovation; BKA et al., 2011) states that strategies are to be developed for adaptation to climate changes that can no longer be averted. It focuses both on questions concerning ecological changes and on issues relating to healthcare and food security. It is about technological, but also systemic or societal research which is supported by analyses, impact studies, scenario and model development, space-based and terrestrial environmental monitoring, etc.

The **climate research program StartClim**[54] was established in 2002 at the initiative of the Austrian Federal Ministry for Sustainability and Tourism (BMNT, formerly BMLFUW) and the research community. An extensive knowledge base has been created through the more than 90 StartClim projects to date, and urgent needs for further research in various topics have been identified. StartClim has also been able to involve disciplines that at first glance do not seem directly connected to the impacts of climate change, but that provide important contributions to answering socially relevant questions related to climate change.

The research program StartClim is designed as a flexible instrument that can rapidly pick up current topics in the area of climate change through short project durations and the annual awarding of project contracts. Since 2008, StartClim has been concerned with climate adaptation. To date, more than 130 Austrian researchers from almost 50 institutions have conducted studies on climate change and its effects. The program has not only produced interesting results but also significantly contributed to expanding necessary know-how in the Austrian climate research arena. StartClim is funded by an open donor consortium (2016: Austrian Federal Ministry for Sustainability and Tourism (BMNT, formerly BMLFUW), Austrian Federal Ministry of Education, Science and Research (BMBWF, formerly BMWFW), Austrian federal government, and Austrian Federal Forestry Office) and is supported by an international scientific advisory board.

With the launch of the **Austrian Climate Research Program** (ACRP)[55] within the Climate and Energy Fund, an important conceptual and institutional framework for supporting research questions on issues of climate change and adaptation was established in Austria. Since 2007, this program has sought to explore the effects generated by climate change and to create a scientific basis for future-oriented decisions in politics, business, and society.

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[53] *Link: https://www.bundeskanzleramt.gv.at/fti-strategie*
[54] *Link: http://www.startclim.at/*
[55] *Link: https://www.klimafonds.gv.at/foerderungen/aktuelle-foerderungen/*

The work of the ACRP focuses especially on research into national manifestations and impacts of climate change, adaptation requirements arising from them, risk management approaches and policy analyses, as well as work on questions related to necessary societal transformation. The program has significantly contributed to expanding Austrian research competence in climate and adaptation research and to increasing international visibility. A total of 168 projects were commissioned from 2007 to 2015. The research work encompasses, among other things, questions from the natural, social, and economic sciences as well as legal and technical ones, all of which are generally approached in an interdisciplinary, sometimes a transdisciplinary manner.

The topics of climate change and adaptation to climate change have increasingly been included in various national research strategies and programs, for example the program Pfeil 20 (Program for Research and Development in the BMNT, former BMLFUW, 2016–2020), which is oriented toward applied and contract research. The research and technology programs of the BMVIT, for example City of the Future, the Energy Research Program of the Climate and Energy Fund, or the "Accompanying Research on Smart Grids," and the BMWFW's research activities are increasingly focusing on questions relevant to adaptation.

It is important to mention that the Central Institute for Meteorology and Geodynamics (ZAMG) is making an important contribution to basic research on climate monitoring and is conducting research projects to better understand the climate in the past and the present, as well as the climate to be expected in the future.

Besides climate research in Austria, research activities in the **European and international context** are concerned with questions of climate adaptation. For example, important project findings can be taken from the Alpine Region Program 2014–2020,[56] the Program Central Europe 2014–2020,[57] or Danube Transnational 2014–2020,[58] as well as the EU Program for Research and Innovation (Horizon 2020)[59]. A compilation of projects on climate change under the European Framework Programs FP5,[60] FP6,[61] FP7[62]) is available at the following link: ***http://ec.europa.eu/research/environment/index_en.cfm?pg=climate***

One of the three core objectives of Horizon 2020 is to deal with major societal challenges, one of which is climate change. Funding is provided for research and innovation intended to lead to concrete implementation measures in society.

Austria took a leading role in developing the **Joint Programming Initiative** (JPI) "Connecting Climate Knowledge for Europe." Joint Programming Initiatives coordinate national focal areas of research, and through joint calls provide the opportunity for collaboration at the European level. These initiatives are concerned with key societal challenges such as climate change, energy and food security, and healthy aging, which cannot be solved at the national level alone. Through them the limited resources for research and development are to be bundled and better use of complementarities made. Austria is involved in eight of the ten initiatives.

The Climate Change Centre Austria (CCCA)[63] was established on the initiative of Austrian universities in order to promote institutionalized cooperation on climate research and climate impact research in Austria. The objective of the **CCCA** is to improve the quality and efficiency of Austrian climate research through

[56] *Link: http://www.oerok.gv.at/index.php?id=1085*
[57] *Link: http://www.oerok.gv.at/eu-kooperationen/etz-transnational-netzwerke/central-europe-2014-2020.html*
[58] *Link: http://www.oerok.gv.at/eu-kooperationen/etz-transnational-netzwerke/danube-transnational-2014-2020.html*
[59] *Link: https://www.ffg.at/Europa/Horizon2020*
[60] *Link: http://cordis.europa.eu/fp5/*
[61] *Link: http://ec.europa.eu/research/fp6/index_en.cfm*
[62] *Link: http://cordis.europa.eu/fp7/projects_en.html*
[63] *Link: https://www.ccca.ac.at/de/home/*

networking and the promotion of cooperation, as well as to enhance its international visibility. It provides a contact point for the research and political communities as well as for the media and the public.

Existing knowledge on climate change in Austria, its impacts, and the requirements and opportunities for mitigation and adaptation was summarized in the Austrian Assessment Report Climate Change 2014 – AAR 2014 (APCC 2014),[64] which was financed by the Climate and Energy Fund. The report, which is similar to that of the IPCC, is a coherent and complete analysis of the state of scientific knowledge for Austria and makes information relevant for decision-making available without, however, making recommendations. The report is organized in three volumes, and its core statements are also available in the form of a summary for decision-makers and a synthesis.

The research needs identified in the AAR 2014 form the basis of the Science Plan of the CCCA, which is currently under preparation.

An overview of research projects focusing on adaptation to climate change is available at the following link: ***www.klimawandelanpassung.at/ms/klimawandelanpassung/de/kwa_allgemein/datenbank/***. This database is continuously updated and offers a good overview of the focus of individual research projects in which Austrian researchers are involved.

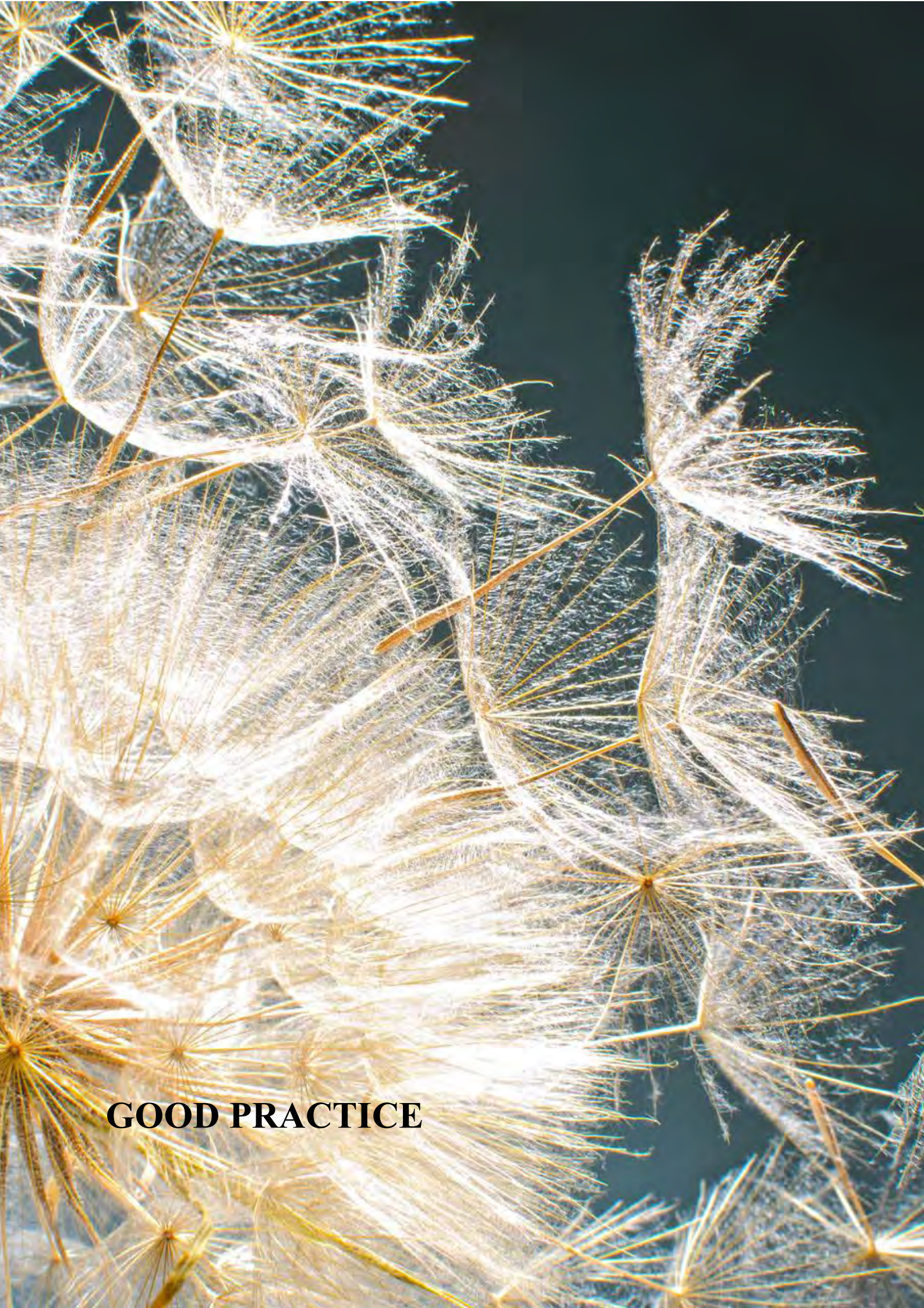
Many of the scientific findings of the numerous research projects also provide an important basis for the political decision-making process. Thus, the present Austrian Adaptation Strategy is built on a series of scientific findings.

Findings from research projects conducted to date, the preparation of the Progress Report and the Assessment Report Climate Change 2014 (APCC 2014) show that further action is required, including in research. The focus is to lie especially on applied research as well as socioeconomic questions. In addition, accompanying research is to be strengthened in order to support the implementation of local and regional adaptation measures and to develop adaptation measures that are as effective and as closely tailored to target groups as possible. Research needs include, among other things, the necessary socio-ecological transformation of society and the economy. For this reason, the relevant research programs are to be adequately financed in the future as well. Improved communication between research, public administration, and practical application is required to permit the findings of national and international research to be considered in the adaptation process at all levels of public administration.

The research needs for the areas of action are presented in the second part of the strategy – the Action Plan; either as separate recommendations for action or within the recommendations.

Further fundamental research requirements relate to the social effects of climate change and adaptation measures (see Chapter 7: Social Aspects of Climate Change). For a number of years, relevant research questions on social aspects of climate change have already been included as focal areas in calls for proposals by research programs such as the Austrian Climate Research Program (ACRP) of the Climate and Energy Fund or by StartClim. The scientific community is currently showing little interest. To date, there have only been isolated research projects concerned with social aspects of climate change in some areas (see Chapter 7 Social Aspects of Climate Change). As the Austrian Assessment Report on Climate Change 2014 (APCC 2014) also shows, there is still an urgent and heightened need for research (e.g., on aspects of the urban climate and climatic comfort – outdoors as well as indoors – with respect to socially disadvantaged strata of the population or on the burdens on lower-income groups because of higher costs for food and energy.)

[64] *Link: https://www.ccca.ac.at/de/wissenstransfer/apcc/assessment-reports/austrian-assessment-report-2014-aar14/*



GOOD PRACTICE

12 GOOD PRACTICE

Examples of good practice serve an important function: They indicate the different ways in which systems and areas can successfully respond to a changing climate. Such examples illustrate the range of possible response options and the numerous approaches to coping with various challenges. The analysis and communication of success factors and also potential barriers to adaptation can support other regions and actors in the implementation of their planned activities. The presentation of such good practice examples fosters a new culture of dialogue for the exchange of experiences and information. This enables actors to learn from each other and, to some extent, mutually address the challenges of adaptation.

See the climate change adaptation database for more examples.[65]

AGRICULTURE

CARBON CALCULATOR FOR PRODUCTIVE SOILS

Sufficient humus content is decisive for the productivity of agricultural soils. Humus, i.e., the organic substance in soil, fulfills many and diverse functions: It improves the capacity of soils to store and buffer water and nutrients, and is also a habitat for large numbers of soil organisms. Besides improving soil fertility, humus also has another important role: Soils are the largest terrestrial carbon sinks. Targeted humus formation stabilizes the functions of the soil and can reduce the loss of crops due to extreme weather.

An easy-to-use carbon calculator was developed in the project "Austrian Carbon Calculator," which was supported by the Climate and Energy Fund. The calculator shows farmers how the type of land cultivation affects the humus supply of the soil. Factors such as crop rotation, fertilization, tillage, irrigation, and cover crops on the agricultural land in question, the local soil type, as well as the current climate and possible changes in the future are taken into account.

The effects of planned climate adaptation measures can be tested with the carbon calculator as well. It supports people involved in agriculture in reviewing their cultivation practices, preparing scenarios for supplying their fields with humus, and targeting measures for humus formation.

The carbon calculator was first conceived for two regions in Austria, the Mühlviertel and the Marchfeld. It is a valuable tool for agricultural enterprises and public agencies to indicate future developments at the local and regional levels.

Further information:
http://www.umweltbundesamt.at/acc

[65] *Link: http://www.klimawandelanpassung.at/ms/klimawandelanpassung/de/kwa_allgemein/datenbank/*

AGRICULTURE

EROSION PREVENTION PROJECT SOUTHEAST STYRIA

Agricultural land is affected above all by the increasing number of extreme climate events. Especially on arable land in phases of incomplete or totally absent ground cover, erosion by water and wind can increase. Factors such as location, slope, and soil type cannot be changed.

Consequently, cultivation and soil management will become more important in the future in order to compensate for possible climate-related problems by means of adaptive management.

The dominant crop in southeast Styria is corn (maize), the basis for feed for pig and chicken production; yields are high because of the climate. Slopes must be planted as well, because of the topography of the area. In recent years, numerous heavy rainfall events have resulted in massive soil erosion. In addition to the losses of soil rich in humus and nutrients, the eroded soil has caused significant damage to infrastructure, incurring costs of several 100,000 euros for cleaning federal and state roads.

For this reason, the Chamber of Agriculture initiated a project in 2014 to reduce erosion on arable land in southeast Styria. The project will continue for seven years.

Figure 7: Winter rape providing ground cover on a cornfield in early May. © LK Steiermark

An agricultural and environmental information campaign informs farmers about the issues, including technical advice concerning the implementation of erosion-prevention measures, complemented by information events and field inspections. Mulch-till corn cultivation is one focus of the project. The mulch comes either from catch cropping or the previous crop, grain corn, which is mixed into the soil using a special cultivator technology so that leftover straw adequately covers the surface of the soil.

The ground cover protects the soil from precipitation and reduces evaporation. Cultivating catch crops and reduced tillage also increase the humus content of the soil as well as its capacity to store water. Using erosion control seed is another innovative approach. It ensures that the soil between the rows of corn is covered by plants and thus protected from heavy rain.

(Comment, to complement the version of the report for the Council of Ministers: The Erosions Prevention Project Southeast Styria will be continued starting in 2017 as part of the “Agri-Environmental Consultancy.” Publications on erosion prevention in southeast Styria are to be found above all in the Water Protection Journal.)

Further information:
http://www.lub.at/

FORESTRY

ADAPTIVE MANAGEMENT STRATEGIES FOR THE AUSTRIAN FEDERAL FORESTS

Scarcely any other industry depends as heavily on the climate as forestry. The Austrian Federal Forests (ÖBf AG) have long recognized the significance of this issue and have sought to meet the challenges of climate change. The ADAPT project was launched and implemented by experts from the Institute for Silviculture at the University of Natural Resources and Life Sciences for this purpose. The direct involvement of forest planners and the relevant ÖBf employees ensured the high practical relevance of the project's results.

The results show that the vulnerability of the ÖBf's forests to the consequences of climate change will drastically increase, especially in the second half of the twenty-first century. While the proportion of highly vulnerable forest stock in the period 2001–2020 is only 5.9 % of the total, 39.6 % of forests were classified as highly vulnerable in the second half of the twenty-first century. In particular, locations with lower water supplies in calcareous sub-soil will be negatively affected. However, sites at higher elevations could benefit from the effects of climate change.

The results of ADAPT serve as a practical, realizable decision-making aid for assessing how forests will develop in certain regions under changing climatic conditions, and determining which management strategies (e.g., adaptation through the selection of tree species, regeneration methods) can counter negative trends. As a result it will be possible to integrate future challenges resulting from climate change into the ÖBf's forest planning practices.

Especially at the strategic level, the project results contribute to an estimation of the extent and the urgency of the necessary adaptation measures. Based on the results of ADAPT, ÖBf's internal silviculture guidelines were revised. Since the completion of the project, ÖBf-internal training and workshops have ensured that its findings are further communicated.

Further information::
http://www.bundesforste.at/unternehmen-nachhaltigkeit/nachhaltigkeit/waldbau.html
https://forschung.boku.ac.at/fis/suchen.projekt_uebersicht?sprache_in=de&menue_id_in=300&id_in=6167
https://www.dafne.at/dafne_plus_homepage/index.php?section=dafneplus&content=result&come_from=&&search_fields[title_ger]=&search_fields[projektleiter]=Lexer&search_fields[antragsteller]=&search_fields[research_objective]=&search_fields[beauftragungsjahr]=&search_fields[offer_number]=&search_fields[keywords]=&search_fields[antragsteller_2]=&project_id=2364

WATER RESOURCES AND WATER MANAGEMENT
ECOSYSTEMS/BIODIVERSITY

INNERALPINE RIVER CATCHMENT MANAGEMENT ON THE UPPER MUR RIVER

Semi-natural wetlands and river landscapes secure the habitat of endangered animal and plant species and support natural flood retention. The Upper Mur River is considered to be one of the ecologically most valuable stretches of river in Austria. Impacts of river engineering measures and intensification of use that threaten habitats and species can be identified in the valley area. For example, a decline of Danube salmon stocks has been observed in recent years because of these developments.

Measures to improve the aquatic habitat as well as passive flood control were taken in two phases (2003–2007 and 2010–2015) on the Upper Mur River within the framework of LIFE-Nature projects. The goal was to secure the existing semi-natural wetland and river landscapes and to initiate the creation of new ones. Structures typical of the river, such as gravel bars, flat river banks, wetland forests, and alluvial forest waters were created on a total of approximately 180 kilometers of the river, producing networks of tributaries branching out in all directions with large bodies of water offering vital habitat for endangered animal and plant species. In addition, 17 hectares were reactivated as areas for passive flood control. Awareness about the ecological significance of the Mur River as a habitat and an experiential space was promoted in the region by providing information and involving schools and the general public.

Further information:
http://www.murerleben.at/

Figure 8. The Apfelberg municipality © Murerleben.at

TOURISM

NATURAL HAZARD MAPS FOR HIGH-ALPINE HIKING TRAILS

Should natural processes (e.g., landslides) at high elevations accelerate as a consequence of climate change, they could pose a danger for people and for infrastructure. While protective measures for residential areas, transportation routes, and areas heavily used for tourism already exist, the safety of people outside protected areas on hiking trails is not guaranteed.

For this reason, the StartClim project AlpinRiskGP (financed by the BMWFW – previously the BMWF) examined one of the most frequently visited mountain landscapes in Austria – the Großglockner-Pasterze region – to assess the risk of rock falls, mudslides, avalanches, and similar processes of erosion. The primary causes of these processes are glacial retreat and the thawing of the permafrost.

A hazard map was created which divides the area under investigation into four hazard classes. In addition, with data from climate models, the conditions for a scenario in 2030 were estimated. By superimposing the network of trails and paths, maps of the vulnerability of individual path segments were created; these were reviewed by experts from the region and evaluated in terms of potential measures. The proposed measures range from concrete local efforts to improve trail safety (e.g., by closing trails or creating new paths) to new forms of organization (e.g., the establishment of a trail information system) or expanding the knowledge of those who spend their free time in the high mountains.

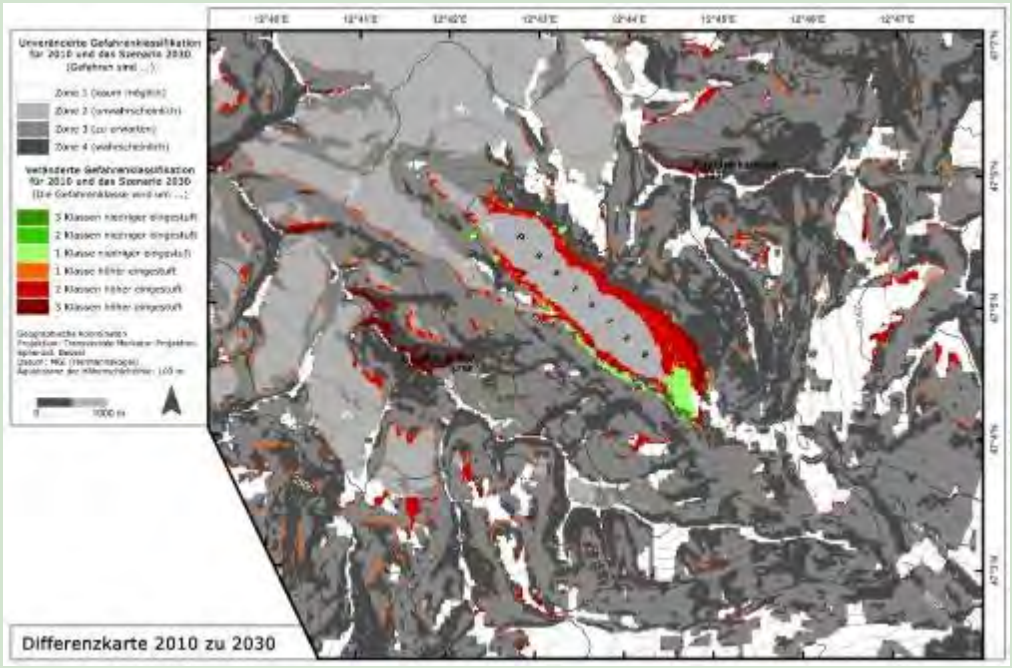


Figure 9: Differential map of hazard classes (2010–2030), © Lieb et al., 2010

The differential map of hazard classes 2010–2030 indicates a general increase in risk (orange to dark red), while the reduction of risk potential will only occur at isolated points (green).

For more information:
http://www.startclim.at/startclim2009/

TOURISM, HEALTH

SUFFICIENT DRINKING WATER ON HOT DAYS

Climate change is perceptible even today, especially in major cities in the summer months. On hot days, the sun massively heats up concrete, and a large part of this heat is stored in high-density areas. Heat waves with daytime temperatures over 30 °C and tropical night-time conditions when temperatures stay above 20 °C will continue to increase in frequency and intensity.

Figure 10: Water fountain on Karlsplatz in Vienna. Photo Bgabel, Creative Commons

Worsening health and well-being and work performance are directly related to this. Because high temperatures can quickly result in shortages of fluid, getting enough to drink is one of the most important preventive measures when dealing with summer heat.

A dense network of water fountains provides refreshment for passersby in the hot season in a number of Austrian cities (including Vienna, Innsbruck, Graz, and Salzburg). As an additional service – especially for tourists – their locations are available online in Vienna and Graz, for example. An app with the locations of 200 water fountains in Salzburg is made available by the state of Salzburg.

For more information and the locations of the drinking fountains:

Vienna

http://www.wien.gv.at/wienwasser/versorgung/brunnen.html

https://m.wien.gv.at/stadtplan/#zoom=14&lat=48.20602&lon=16.37709&layer=trinkbrunnen&base=karte

Study: "Hot Town, Summer in the City," financed by the BMWFW—previously the BMWFJ):

http://www.startclim.at/startclim2010/

Graz

http://www.holding-graz.at/wasserwirtschaft/trinkbrunnen/standorte.html

Salzburg

http://wasser.salzburg.mobi/

ENERGY, CONSTRUCTION AND HOUSING

DISTRICT COOLING: AN ENERGY-SAVING COOLING ALTERNATIVE

With rising temperatures, offices, apartments, and shops heat up significantly in the summer. Consequently, the demand for air-conditioned workplaces and business premises has significantly increased in recent years. Compressor-based coolers cool efficiently, but consume electricity and cause climate-relevant emissions.

District cooling represents an environmentally friendly, electricity- and CO_2-saving alternative. District cooling is a sensible cooling choice primarily for consumers in urban areas with high energy demand, such as hospitals, hotels, event venues, and office buildings. Generation of district cooling takes place largely in absorption cooling machines, through which waste heat rather than electricity produces the refrigeration. The origin of the heat is critical in determining environmental friendliness; in Vienna, the heat comes from combined heat and power plants and from the thermal treatment of waste.

Buildings can be supplied by a cooling center within the district cooling grid or remotely. With decentralized generation of district cooling, a cooling center is installed in the customer's building and is supplied with input energy over the district heating grid. This option is expedient when no district cooling grid is available.

In Vienna there are 13 district cooling centers providing district cooling for hospitals, office buildings, shopping centers, the central train station, etc. In Linz, the Brucknerhaus and the Elisabethinen Hospital are district cooling customers. The state hospital in St. Pölten is cooled through the district cooling system. A significant expansion of the offer is planned.

For more information:
https://www.wienenergie.at/eportal3/ep/channelView.do/pageTypeId/67823/channelId/-47780
http://www.fernwaerme.at/klim/8/

CONSTRUCTION AND HOUSING, ENERGY

RAISING AWARENESS – CONSTRUCTION SUITABLE FOR SUMMER

Due to higher extreme and average temperatures and more frequent and intense heat waves, the issue of building cooling and summer suitability will become increasingly important in the future. Cooling demand will be especially rise in urban areas. An immediate reaction can already be observed in the growing use of air conditioning, which runs counter to climate change mitigation efforts, as it causes a significant increase in energy consumption. Building design must therefore not only meet the requirements for optimized thermal insulation, but also take into account summer cooling needs.

Information materials serve to raise awareness, provide help, and highlight the many different ways of making buildings suitable for the summer and optimizing their usage and energy consumption. Brochures and guides indicate climate-friendly measures and strategies for achieving comfortable internal temperatures in the summer months. Comprehensive information is provided in the brochure

"Sommertauglich Bauen – Wie Ihr Haus im Sommer angenehm kühl bleibt" [Construction Suitable for Summer Conditions: How to keep your house pleasantly cool in the summer] and the guideline "Sommertauglich entwerfen und bauen – Leitfaden zum effizienten Bauen" [Design and construction suitable for summer: Guidelines for efficient construction" published by the OÖ Energiesparverband [Upper Austrian Energy Saving Association]. The handbook covers in detail issues of "reduction of heat entry," "heating/cooling storage," "optimization of the use of daylight," "technical building systems," and "the use of plants."

Another source of information is the brochure "Summer Suitability in Existing Buildings," published by the Working Group on Resource-Oriented Construction at the University of Natural Resources and Life Sciences Vienna. In addition to basic strategies on the topics of building shells, thermal mass, and shading options, cooling strategies and concepts for the thermal renovation of casement windows in currently ongoing projects are described.

For more information:
Upper Austrian Energy Saving Association :

Guideline:
http://www.baunat.boku.ac.at/fileadmin/data/H03000/H87000/H87500/files/projekte/sommertauglichkeit/sommertauglichkeit_v11_lowres.pdf

Broschüre:
http://www.energiesparverband.at/fileadmin/redakteure/ESV/Info_und_Service/Publikationen/Sommertauglich_Bauen.pdf

ECOSYSTEMS/BIODIVERSITY

ENHANCING DIVERSITY AND CREATING HIKING OPPORTUNITIES

Human uses have left their mark on our cultural landscape, where increasing numbers of landscapes are used intensively. Land-use changes and the intensification of land uses bring about habitat losses for many animal and plant species. Climate change is an additional burden for many endangered species. The few remaining habitats of these animals are often isolated insular habitats, so that opportunities for migratory movements are lacking. The initiative "Nature-active Upper Austria" is to provide an incentive to re-enhance the diversity of our landscape, thus establishing habitat connectivity long-term.

The goal of this funding initiative is to create new habitats for endangered plant and animal species and to improve existing habitats. The establishment of new habitats such as hedges, dry stone and fieldstone walls, or wetland habitats creates new sanctuaries and migration opportunities for living organisms.

Private individuals, associations, municipalities, and schools are supported when they create valuable habitats. But support is also available for the improvement/revitalization of existing habitats (such as ponds, wet meadows, moors, etc.).

Further information:
http://www.land-oberoesterreich.gv.at/35965.htm

CONSTRUCTION & HOUSING, URBAN GREEN AND OPEN SPACES,
SPATIAL PLANNING, HEALTH

ROOF AND FACADE GREENING

Green roofs and facade greening improve the urban climate and contribute to urban ecology. Green roofs and roof gardens offer many different benefits: They provide new habitats for animals and plants, improve the microclimate, and in the summer have a cooling effect for the rooms underneath because of increased evaporation. They absorb up to 90% of precipitation (retention effect), remove dust and air pollutants (due to the higher humidity), and serve heat- and sound-insulating functions. They can also be recreational spaces for people in densely built-up urban areas.

Extensively greened roofs are semi-natural vegetation areas that for the most part sustain themselves or continue to develop. They require little maintenance. They cannot be walked on, need no watering, are suitable for solar technology, and require a layer of soil at least 8 cm deep.

The soil on intensively greened roofs is at least 30 cm deep. Meadows, shrubs, and vegetable beds can be planted on the walkable areas. Such roofs require more time and effort for maintenance and watering; however, they can also be used as full-fledged gardens. The statics of the roof construction must be reviewed because of the higher weight per unit area.

Facade greenings also have impacts on the microclimate through evaporation and shade, and bind air pollutants. Evergreen climbing plants have a cooling effect in the summer and reduce heating costs in the winter because of the insulation they provide. They are a habitat for animals in the city and make the public streetscape more attractive. A green facade with a surface area of 850 m² can achieve the cooling capacity of approx. 75 air conditioners with 3,000 watts of power run for 8 hours.

A registry of green roof potential has been prepared for Vienna, showing that 34% of the total roof area can be greened.

Roof and facade greening are financially supported in Vienna and Linz, for example.

Further information:
https://www.wien.gv.at/umweltschutz/raum/gruendaecher.html
https://www.wien.gv.at/umweltschutz/raum/gruene-waende.html
http://www.umweltberatung.at/leitfaden-fassadenbegruenung
https://portal.linz.gv.at/Serviceguide/viewChapter.html?chapterid=121934
http://gruenstattgrau.at/

PROTECTION FROM NATURAL HAZARDS

HORA 2.0 –
ONLINE PLATFORM FOR NATURAL HAZARD DETECTION

Following the severe flood events of recent years, in 2002 the Federal Ministry of Sustainability and Tourism, BMNT (formerly Lebensministerium) and the Insurance Association (VVO) jointly initiated the project "Flood risk zoning in Austria – HORA," a nationwide risk zoning system for natural hazards with a special focus on floods. The objective of the project was to document the risk of natural disasters (especially floods) for all of Austria, in order to be able to better assess damage potentials. To this end, data on the high water levels of 25,000 kilometers of river in Austria were gathered.

In the summer of 2011, the HORA platform was updated and expanded. Since then, a new version of the app has been available at: ***http://hora.gv.at***. The Internet platform offers all citizens the possibility of obtaining an initial risk assessment of various natural hazards and weather events (such as flooding, earthquakes, storms, hail, lightning, and snow load) simply by entering an address. In addition, current weather warnings for floods, hail and heavy rainfall, earthquakes, etc., are available. In addition, a HORA-APP is available for all widely-used smart phones, making an estimation of risk potential even easier.

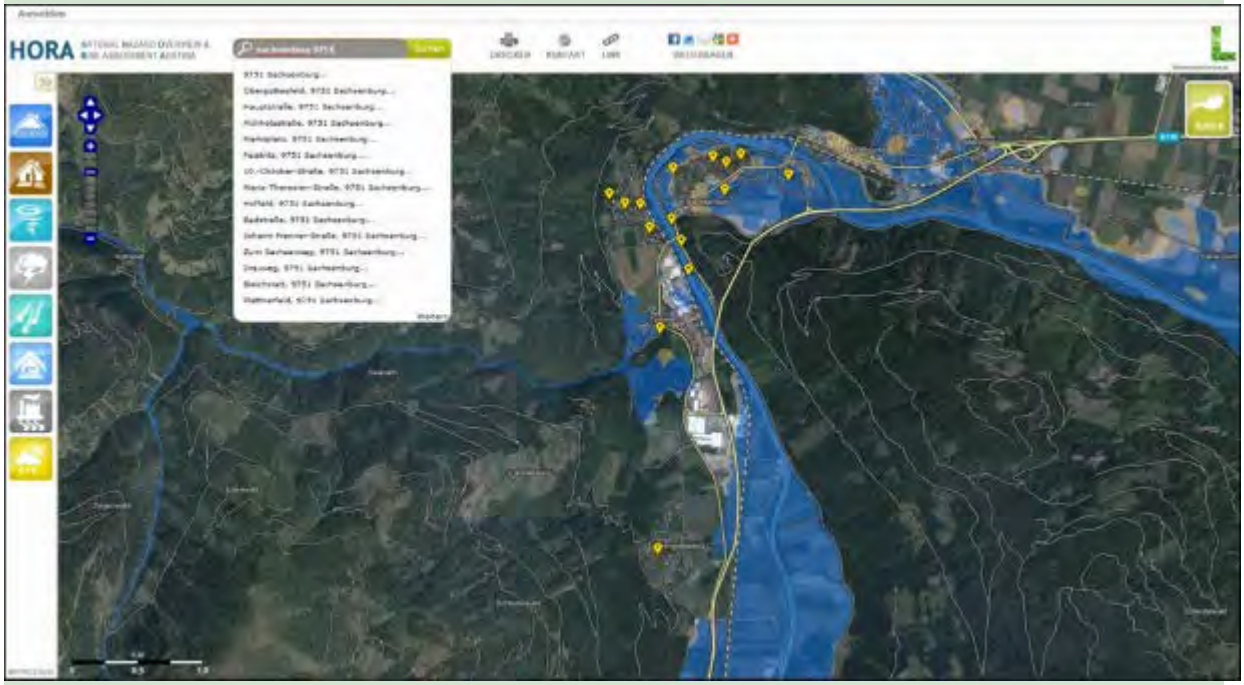


Figure 11: Excerpt from the digital hazard map HORA.

HORA's primary objective is to raise risk awareness within the population, so that precautions can be taken in a timely fashion. Its visualization of hazardous areas is intended to serve as an important basis for the optimization and prioritization efforts of municipalities, states, and the federal government in flood protection and spatial planning.

For more information:
http://www.hora.gv.at/

PROTECTION FROM NATURAL HAZARDS

SEVERE WEATHER EVENT WARNING BY APP/TEXT MESSAGE

For several years already, local (by post code) and precise up-to-date forecasts and information about the nature and intensity of an approaching severe weather event (storm, heavy rain or snow, ice, hail, thunderstorms) have been available electronically. The warnings are usually disseminated by app or text message. This permits early safety precautions to be adopted, saving lives and preventing or reducing damage. In cooperation with the Central Institute for Meteorology and Geodynamics (ZAMG), several institutions, the Austrian Storm Center (Unwetterzentrale), insurers and radio station Ö3) provide this (sometimes fee-based) service.

Figure 12: Severe weather event warning by app. © Maria Deweis

The "City of Graz Fire Department App" was developed by the Division of Disaster Management and the Fire Department as a service to the general public. It indicates hazard status using the established traffic light color scheme (green = no direct danger, red = acute danger). In addition to an early warning, users receive information about individual ways to protect themselves and prevent harm from flooding, storms, and snow. The app also includes a map with the locations of the sandbag sites and fire stations in Graz.

Further information:
http://warnungen.zamg.at/html/de/heute/alle/at/
https://uwz.at/
http://at.wetter.com/wetter_aktuell/wetterwarnungen/warnungen_aktuell/oesterreich/EUAT.html
https://www.wienerstaedtische.at/service/apps-sms/sms-services/wetterservice.html
https://www.uniqa.at/versicherung/cms/ueber_uniqa/Unwetterwarnung.de.html
https://www.generali.at/privatkunden/service/mobile-services-apps/generali-unwetter-app/
https://www.versichern24.at/unwetterwarnung-sms-f%C3%BCr-ganz-%C3%B6sterreich
http://www.raiffeisen-versicherung.at/eBusiness/01_template1/890584643638596258-NA-909382020527631419-NA-1-NA.html
https://ergo-versicherung.at/a/ergo-unwetterwarnung/
https://www.zurich.at/service/tools/sms-unwetterwarnung
http://www.merkur.at/cms/ziel/528717/STD/
https://www.keinesorgen.at/services/ich-bin-kunde/wetterwarn-service.html
https://weathersafe.allianz.com/ch/user/login
https://www.grawe.at/sms-unwetterwarnung/
https://www.wuestenrot.at/de/formular/anmeldung-sms-unwetterservice.html

City of Graz Fire Department App*:*
http://www.katastrophenschutz.graz.at/cms/beitrag/10234307/2090541/?346241412

DISASTER MANAGEMENT

TEAM AUSTRIA:
HELP WHEN HELP IS NEEDED

With the increase in extreme weather events, there is also an increased need for helpers in the management of natural disasters. That is why a new idea was implemented in Austria in 2007. Team

Austria is an initiative of the radio station Hitradio Ö3 and the Red Cross with the goal of supporting emergency response organizations rapidly and in a straightforward manner in disaster situations. Team Austria members help, for example by shoveling snow after massive snowfalls and cleaning up after extreme weather events or major flooding as occurred in 2013.

The strength of Team Austria stems from the abundance of different skills offered by its helpers; precise selection of these skills, identified at the helper's registration, facilitates targeted application. Necessary tasks in disaster events range from simple auxiliary work (e.g., filling sandbags) to jobs that require specialized expertise (e.g., care of disaster victims, assistance in construction).

Assistance is voluntary: Whoever has time and wants to help can participate. Anyone over the age of 18 can take part. All volunteers are registered in a database and can quickly be notified if they are needed; currently (as of August 2016) over 50,000 members have enrolled. All team members on duty are insured and receive a basic training course in disaster relief from the Red Cross in preparation for their active participation. The operation is organized by the Red Cross.

In 2008, the initiative received the silver medal in the category of Social Affairs from the International Advertising Association. The idea and the concept of Team Austria have since been copied by other European countries.

For more information:
https://www.facebook.com/Teamoesterreich/
http://oe3.orf.at/teamoesterreich

HEALTH

POLLEN WARNING SERVICE

Because of the extended vegetation period, trees, shrubs, and grasses blossom earlier and tend to produce more pollen. The pollen concentration in the air has increased, especially in urban areas. This increases the pressure on persons who have allergic reactions to the most varied types of pollen.

It is important for people suffering from an allergy to obtain information regularly about the current pollen count and to adapt their behavior to the situation. Institutions such as AGES (Austrian Agency for Health and Food Safety Ltd.) monitor the distribution of allergenic plants such as ragweed, and provide tips on how to prevent and fight them.

The Austrian Pollen Warning Service provides information about the current pollen count on its website and through an app. The website also provides practical behavioral tips for persons allergic to pollen and enables them to keep an online diary. By comparing their symptoms with the various types of pollen in the air, they can determine whether the measures taken have had the desired success.

Further information:
https://www.pollenwarndienst.at/de/aktuelle-werte.html
http://www.ages.at/themen/schaderreger/ragweed-oder-traubenkraut/

HEALTH

HEAT PROTECTION PLANS AND WARNING SERVICES

Hot days with temperatures in excess of 30°C and heat waves have become more frequent in recent decades. The summer of 2015 was one of the most extreme summers ever recorded and the second warmest summer Austria-wide since 1767. According to the Austrian Assessment Report Climate Change, a further increase in the frequency of hot days and heat waves must be expected (APCC 2014). A heat wave is defined as at least three successive days with high heat stress.

A number of federal states have already established heat protection plans or heat warning services to protect the general public from heat stress.

For example, the federal state of Styria presented a heat protection plan in 2011 and updated it in 2015. The action plan of the federal state of Styria primarily serves to increase awareness of the health-related problems caused by prolonged heat waves. Practical tips and a guide for authorities and institutions should help to prevent heat-induced illnesses and fatalities.

The cornerstones of the heat protection plan include:

- The identification of at-risk groups and individuals,
- Ensuring care and support by relatives or volunteers,
- Providing timely information to important institutions (nursing homes, hospitals, schools and kindergartens, mobile services, emergency services, etc.),
- Leaflets for individual target groups available for download
- Providing detailed information on appropriate behavior and preventive measures,
- Raising awareness of and making specialized expertise and knowledge about heat-related problems and illnesses available to concerned parties
- Informational materials for the mass media.

The heat protection plan for Carinthia was prepared following the one for Styria. A preventive heat warning service has existed since the year 2010 which, in cooperation with the ZAMG, makes relevant institutions and the population of Vienna aware of looming heat stress of at least three successive days. Vienna published a heat advice booklet in 2015. Preparation of a heat protection plan is planned. Since 2016, a heat warning service has also existed in Lower Austria, which sends out a warning, including informational materials, to a previously prepared mailing list in the event of anticipated extreme heat stress. The institutions are required to decide for themselves which measures are necessary. The warning is cancelled after the end of a heat wave.

Further information:
http://www.gesundheit.steiermark.at/cms/beitrag/11685019/72561200/
https://www.ktn.gv.at/Themen-AZ/Details?thema=32&subthema=39&detail=472
https://www.wien.gv.at/gesundheit/sandirektion/hitzebericht.html
https://klimaschlau.wien.gv.at/site/wiener-hitzeratgeber/

TRANSPORTATION INFRASTRUCTURE

GREEN STREETCAR TRACKS

Green streetcar tracks are a special feature of the streetscape in more than 70 European cities. Green streetcar tracks contribute to the rehabilitation of public space as well as the retention of rainwater and improvements in the microclimate. Whereas asphalt roads heat up in the summer and give off the heat at night, plants give off moisture and cool the air in the city. In addition, plants bind dust and toxic substances from the air. For this reason, green tracks are often demanded as a sustainability measure for new streetcar construction projects. Green tracks can be built with high or low vegetation.

If the design involves a layer of impermeable material, the plants are not connected to the soil below. The soil is not unsealed; in this case, the lawn is above all a decorative element. However, the advantage of this design is that various surfaces – asphalt, cobblestones, lawn – can alternate frequently and be used as needed between the tracks This design is in use in Linz, for example, and has become the standard for new construction projects.

Systems that are open at the bottom enable water to seep underground. A thicker layer of soil contributes to longer water retention. Parallel longitudinal sleepers support the tracks, and the water can seep underground between them. This design requires manual maintenance.

In Linz, green tracks are used extensively and have practically become the standard for new construction projects. The substrate consists of a layer of gravel for drainage with a layer of humus on top. The tracks are mowed twice a year, and are not irrigated. When snowplows cross the tracks, they avoid damage by keeping 4 cm distance between the plow and the upper edge of the tracks. One reason for the extensive use of green tracks in Linz is the desire for a visually appealing cityscape. This is why the public transportation service plans green lines from the outset.

In Vienna, a green track with plants exists, for example, on a section of line in Lainz.

Further information:
http://www.tramway.at/fachartikel/2013-06-04-RS-Rasengleise.pdf
http://publik.tuwien.ac.at/files/PubDat_207646.pdf

SPATIAL PLANNING

SPATIAL PLANNING IN THE ALPINE REGION (IMPLEMENTATION IN MODEL REGIONS)

The effects of climate change (such as increasing water scarcity, heat waves, and especially the increasing risk of natural hazards) substantially influence spatial planning, land use, and life-sustaining ecosystem services. Questions such as “What role can spatial planning play in adaptation to climate change?” and “How ‘climate-change fit’ are our spatial planning systems and processes?” were the focus of a project funded by the Alpine Region Program (ETZ 2007–2013), CLISP (Climate Change Adaptation by Spatial Planning in the Alpine Space).

In the course of this project, detailed investigations were carried out in a total of ten model regions in the Alpine space. In Austria, this included the federal state of Upper Austria as well as the NUTS-3 regions of Liezen (Styria) and Pinzgau-Pongau (Salzburg). For each model region, a first step analyzed the vulnerabilities of selected sectors (the focus in Pinzgau-Pongau and Liezen was primarily on tourism and residential development; in Upper Austria, on tourism, agriculture, forestry, water management, and energy, among others). In a second step, selected spatial planning instruments were evaluated, their strengths and weaknesses evaluated, and concrete recommendations developed. Another work package in the model regions involved the initiation of a stakeholder process on the issues of risk management and risk control in the region, including the organization of several workshops and interviews.

One result was the development of a guide to help review the suitability of spatial planning strategies with respect to the challenges of climate change. The guide includes practical step-by-step instructions for evaluating the climate-change fitness of spatial planning, and recommends useful tools and resources for conducting the evaluation. Evaluation criteria and checklist with a practical orientation support the review of the extent to which spatial plans and concepts take questions relating to climate adaptation into account. Important elements of the guide were tested and successfully implemented in practice in the model regions.

Further information:
http://www.klimawandelanpassung.at/ms/klimawandelanpassung/de/anpassungandenklimawandel/kwa_tools/kwa_leitfaden/kwa_clisp1/

SPATIAL PLANNING, PROTECTION FROM NATURAL HAZARDS

PROGRAM FOR FLOOD-SAFE DEVELOPMENT OF RESIDENTIAL AREAS IN STYRIA

Enacted in 2005, the Styrian regional planning program for the flood-safe development of residential areas includes mandatory regulations with clearly defined legal consequences for zoning and construction in flood plains and hazardous areas. Flood discharge zones (HQ100), red hazard zones, and blue reserved areas (e.g., areas particularly suited for flood protection measures) according to the risk zone maps laid out in forestry regulations, as well as a strip of shoreline along naturally flowing waters of at least 10 meters in width, are to be kept free from building activities and should not be rezoned to allow construction. Exceptions to the zoning and construction ban within the HQ100 area are clearly defined. In areas of potential hazard, where neither the HQ100 boundaries nor the hazard zones apply, either empirical high-water inundation lines from the past should be used for zoning decisions, or the opinions of the Torrent and Avalanche Control authorities should be sought.

For more information:
http://www.landesentwicklung.steiermark.at/cms/beitrag/12636184/141975683/

URBAN GREEN AND OPEN SPACES, SPATIAL PLANNING, ECOSYSTEMS/BIODIVERSITY

CLIMATE REGULATION IN CITIES: "GREEN NETWORK GRAZ" AND "REVITALIZE GRAZ'S COURTYARDS"

Building density, soil sealing, and the emission of air pollutants and waste heat can lead to higher than average temperatures and pollution levels, lower wind speeds, and reduced humidity in cities. This effect, referred to as the urban climate effect, will be further reinforced by climate change. Green and open spaces serve an important function in climate regulation, and can counteract the temperature rise in cities. Accordingly, two projects have been implemented by the city of Graz in an effort to improve the urban climate and the quality of life of the city's residents.

"Green Network Graz"

The aim of this project is to link existing green and open spaces by means of connecting paths and green elements. In addition to the ecological and urban climate impacts, a recreational function is also a focus of the project. Attractive footpaths and bicycle paths will offer alternative transportation opportunities. Recreational areas will begin in effect at residents' front doors or will be easy to access by means of "green paths."

The Green Network is not only a strategy paper on urban development; it also clearly defines certain needs for action in urban development. It serves as the basis for urban planning, zoning, and recommendations on applications for building permits.

For more information:
http://www.stadtland.at/htm/projekte/grNetzGraz.htm
http://www.eltis.org/discover/case-studies/green-network-graz-austria

"Revitalizing Graz's Courtyards"

In addition to parks and urban forests, cities also feature courtyards that can be used as living and activity space. As semi-public and private open spaces, they can contribute significantly to the quality of life in densely-built neighborhoods. With appropriate planting, they improve the microclimate and thereby improve the quality of life in adjacent buildings. Especially in areas with high population density and few parks open to the public, courtyards are of particular importance. In the framework of a project funded by the European Union, the sociological, planning, and legal aspects of the conservation and revitalization of Graz's courtyards were investigated and implemented in pilot projects.

Further information:
http://www.verantwortung-zeigen.at/index.php?id=1117
http://www.gat.st/news/grazer-innenhoefe-beleben-0

COMMUNICATION AND EDUCATION

13 COMMUNICATION, EDUCATION, AND SUPPORT

Especially when it comes to issues that affect society as a whole (such as adaptation to climate change) and are marked by uncertainty and a high degree of risk, intensive **social dialogue** is needed. This is of central importance, as measures necessary for adaptation relate to various decision-making levels and in addition will impact on the immediate areas of everyday life of many people. The need for adaptation applies equally to the general public and companies, interest groups, and government administrators (local to federal). Communication and education are key in order to support affected persons, enable robust decisions concerning the future, and enhance the successful implementation of the climate change adaptation strategy at hand.

For adaptation strategies and measures to be successfully implemented, they must have the support of **all of society** to the greatest extent possible.

It is of key importance to convey information on the consequences of climate change as well as adaptation measures in a manner specific to the target group and of practical relevance in order to enhance public awareness of the problem and to create capacities for adaptation. This makes it possible to include the "best" available knowledge in decision-making and to promote implementation.

Some principles should be kept in mind in order to communicate the complex and diverse topic effectively. There are no simple and transferable one-size-fits-all solutions for the various target groups – each of which is heterogeneous. However, the following suggestions can support the development of tailored communications formats (Prutsch et al., 2014b). Careful planning and good preparation are necessary for a practical approach that motivates people to take action:

1. Explain concepts and terms comprehensibly
2. Communicate uncertainties and use sound scientific data
3. "Translate" what climate change and adaptation mean in everyday life
4. Take up the target group's local knowledge
5. Propose concrete solutions for adaptation
6. Communicate successful examples of adaptation
7. Communicate in a manner oriented to the target group
8. Obtain and maintain the target group's attention
9. Use trusted messengers and opinion leaders accepted by the target group
10. Address emotions
11. Use images, visualizations, and virtual reality
12. Create links to existing values and norms
13. Use existing networks and suitable communications formats and channels
14. Evaluate the impact of the communication

COMMUNICATION ON ADAPTATION TO CLIMATE CHANGE IN AUSTRIA

In recent years, several Austrian web platforms have been launched with the intent of transferring information from politics and research to the general public. Worth mentioning is the website of the BMNT ***https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie*** which reports on the ongoing political process of adaptation to climate change at the national level. As part of the participatory process accompanying the development of the Austrian Adaptation Strategy, a website was set up to present Austria-specific information on climate change and adaptation (***www.klimawandelanpassung.at***, conceptualized and implemented by the Environment Agency Austria with financing from the Climate and Energy Fund). In November 2010, the climate research department of the Central Institute for Meteorology and Geodynamics (ZAMG) opened an information portal on the subject of climate change (***http://www.zamg.ac.at/cms/de/klima/informations portal-klimawandel***). This platform seeks to present sound scientific information on climate change in an understandable form.

In addition to the information available on the Internet, since January 2011 a newsletter on adaptation to climate change,[66] which provides practical information for decision-makers, interest groups, etc. has existed (designed and implemented by the Environment Agency Austria with financing from the Climate and Energy Fund).

Another format for communicating about adaptation to climate change is the brochure "Climate Change – What To Do?"[67] (BMNT 2014c (formerly BMLFUW 2014c)), which was prepared by the BMNT (formerly BMLFUW) in cooperation with the Environment Agency Austria. This brochure for the general public gives tips and advice for integrating climate adaptation approaches into personal surroundings.

In addition to the brochure, two videos that discuss climate change and adaptation in moving images were produced with financing from the Climate and Energy Fund. The first video[68] discusses the consequences of climate change; the second focuses on possible adaptation measures in a humorous way[69] (both videos in cooperation with the Environment Agency Austria and the BMNT (formerly BMLFUW). Another video presents the topic for the target group of municipalities (prepared in cooperation with the Climate Alliance, financed by and with content-related input from the BMNT (formerly BMLFUW)[70].

Access to well founded and targeted information through the Internet significantly contributes to the raising of awareness. In addition to the information provided on the Internet, appropriate topics should be integrated into education at school. Developing appropriate teaching materials is therefore an additional essential element. Integrating climate mitigation topics in schools can draw on many good experiences, e.g., the federal states' Climate Coloring Book or the Climate-Fit Initiative of the Environmental Education Center Styria. The initiative "Climate Schools" in the framework of the Energy and Climate Model Regions (financed by the Climate and Energy Fund) now includes more than 180 schools across Austria. Numerous climate mitigation projects with young people are being implemented in this way. The Climate Alliance Austria is now conducting the new project "Great Accomplishment for the Climate" on behalf of the BMNT (formerly BMLFUW). It motivates students in schools to deal more deeply with the topics of climate mitigation and climate adaptation[71]. The examples can be models for developing materials and teaching concepts on climate adaptation.

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[66] *Link: http://www.klimawandelanpassung.at/ms/klimawandelanpassung/de/newsletterregistrierung/kwa_archiv/*
[67] *Link: https://www.bmnt.gv.at/umwelt/klimaschutz/klimapolitik_national/anpassungsstrategie/broschuere.html*
[68] *Link: https://www.youtube.com/watch?feature=player_embedded&v=UZRSm-vz_as*
[69] *Link: https://www.youtube.com/watch?v=cvJ2D_kcv08&feature=player_embedded*
[70] *Link: http://www.klimabuendnis.at/klimawandelanpassung*
[71] *Link: http://www.klimabuendnis.at/bildung-9-13-schulstufe/reife_leistung_workshop*

Another concrete step in this direction is the research project "Triple AAA – Action for Adaptation Awareness[72]" (supported by the FFG under the direction of the University of Innsbruck).

The goal of the project "k.i.d.Z.21-Austria" is to enhance the perception and awareness of young people with respect to climate change and to strengthen their capacity to act (supported by the Climate and Energy Fund and under the direction of the University of Innsbruck).

However, **information** is not always sufficient to move people to **take action** (see IPCC 2007, Grothmann et al., 2009, Wirth et al., 2014). Consequently, in a further phase, methods and approaches must be developed to increase people's motivation and ability to take action. Possible options in this regard include advertising campaigns, personal interviews or advice/guidance, and articles in professional journals. Although examples and experience in this field are still scarce in Europe (e.g., dialogues on the German Adaptation Strategy[73] and the educational program of UKCIP[74]), communication and education are regarded as essential elements of successful adaptation in all current adaptation strategies in European countries (Swart et al., 2009).

The importance of communication, education and support for raising awareness and increasing the ability to act of all parties concerned is also recognized in Austria. For example, activities to promote communication specific to target groups have been increased in recent years.

A new set of guidelines for successful communication about climate change and adaptation (Prutsch et al., 2014b)[75] was prepared in the context of the research project "From Change to Action: Effective Communication on Climate Change and Adaptation" (abbreviated: CcTalK!, supported by the Climate and Energy Fund and under the direction of the Environment Agency Austria). It is directed toward all those persons required to communicate about adaptation to climate change, e.g., persons in public administration, decision-makers, NGOs, advocacy groups.

An online platform[76] for dialogue with young people about the climate and climate-aware behavior was established in the framework of the project AUTreach (AUTreach stands for "Engaging the Young in Climate Change," supported by the Climate and Energy Fund and under the direction of BOKU). It provides an overview of climate communications formats for young people (e.g., videos, games, apps, etc.) and also a practical guide for successfully designing youth-specific climate formats.

The goal of the manual entitled "Methods and Tools for Adaptation to Climate Change" (Prutsch et al., 2014a)[77] is to support the political community and public administration in cities and the federal states as well as persons involved in regional management during the process of adaptation to climate change. In concrete terms, it is a guide to dealing strategically with the consequences of climate change. The manual's special feature is that it was prepared in collaboration with potential users, such as those from the federal state governments, NGOs, and regional management.

In the context of the project KlimaNetz a set of guidelines "Healthy in climate change? How to increase defenses in your municipality!" was developed (Feiner et al., 2012)[78]. These guidelines focus on human and

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[72] Link: https://www.uibk.ac.at/geographie/educomsd/projects/tripple_aaa/
[73] Link: http://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/werkzeuge-der-anpassung/projektkatalog/stakeholder-dialoge-chancen-risiken-des
[74] Link: http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=205&Itemid=320
[75] Link: http://klimawandelanpassung.at/index.php?id=26275
[76] Link: http://autreach.boku.ac.at/infos/
[77] Link: http://klimawandelanpassung.at/index.php?id=25504
[78] Link: http://www.klimanetz.at/

social capital and present the process for developing adaptation measures in six steps. A particular focus in on the municipalities of Virgen and Klosterneuburg as examples.

The topic of adaptation to climate change is also integrated in the "Guide Climate Mitigation in Municipalities"[79], commissioned by the BMNT (formerly BMLFUW) and prepared by the Climate Alliance Austria.

In addition, the project CC-ACT (under the direction of the Environment Agency Austria) also targets municipalities. A supporting online tool is to be prepared for them. However, since municipalities have only limited resources for dealing with new topics, disseminators (e.g., leaders, LA 21, Climate and Energy Model Regions, Climate Alliance, regional management actors) are provided with training for preparing measures to deal with the consequences of climate change and getting them off the ground in collaboration with the municipalities. The online tool and the training concept are available at ***www.ccact.anpassung.at***.

Sector specific support was created in the framework of the project adapt2to4 for transportation infrastructure with the "Adaptation Roadmap for Austrian Road Infrastructure" [80] (König et al., 2014). In addition, a guide titled "Strategic Support for Project Planning to Take Account of the Consequences of Climate Change" (Dallhammer et al., 2015) was prepared in the project ENVISAGE-CC for those submitting projects for approval in EIA procedures.[81] In the context of the project CLISP financed by Alpine-Space, guidelines for dealing with climate change were developed which are available online under the title "Evaluating the Climate Change-fitness of Spatial Planning. Guidelines for Planners"[82] (Pütz et al., 2011).

The CCCA (see also Chapter 11: Research Environment and Research Needs) is also a contact point for the media and the public, and supports networking projects as well as a sustainable climate dialogue in order to strengthen exchange between research and practice. Numerous other institutions are grappling with the topic and providing information and advice concerning all aspects of climate change. The CCCA is currently working on a competence map of climate impact research in Austria to present an overview of the various products and services.[83]

[79] *Link: http://www.klimabuendnis.at/aktuelles/leitfaden*
[80] *Link: http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0495.pdf*
[81] *Link: http://www.klimawandelanpassung.at/fileadmin/inhalte/kwa/pdfs/Envisage_StrategischeUnterstuetzung_BOKU-Met_Report_24.pdf*
[82] *Link:http://www.klimawandelanpassung.at/ms/klimawandelanpassung/de/anpassungandenklimawandel/kwa_tools/kwa_leitfaden/kwa_clisp1/*
[83] *Link: https://www.ccca.ac.at/de/ccca-aktivitaeten/kompetenzlandkarte/*

GLOBAL CONTEXT

14 GLOBAL CONTEXT

Consequences of climate change will affect people, the environment and economic and social development in various regions of the world even more severely than in Austria and Europe.

These adverse effects will primarily affect developing countries, which often have unstable and endangered natural habitats and are mainly dependent on natural resources and the associated economic sectors (such as agriculture, forestry, and fishing). Due to inadequate social and economic development, these countries have only limited ability to adapt to climate change.

Global climate change increases the risk that global poverty and social conflict will intensify. Counteracting the negative consequences of climate change represents an important common goal of both industrialized and developing countries.

The SDGs were established as a global, binding basis for shaping global development sustainably with respect to social, ecological, and economic aspects. The primary concern of the SDGs is to end extreme poverty "in all its forms everywhere." At present, about a billion people are affected by it, and must survive on less than €1.11 per day.

Support of developing countries in climate adaptation (increasing adaptive capacity, technology transfer, financing) as well as the necessity to increase support for poorer countries in minimizing and avoiding loss and damage caused by climate change, for example by establishing insurance and early warning systems or by combating slow-onset events, is an important part of the Paris Agreement (UNFCCC 2015).

International climate finance is an important instrument for supporting developing countries. Austria has committed to the goal of the developed countries to make $US100 billion available annually through 2020 to support climate-relevant measures in the areas of mitigation and adaptation in developing and threshold countries. In collaboration with the Federal Ministry of Finance, BMF and the BMEIA, the BMNT (formerly BMLFUW) prepared the strategic guide "Austria's Strategy for International Climate Finance for the Years 2013–2020" (BMNT, formerly BMLFUW 2013), which was presented to the Council of Ministers in June 2013. The primary goal of this strategy is to create a framework for Austria to fulfill future legal commitments to international climate finance as effectively, efficiently, and transparently as possible, and in coherence with national measures. The Working Group International Climate Finance (AGIK) was established in accordance with strategy. It is chaired by the BMNT (formerly BMLFUW); its members include representatives of the BMF, the BMEIA, the BMBWF (formerly BMWFW), the BMVIT, the federal states, the social partners, and civil society. The goal of AGIK is to optimize national coordination of climate finance and to reflect on developments at the European and international levels. In accordance with the strategy, a report is presented annually on Austria's international climate finance.

The Three-Year Program of Austrian Development Policy 2016–2018 (BMEIA 2015) mentions climate change and adaptation as an important topic in the area of environment and climate mitigation. Measures to reduce greenhouse gas emissions as well as adaptation measures are to be promoted in projects and programs.

This issue of adaptation is playing an increasing role in development, security and environmental cooperation, as well as in migration policy. For this reason, the Austrian Adaptation Strategy also addresses the international aspects of climate change.

SECURING LIVING CONDITIONS

In many regions of the world, climate change will significantly affect living conditions, leading to, for example, a severe threat to the food supply due to water shortages. Other effects of climate change will include heat-related deaths, the spread of vector-borne diseases such as malaria, and changes in access to natural resources. The possible increase of extreme events, such as the frequency of droughts and the intensity of tropical cyclones, or also continuous changes such as sea level rise, increase the likelihood of migratory movements. This is true especially when these events impact upon people (vulnerable groups) who have few opportunities to adapt. Climate change very often contributes indirectly to migratory movements (EK 2013b). Migration due to climate change will occur mostly in developing countries. Increasing attention has been paid to the link between climate change and migration in recent years. Determining the linkages between climate change and migration unequivocally proves to be extremely complex. Beside economic deprivation, lack of prospects in life, political or religious persecution, and wars, climate change is an additional factor making people leave their homes. Environmental changes and extreme weather events often contribute indirectly to crises and conflicts or also to difficult social and economic situations and thus also to migratory movements.

The number of environmental refugees, estimated at 25 million for the year 1999, will rise to 150–200 million by 2050. Sea-level increases alone are expected to cause ten million additional environmental refugees over the next ten years (EC 2007c). Sea level rise of between half a meter and one meter by 2100, as prognosticated by the IPCC – individual studies arrive at much higher values – is an existential threat to hundreds of millions of people in coastal areas and on islands (IPCC 2014a). For example, affected areas include half of Bangladesh as well as the Pacific islands of Kiribati and Tuvalu. One meter of sea level rise would mean permanent loss of land.

GLOBALLY SUSTAINABLE ECONOMY

Both industrialized and developing countries face the challenge of developing social and ecologically sustainable economies (BMNT, formerly BMLFUW 2002). In addition, measures addressing adaptation to climate change must be implemented. For developing countries, these two tasks are aggravated due to the lack of financial resources and the appropriate know-how.

In addition, unsustainable production and consumption patterns in industrialized countries have negative consequences for developing countries and lead to increased pressure on natural resources. All countries thus bear responsibility for the sustainable development of our planet (BMEIA 2009). Of particular importance are the unintended indirect effects of climate change mitigation or adaptation measures in wealthier countries due to market forces: land grabs, animal feed imports, and demand for biofuels all entail additional conflict potential (Breitwieser 2011).

CONSERVING AND PROTECTING THE ENVIRONMENT

On a global scale, the state of the environment and natural resources has steadily deteriorated over recent decades in many regions; climate change exacerbates this situation. The integration of environmental protection measures and the conservation of natural resources thus number among the most important tasks of development cooperation, as is evident in Austrian legislation.

The consequences of climate change and the need for adaptation especially intensify the problems of poor populations in rural areas and coastal communities already exposed to difficult agro-ecological conditions, environmental risks, and greater climate variability. Insecure land rights, lack of access to environmental information, and the impact of natural disasters threaten their existence to a large extent. Legislation in such

regions is often poorly implemented, and the capacities of ministries, regions, municipalities, and institutions are weak (BMEIA 2009).

RECOMMENDATIONS

- Taking into account all climate factors (climate change mitigation and adaptation), third countries and regions should be directly supported in measures for sustainable development.
- Development cooperation should be strengthened with the objective of improving environmental and living conditions, health, nutrition, etc., locally.
- Participatory initiatives that help local societies to improve their resilience to climatic risks should be fostered.
- Studies on the contextual origins of migration to Austria and Europe should be initiated, so that migration flows can be reduced or controlled.
- In the Austrian climate change adaptation policy, external consequences must be taken into account in order to prevent the outsourcing of negative or counterproductive effects.
- Sectoral know-how transfer should flow in both directions: mutual learning.
- For activities with an international dimension (such as importing products), aspects of climate change adaptation must be increasingly considered.

RECOMMENDATIONS FOR ACTION

15 RECOMMENDATIONS FOR ACTION

15.1 OVERALL PRINCIPLES

To support the planning and implementation of adaptation measures,

LEGAL ASPECTS

- Supplementing and extending existing administrative framework conditions (regulations, funding guidelines, etc.) with aspects relevant to adaptation to climate change.

SOCIAL ASPECTS OF CLIMATE CHANGE

- Balanced consideration of the consequences of climate change on both the ecosystem and socio-economic systems in adaptation measures and minimization of the risks to democracy, health, security, and social justice in society. Employment and distributive justice, among other things, are to be given special attention. Social integration and cohesion must be supported, fundamental rights and cultural diversity respected, equality of men and women guaranteed, and discrimination of any kind prohibited.

INFORMATION AND EDUCATION

- Promotion of the exchange of knowledge and experiences between politics, administrations, science, and concerned actors.
- Increase in the exchange of knowledge and experiences with regard to modern, climate change-resistant systems and practices through consulting, training, and information. Access to information for concerned parties should thus be facilitated and effective dissemination and use of knowledge ensured. Corresponding adjustments in research, consulting, and educational facilities are to be carried out.
- Encouragement of the use, networking, and extension of existing instruments and platforms to gain a common understanding of the relevant climatic changes. Such dialogue forums can contribute to better coordination among the actors concerned, interest groups, administrations, and science, as well as to a more efficient and rapid implementation of adaptation measures.
- Improvement of underlying data (knowledge of the system and effects of climate change) and the provision and expansion of information toward a climate information system for actors and decision-makers as a basis for decisions.
- Continued inclusion and improvement of appropriate topics as educational priorities in all school types and at all levels of education, development of suitable teaching materials, and training and further education of disseminators in schools and other educational institutions.

INDIVIDUAL RESPONSIBILITY

- Reinforcement of individual responsibility in the population through awareness raising and information,

EXTERNAL CONDITIONS

- Consideration of varying global conditions such as long-term energy price increases,

OVERALL VIEW

- Minimization of conflicts of use through a holistic approach: Forward-looking balancing in the planning of measures in terms of their implications for nature conservation, climate change mitigation, and for other areas of action is desirable (e.g., river basin management). In doing this, complex interactions should be described and measures that are expected to produce synergy effects should be favored.
- Development of a customized risk-management system in order to improve the identification, prevention, and mitigation of risks as well as the management of damages incurred. Within the framework of an iterative risk-management process that involves adaptation and emission reduction, the damages arising from climate change, positive side effects, sustainability, equity, and attitudes toward risks should all be taken into account (IPCC 2008).

FOR MULTIPLE HIGHLY RELEVANT AREAS OF ACTION – PROTECTION OF THE RESOURCE SOIL/LAND

- Reduction of land use and limitation of further sealing of soil surfaces: Increasing land use and constantly increasing sealing of soil surfaces in Austria contradict sustainable management of the limited resource land, and must also be judged negatively from the perspective of adaptation. Beside direct land use, the increasing sealing of land surfaces is also bringing about restriction of the areas necessary for water retention. This heightens the danger of (especially local) flooding. Impervious surfaces additionally promote the formation of heat islands.

Due to partially long lead times for the measures to become effective, the consideration of different time scales for adaptation measures is necessary.

15.2 TABULAR COMPILATION OF RECOMMENDATIONS FOR ACTION

In order to support a coordinated and harmonized approach at the national level, the Austrian Adaptation Strategy provides recommendations in 14 areas of action (see the following tabular summary). The Action Plan describes the recommendations in detail. These recommendations are based on the most recent knowledge.

Agriculture

NO.	TITLE	OBJECTIVE	ACTORS
3.1.4.1	Sustainable soil composition and protection of soil fertility, structure, and stability	Safeguarding natural soil functions; build-up and long-term stabilization of optimal humus content in soils; conservation of aggregate stability, promotion of soil life, and safeguarding of adequate water intake and water retaining capacity; Prevention of damage (especially soil compaction and erosion) and conservation of soil productivity through sustainable and site-adapted land use and a soil-conserving tillage method.	Federal and state governments, interest groups (advice, information), academic and non-academic research institutions, farmers, Bio-Austria, b^4 Corporate Soil Competence (Austrian Agency for Health and Food Safety (AGES), BFW, Environment Agency Austria, BAW), agricultural schools, rural training institutes, apprenticeship and specialized training units
3.1.4.2	Enhanced establishment and promotion of water-saving irrigation systems and improvements in irrigation planning	Efficiency improvements in irrigation and water use through the introduction of modern technological developments permitting the optimization of irrigation in terms of timing and amount of water.	Federal and state governments, municipalities, interest groups, academic and non-academic research institutions, farmers, industry
3.1.4.3	Breeding and targeted use of water-saving, heat-tolerant plants (species/varieties) for regionally adapted management	Use of species and new varieties of plants that can tolerate changing climatic conditions. Especially heat-tolerant and water-saving crops and grasses and species with low susceptibility to pests should be favored.	Federal government (research funding), building and use of national and European networks, plant breeders, academic and non-academic research institutions, AGES, LFZ Raumberg-Gumpenstein, federal state experimental institutes, agricultural training institutes, farmers (implementation – changes in varieties)
3.1.4.4	Adjustment of fertilizer management to seasonal weather patterns	Need-based and site-specific plant nutrition as a contribution to plant quality, plant health, and yield security.	Federal government, academic and non-academic research institutions, interest groups, AGES, HBLFA Raumberg-Gumpenstein, Committee for Soil Fertility and Soil Conservation, farmers
3.1.4.5	Provision of scientific advice on potential new agricultural diseases and pests	Improvement in the state of knowledge regarding emerging diseases, to enable a quick and efficient response.	Federal and state governments, interest groups, AGES, academic and non-academic research institutions, farmers, industry (producers of plant protection products)
3.1.4.6	Environmentally sound and sustainable use of plant protection products (pesticides)	Optimization of plant protection measures through changes in the timing and method of application and/or spectrum of pesticides, and establishment of systematic monitoring, with the goal of fostering environmentally friendly and sustainable agricultural practices.	Federal and state governments, interest groups, AGES, academic and non-academic research institutions, Committee for Soil Fertility and Soil Conservation, agricultural trade, farmers, industry
3.1.4.7	Review of site suitability based on changing climatic conditions and development of recommendations for the selection of a site-adapted crop	Selection of suitable crops for the respective site conditions.	Federal and state governments, water management authorities, AGES, HBLFA Raumberg-Gumpenstein, interest groups, natural hazard insurers, academic and non-academic research institutions
3.1.4.8	Risk minimization and the development and extension of risk-sharing instruments	Reduction of weather-related production risks and the development and extension of additional insurance models.	Federal and state governments, water management authorities, AGES, HBLFA Raumberg-Gumpenstein, interest groups, natural hazard insurers, academic and non-academic research institutions
3.1.4.9	Integrated landscaping for soil protection and the improvement of agricultural ecology, including the conservation and maintenance of landscape features	Improvement of the agro-ecological situation and conservation of natural biodiversity by reducing wind-exposed areas/wind speed and soil erosion, and improving water retention.	Federal and state governments, interest groups (advice, information), farmers, nature conservation associations, tourism associations

NO.	TITLE	OBJECTIVE	ACTORS
3.1.4.10	Preservation of existing pastures and revitalization of abandoned pastures	Maintenance of the protective and recovery function, of feed production and the targeted revitalization and rehabilitation of abandoned pastures under consideration of nature conservation aspects.	Federal and state governments (funding of pasture management), interest groups, Almwirtschaft Österreich (Austrian Pasture Management), potentially tourism associations, farmers
3.1.4.11	Optimization of greenhouse cultivation in terms of energy, water, and cooling supply strategies	Efficiency improvements in energy and water consumption in greenhouse and plastic-sheet cultivation, in particular with regard to increasing heat stress in the summer and potentially more frequent natural disasters.	Federal and state governments, academic and non-academic research institutions, interest groups, Austrian Vegetable Growers Association, municipalities, producer associations, industry, farm managers
3.1.4.12	Promotion of animal welfare and animal health under changing climatic conditions	Expansion of knowledge and evaluation of the effects of climate change on animal health, and the development of preventative measures and, if need be, necessary veterinary measures as a basis for decision-making of authorities and farmers.	Federal and state governments, research, veterinary authorities, AGES, interest groups, HBLFA Raumberg-Gumpenstein, farmers, Austrian Animal Health Service (TGD), and animal health services of the federal states
3.1.4.13	Consideration of future requirements for the cooling of stables due to increasing thermal stress	Reduction of thermal stress on farm animals, appropriate and stress-free livestock rearing, and reduction of harmful pollutants in stables.	Federal and state governments, interest groups (funding for stable adjustments), farmers, academic and non-academic research institutions (in particular, HBLFA Raumberg-Gumpenstein, BOKU, VMU), municipalities
3.1.4.14	Optimization of adaptation and combat strategies for new diseases and pests	Further optimization and, if needed, extension of existing warning systems, improvement of information and data transfer (e.g., between meteorological units, science, and farmers), and nationwide monitoring of potentially harmful organisms; Designation of particularly endangered areas and the development and adjustment of decision-making aids for measures.	Federal and state governments, academic and non-academic research institutions, interest groups, AGES, HBLFA Raumberg-Gumpenstein, insurers, farmers

Forestry

NO.	TITLE	OBJECTIVE	ACTORS
3.2.4.1	Modification in the selection of tree species and provenance, including targeted promotion of diversity through appropriate silvicultural management and rejuvenation of overaged stock	Increase of stability and reduction of vulnerability of forest ecosystems to pests and diseases; Increase in diversity at all levels (genetic, species-specific, structural, diversity of habitat, etc.) adapted to the respective site-specific conditions; Increase of stability and reduction of susceptibility to disturbances, e.g., through the timely introduction of rejuvenation measures.	Forest owners, interest groups, academic and non-academic research institutions, federal and state governments, EU (responsibility lies with all those listed)
3.2.4.2	Soil-friendly management	Preservation of the physical and ecological functions of the soil, in particular in terms of water retention and nutrient supply.	Forest owners, logging companies, public agencies, interest groups, research institutions, federal and state governments, EU, water management authorities, forestry workers, municipalities, leaseholders
3.2.4.3	Reduction of damage caused by wildlife	Reduced damage caused by game animals in order to safeguard rejuvenation and stock stability.	Hunters, forest owners, federal states (laws pertaining to hunting and spatial planning), federal government, interest groups of all affected land use sectors
3.2.4.4	Development of an advisory service for forest owners as concerns adaptation of forests to climate change	Improvements in consulting, training, and further education of forest owners taking into account latest research results.	Federal government, forest authorities, Chamber of Agriculture and other advisory institutions, academic and non-academic research institutions
3.2.4.5	Adjustment and improvement of crisis and calamity management	Mitigation of damage from harmful events such as windfalls or bark beetle calamities.	Federal and state governments, forest authorities, other authorities (e.g., water authorities), interest groups, forest owners, forestry federations (forest management collaborations (WWGs), forest associations), transport industry, wood and paper industries, EU
3.2.4.6	Establishment of preventative measures in view of the potential increase in forest fires	Development of preventive measures and systems for elaboration or revision of emergency plans to combat forest fires.	Federal and state governments, municipalities, interest groups, forest owners, forest management collaborations (WWGs), forest associations, academic and non-academic research institutions, EU
3.2.4.7	Forest pollution control – Integrated forest inventory and monitoring of immissions	Nationwide inventory of Austrian forests by combining the forest inventory with remote sensing methods (laser scanning, multi-spectral satellite imagery) for enhanced system knowledge, and the establishment of an immissions-monitoring system.	EU, federal and state governments, Federal Research and Training Center for Forests, Natural Hazards, and Landscape (BFW), Environment Agency Austria (EAA)
3.2.4.8	Development of modified and innovative techniques for wood processing taking into account potential changes in wood quality and tree species	Development of efficient, innovative techniques for wood processing in order to increase the value added in the wood use chain.	Academic and non-academic research institutions, wood-working and -processing industry, interest groups, Cooperation Platform Forestry-Wood-Paper (FHP), federal government, EU (Forest Technology Platform)

Water Resources and Water Management

NO.	TITLE	OBJECTIVE	ACTORS
3.3.4.1	Analysis of existing data and promoting collection of further data on water resources	Reduction of knowledge deficits regarding the effects of climate change on water resources and their use.	Federal and state governments, districts, municipalities, academic and non-academic research institutions, water suppliers (water consumption/use and demand)
3.3.4.2	Improving coordination/information concerning water consumption and water demand	Data collection, as complete as possible, on actual water consumption by various user groups as a basis for managing and safeguarding the water supply.	Federal and state governments, interest groups, regions, municipalities
3.3.4.3	Guarantee of future water supply	Increasing qualitative and quantitative security of the water supply in areas threatened by water scarcity by means of planning and technological measures.	EU, state governments, municipalities, water suppliers
3.3.4.4	Responsible use of water resources	Protection of water resources in areas threatened by water shortages by encouraging increased use of efficient water-saving technologies and targeted awareness raising.	State governments, municipalities, water suppliers, water users, academic and non-academic research institutions
3.3.4.5	Increased consideration of low water in the management of water resources	Ensuring the achievement of water management objectives in periods of low water.	Federal and state governments, municipalities, academic and non-academic research institutions
3.3.4.6	Achieving and ensuring the good ecological and chemical status of water bodies (including groundwater)	Achieving and ensuring the good ecological and chemical status of water bodies (including groundwater) or the good ecological potential.	Federal and state governments, municipalities, EU, and other actors such as power suppliers, water suppliers, industry, flood associations, AGES, etc.
3.3.4.7	Proactive water management planning for groundwater resources	Reducing the risk of the consequences of climate change affecting groundwater bodies and groundwater-dependent ecosystems, in order to contribute to the preservation of a good quantitative, chemical, and hygienic status of groundwater bodies.	Federal and state governments, municipalities, EU, nature conservation organizations
3.3.4.8	Adaptive flood risk management with robust measures	Prevention of an increase in peak flows and damage.	EU, federal and state governments, municipalities, academic and non-academic research institutions
3.3.4.9	Greater emphasis on water temperature in water management measures	Reduction of the influence of higher water temperatures on the use and protection of water bodies.	Municipalities, federal and state governments, EU, and other actors such as energy suppliers, water companies, fisheries, industry
3.3.4.10	Installation of industrial water management instruments	Ensuring industrial water supply for the various areas of action: agriculture (irrigation), energy industry (cooling), irrigation of golf courses and football fields, lumber yard sprinkling, industry and commerce, and in air conditioning and cooling systems.	EU, federal and state governments, managers

Tourism

NO.	TITLE	OBJECTIVE	ACTORS
3.4.4.1	Taking account of climate change in tourism strategies	Intensification of strategic consideration of issues of climate change and tourism as framework conditions for the implementation of adaptation measures.	State governments, federal government, actors such as mobility providers, international actors, etc. Furthermore, extensive networking between the various administrative levels (vertical) and between the areas of action (horizontal) is desirable.
3.4.4.2	Development of climate-friendly adaptation measures based on tourism strategies	Increased consideration of adaptation measures that best contribute to the reduction of greenhouse gas emissions and provide added value for businesses, besides minimizing climate risk.	Federal and state governments, regions, municipalities, local tourism organizations, Association of Towns and Municipalities, interest groups, individual entrepreneurs, advisory institutions and services, incoming & outgoing trade, networks (e.g., RegioNext (Styria) and Planning Association, Tyrol), LEADER regions.
3.4.4.3	Development, provision, and improvement of regional data as the basis for decision-making for adaptation measures	Minimizing existing uncertainties and preparing robust bases for decision-making, especially by integrating regional climate change scenarios.	Alpine clubs, vacation destinations. The input of both the federal government and the states is required with regard to the creation of new underlying data (e.g., regional climate scenarios, information on new offers).
3.4.4.4	Support for climate change-endangered winter sports regions by creating offers not dependent on snow	Securing value creation from tourism long-term by diversifying offers.	Federal and state governments, regions, municipalities, local tourism organizations, Association of Towns and Municipalities, interest groups, individual entrepreneurs, advisory institutions and services, incoming & outgoing trade, networks (e.g., RegioNext (Styria) and Planning Association, Tyrol), LEADER regions
3.4.4.5	Strengthening Alpine summer tourism	Protecting Alpine infrastructure and taking up opportunities due to climate change in summer tourism.	Federal and state governments, regions, municipalities, local tourism organizations, Association of Towns and Municipalities, interest groups, individual entrepreneurs, advisory institutions and services, incoming & outgoing trade, networks (e.g., RegioNext (Styria) and Planning Association, Tyrol), LEADER regions
3.4.4.6	Expansion of city tourism in Austria	Creating urban tourism offers adapted to climate change and strengthening the establishment of year-round offers.	Federal and state governments, tourism industry, municipal governments, urban planning, tourists

Energy – Focus on the Electrical Industry

NO.	TITLE	OBJECTIVE	ACTORS
3.5.4.1	Optimization of the network infrastructure	Avoidance of foreseeable supply shortages and overcapacities and reduction of vulnerability to extreme weather events.	Federal and state governments, electricity industry, e-control, network operators, EU, academic and non-academic research institutions
3.5.4.2	Promotion of decentralized energy production and feed-in	Use and optimization of regional renewable resources to enhance security of supply and raising awareness of the general public with respect to energy topics.	Federal government (BMWFJ, BMNT (formerly BMLFUW), BMVIT, BMF), state governments, electricity industry, e-control, network operators, EU
3.5.4.3	Increased research on potential methods of energy storage	Balancing out supply shortages or excess capacities.	BMVIT, BMBWF (formerly BMWFW), state governments, Climate and Energy Fund, academic and non-academic research institutions, energy industry
3.5.4.4	Stabilization of the transport and distribution network through appropriate climate-adapted system planning	Reduction of the susceptibility of transportation networks to interference and the prevention of overload or supply shortages arising from the expected climatic changes.	Federal and state governments, energy industry, local residents
3.5.4.5	Optimization of the interaction between generation (from various sources) and consumption in the power supply system under varying supply and demand	Avoiding critical peak loads in the case of shortages; relieving the transmission system during peak loads; optimization of the decentralized network feed-in; optimization of the decentralized grid feed-in.	Network operators, EU, federal and state governments, municipalities, energy industry, e-control, industry (producers/generators of devices), customers
3.5.4.6	Factoring in the effects of climate change when making decisions on energy and research activities, such as from the point of view of further diversification	Increasing security of supply through more diversified energy sources structures and far-reaching avoidance of negative consequences for other areas and their adaptive capacity.	Energy suppliers, federal government (BMBWF (formerly BMWFW), BMVIT, BMNT (formerly BMLFUW), BMF), state governments, municipalities, energy service providers, interest groups, NGOs (e.g., Austrian Biomass Association, photovoltaics)
3.5.4.7	Reduction of internal loads to avoid summer overheating in buildings by reducing power consumption and increasing final energy efficiency	Improvement of thermal comfort in buildings during heat waves in the summer by increasing efficiency to reduce both internal heat loads and energy consumption.	Federal and state governments, EU, building users, real estate developers, building technology planners, IT planners, device developers, academic and non-academic research institutions
3.5.4.8	Consideration of the impact of climate change on energy demand and energy supply in energy strategies	Consideration of the energy required for heating and cooling as well as the changed supply of renewables due to climate change in energy strategies, policies, or action plans.	Federal and state governments, regions, municipalities, energy suppliers, network operators, Climate and Energy Fund, klimaaktiv, e5 program, Climate Alliance, energy agencies, agriculture and forestry, academic and non-academic research institutions

Construction and Housing

NO.	TITLE	OBJECTIVE	ACTORS
3.6.4.1	Implementation of structural measures (in new buildings and in renovations) to ensure thermal comfort	Ensuring thermal comfort indoors through structural measures, especially with regard to the increased incidence of hot days.	Federal and state governments, architectural firms, planning firms, building owners, real estate developers, academic and non-academic research institutions
3.6.4.2	Encouraged use of passive and active cooling with alternative, energy-efficient, and resource-saving technologies	Ensuring thermal comfort inside new buildings, in renovations, and in existing buildings by means of passive and alternative ("active") cooling strategies.	Federal and state governments, (energy consultants), environmental consultants, architectural firms, planning firms, building owners, real estate developers, research, technology companies
3.6.4.3	Climatological improvement of urban spaces, with particular emphasis on micro- and meso-climatic conditions in urban and open space planning	Optimization of living conditions and conditions of human and wind comfort, as well as reduction in the heat-island effect through urban and open space planning.	BMNT (formerly BMLFUW), BMVIT, federal states, municipalities, Climate and Energy Fund, real estate planning firms, planning firms, microclimate experts, academic and non-academic research institutions, real estate developers
3.6.4.4	Implementation of structural measures on buildings to protect them from extreme weather events	Structural adaptation of buildings (new and existing buildings) for protection from extreme weather events.	Federal and state governments, architectural firms, planning firms, building owners, real estate planning firms, technology firms, academic and non-academic research institutions, microclimate experts
3.6.4.5	Increase of water retention	Prevention of local flooding through structural measures around buildings.	Federal and state governments, municipalities, planning firms
3.6.4.6	Adaptation of building standards and norms to climate change	Consideration and integration of adaptation requirements in construction standards and norms.	Federal and state governments, Austrian Institute of Construction Engineering (OIB), Austrian Standards International
3.6.4.7	Evaluation and further development of funding instruments for taking account of climate change aspects in new constructions and renovations	Increased emphasis on adaptation needs in the funding of new construction and the renovation of residential and non-residential buildings.	Federal and state governments, in part interest groups, municipalities, public-private partnerships, BMJ, BMWFJ
3.6.4.8	Research on adaptation to the consequences of climate change in the area of construction and housing	Improvement of the knowledge base with the goal of optimized adaptation to the effects of climate change and improvement of underlying data.	EU, federal government, research funding bodies (Climate and Energy Fund, FWF, FFG), academic and non-academic research institutions
3.6.4.9	Pilot projects on "climate change-adapted architecture"	Demonstration of the feasibility and advantages of "climate change-adapted architecture."	EU, federal and state governments, research funding bodies (Climate and Energy Fund, FWF, FFG), academic and non-academic research institutions, innovative real estate developers/building developers, municipalities, microclimate experts, medical doctors, sociologists, psychologists, logistics specialists
3.6.4.10	Public information and raising of awareness of the issue of adaptation to the consequences of climate change in the area of construction and housing	Raising awareness and dissemination of knowledge on the subject of adaptation to the effects of climate change and the necessary adaptation measures.	Federal and state governments, municipalities, NGOs, interest groups

NO.	TITLE	OBJECTIVE	ACTORS
3.6.4.11	Training and further education on issues of adaptation to the consequences of climate change in the area of construction and housing	Creation of a sound knowledge base for the implementation of measures for adaptation to the consequences of climate change.	Federal government, training and education institutions, interest groups (chambers), academic and non-academic research institutions

Protection from Natural Hazards

NO.	TITLE	OBJECTIVE	ACTORS
3.7.3.1	Development (education) and promotion of danger and risk awareness as well as individual responsibility in the population	Anchoring and strengthening awareness of self-reliance when dealing with risks from natural hazards.	Federal government (departments), state governments (departments), municipalities, tourism organizations, individuals, National Crisis and Disaster Protection Management (SKKM), ZAMG, Geological Survey of Austria, ÖROK, state school authorities
3.7.3.2	Promotion of sustainable spatial development strategies, including increased consideration of planning in hazard areas and identification of risks	Keeping areas potentially affected by natural hazards free from use for residential, commercial, or infrastructure purposes, or risk-oriented control of such use.	Federal government (hazard zone maps, GZP), state governments, municipalities
3.7.3.3	Promotion of water retention in catchment areas and reactivation of natural floodplains (and areas), particularly as a contribution to provision of additional inundation areas	Reduction of peak flows by ensuring water retention in the catchment area.	Federal and state governments, municipalities, infrastructure managers, land owners, water boards, ÖROK
3.7.3.4	Promotion of the development of forecasting, (early) warning and measurement systems	Expansion of the scope of data and information on hazardous natural processes and the resulting possibility of (early) warning.	BMLFUW, BMVIT, federal states, municipalities, interest groups, scientific institutions, infrastructure operators, ZAMG, Geological Survey of Austria, emergency response organizations
3.7.3.5	Promoting research into the impact of climate change on extreme events, on changes in the natural environment, on human use and on how to deal with uncertainties in decision-making	Provision of decision-making bases using the state of the art in science and technology.	EU, federal and state governments, academic and non-academic research institutions, university cooperation arrangements, national research programs
3.7.3.6	Promoting adoption of measures for reducing risk while taking account of appropriate risk transfer mechanisms	Raising awareness about the need for complementary insurance-based preparedness measures.	Federal and state governments, municipalities, insurance industry, individuals
3.7.3.7	Promotion of property protection measures (permanent and temporary) to encourage individuals to take safeguarding measures	Prevention of damage to buildings and property related to the effects of natural hazards.	Federal and state governments, municipalities, association of insurers, science, developers, individuals, OIB (Austrian Institute of Construction Engineering), certification body

Disaster Management

NO.	TITLE	OBJECTIVE	ACTORS

NO.	TITLE	OBJECTIVE	ACTORS
3.8.3.1	Continuous implementation of the objectives of the SCCM Strategy 2020, with greater consideration of the effects of climate change	Timely and forceful implementation of the SKKM Strategy	Federal and state governments, municipalities, science, industry, emergency response organizations
3.8.3.2	Establishment of a national risk reduction platform	Comprehensive exchange between and networking of all relevant institutions, improvement of knowledge transfer from research, dissemination of information on technical innovations and product developments as well as support for a broad dialogue.	Authorities at the federal level (Ministry of the Interior, BMI, Ministry of Defence, BMLV (formerly BMLVS), BMVIT, BMNT (formerly BMLFUW), BMASGK (formerly BMG)) and at the state and municipal levels, emergency response organizations (fire departments, Red Cross, etc.), industry (e.g., insurance, operators of critical infrastructure), science, general public
3.8.3.3	Preservation and, if necessary, improvement of the conditions for volunteering in the field of disaster management	Maintaining and improving suitable framework conditions as well as maintaining the attractiveness of volunteering as one of the important pillars of disaster management in Austria.	EU, federal and state governments, municipalities, emergency response organizations, humanitarian organizations, volunteers, industry, trade unions
3.8.3.4	Increasing the flexibility of financing and funding instruments in the field of disaster management	Creation of a financing mechanism for short-, medium-, and long-term activities of integrated disaster management on the basis of defined criteria.	Federal and state governments, emergency response organizations, (insurance) industry, science
3.8.3.5	Risk communication as a contribution to strengthening individual provision in the area of disaster management	Exposure to natural disasters is recognized by the general public and appropriate precautionary measures are carried out.	Federal and state governments, municipalities, emergency response organizations, insurers, Civil Defense Association, ZAMG, Austrian Storm Center, industry, the media, academic and non-academic research institutions
3.8.3.6	Increase in training offers in the field of disaster management	Improving training and increasing competencies of the actors in disaster management with respect to natural hazards and climate change.	Actors in disaster management, educational institutions of disaster management, tertiary educational institutions
3.8.3.7	Continuation of the national risk analysis and development of a uniform methodology for carrying out risk analyses	Further development of the current uniform method for assessing disaster risks as the basis for coordinated, integrated, risk-based, and cost- and benefit-oriented planning of measures in Austria.	Federal and state governments, municipalities, infrastructure managers, research institutions, □insurance industry
3.8.3.8	Promoting participatory approaches to the integration of all players in disaster management	Promotion of the inclusion of all actors in opinion formation, decision, and implementation processes and involvement of civil society, as well as use of new communication platforms (social media) to achieve integrated disaster management.	EU, federal and state governments, municipalities, industry, academic and non-academic research institutions, the general public
3.8.3.9	Continuation and networking of research activities and development of innovations related to disaster management	Promotion of inter- and transdisciplinary research activities, provision of bases for decision-making, and development of technical innovations derived from the SKKM strategy 2020 or its implementation.	SKKM working groups, federal and state governments, municipalities, industry (particularly operators of critical infrastructure), academic and non-academic research institutions, emergency response organizations

Health

NO.	TITLE	OBJECTIVE	ACTORS
3.9.4.1	General public relations and specific work on preparing for extreme events or outbreaks of infectious diseases	Raising awareness, informing the public and improving the capabilities of coordinated emergency services and the responsible institutions in order to prevent or minimize health risks and lower fatal casualties in cases of extreme events or outbreaks of infectious diseases.	BMG, BMASK, state governments (technical authorities), ÖÄK (Austrian Medical Chamber), Gesundheit Österreich GmbH, ÖGD, ÖGB, Chamber of Labor, the media, AGES, universities, schools, Adult Education Centers, national and EU-wide networking, BMNT (formerly BMLFUW), BMBWF (formerly BMFWF), tourism organizations
3.9.4.2	Dealing with heat and drought	Reducing heat stress and preventing additional climate change-related negative health effects in the population in especially heat-prone areas (e.g., urban areas affected by the heat-island effect).	BMG, BMASK, ÖGD, BMWA, BMUKK, state governments, Gesundheit Österreich GmbH, ÖGB, cities, municipalities, infrastructure providers, public transportation, aid organizations, trade unions, Chamber of Labor, Chamber of Commerce, Association of Towns and Municipalities, urban planners, ÖÄK, the media, NGOs, academic and non-academic research institutions
3.9.4.3	Dealing with floods, mudslides, avalanches, landslides and rock falls	Maintaining supply functions of central services in cases of disaster and preventing fatal casualties, and acute and chronic as well as physical, and mental health effects.	Cooperation between federal and state governments, municipalities, aid organizations, health care, disaster protection management, hospital operators, BMI, psychosocial services, emergency services, the army, ÖÄK, psychotherapy associations, hospitals, insurers, water suppliers, BMG, ÖGD, BMNT (formerly BMLFUW), state governments, Gesundheit Österreich GmbH, AGES, ÖWAV, ÖVGW, NGOs, universities
3.9.4.4	Advancement of knowledge and preparation for handling pathogens/infectious diseases	Improving the knowledge base on climate change-related alterations in the establishment and spread of pathogens and infectious diseases Suppression of the establishment and spread of pathogens, infectious diseases, and disease carriers (vectors); Improving early recognition, diagnosis, and therapies for “new and emerging diseases.”	BMASGK (formerly BMG, BMASK), BMBWF (formerly BMWFW), BMLV (formerly BMLVS), BMNT (formerly BMFLUW), , state governments, academic and non-academic research institutions, AGES, Gesundheit Österreich GmbH, ÖÄK, EU (ECDC)
3.9.4.5	Risk management with regard to the spread of allergenic and toxic species	Prevention/reduction of adverse health effects due to allergenic and toxic plants and animals.	BMASGK (formerly BMG), AGES, BMNT (formerly BMLFUW), state governments, Chamber of Agriculture, Gesundheit Österreich GmbH, academic and non-academic research institutions, municipalities, gardeners, ÖÄK, the media
3.9.4.6	Dealing with pollutants and ultraviolet radiation	Prevention/reduction of adverse health effects due to changes in exposure to pollutants resulting from extreme events and climate change.	BMNT (formerly BMLFUW), BMASGK (formerly BMG, BMASK), state governments, Chamber of Agriculture, Gesundheit Österreich GmbH, ÖÄK, AGES, ÖGB, Chamber of Labor, municipalities, the media

NO.	TITLE	OBJECTIVE	ACTORS
3.9.4.7	Linking in and further development of monitoring and early warning systems	Preparation of the general public, health care, and aid organizations for climate change-related effects and emergency situations in order to reduce/prevent health consequences through the development of a common, coherent monitoring structure, in particular by linking existing systems. This structure should be adjustable to the respective risks (e.g., floods, heat, cold, pathogens/infectious diseases).	BMG, BMLVS, BMASK, state governments, academic and non-academic research institutions, Gesundheit Österreich GmbH, ÖÄK (Austrian Medical Chamber), ÖGB, insurers, Statistics Austria, ZAMG, cities/municipalities, care services, retirement homes, nursing homes, hospitals, psychosocial services, Chamber of Labor, disaster protection management, emergency services, civil defense associations, the media
3.9.4.8	Incorporation of climate-relevant topics in the training and further education of doctors and personnel in medical, therapeutic, and diagnostic health professions (MTDG)	Increasing the competence of doctors and health care personnel in handling climate-relevant health topics.	BMGF, state governments, ÖÄK (Austrian Medical Chamber), training academies, hospital operators, academic and non-academic research institutions, Gesundheit Österreich GmbH, public health services, psychosocial services, the media

Ecosystems and Biodiversity

NO.	TITLE	OBJECTIVE	ACTORS
3.10.4.1	Improving the knowledge base through research on the effects of climate change on ecosystems/biodiversity	Advancement of knowledge on the impacts of climate change on ecosystems and biodiversity as a basis for and support of the implementation of potential measures.	Federal government (BMBWF (formerly BMWFW), BMNT (formerly BMLFUW), state governments, academic and non-academic research institutions, ZAMG, Austrian Academy of Sciences, FWF, Climate and Energy Fund (ACRP, Austrian Climate Research Program)
3.10.4.2	Increased consideration of climate change in existing monitoring systems and further establishment of monitoring and early warning systems	Continuation, adjustment, extension, and consolidation of existing or evolving environmental monitoring networks with the overall aim of identifying the effects of climate change on species, habitats, and ecosystem services and applying this information in early-warning systems.	BMBWF (formerly BMWFW), BMNT (formerly BMFLUW), state governments, NGOs, BFW, ÖAW, FWF, universities, Environment Agency Austria, Austrian Climate Research Program (ACRP), Long Term Ecological Network (LTER), museums (e.g., Zobodat)
3.10.4.3	Integration of climate change in nature conservation	Consideration of the impacts of climate change and representation of potential needs for action in nature conservation concepts.	State governments, BMNT (formerly BMLFUW)
3.10.4.4	Strengthening of knowledge transfer on the importance of biodiversity and ecosystems for climate change adaptation in training, and increased public relations efforts	Increased integration of the importance of biodiversity for the adaptation of society to climate change in education and accelerated public relations efforts.	State governments (nature conservation departments), land users, biodiversity research institutes, NGOs, Ministry of Science, universities, training facilities for the relevant interest groups (e.g., agricultural and forestry training institutions), nature park academies, associations
3.10.4.5	Maintenance of extensive land use in mountainous and Alpine elevations and in selected locations	Protection of the traditional cultural landscape as a sanctuary for its species.	EU, BMNT (formerly BMLFUW), state governments (nature conservation departments), land users, land owners, NGOs, interest groups, agricultural authorities, municipalities, HBLFA Raumberg-Gumpenstein, tourism associations
3.10.4.6	Adapting leisure and vacation activity offers	Management and adjustment of leisure activities that threaten biodiversity in favor of sustainable leisure activities.	Associations, businesses, and professionals in the tourist industry, cable-car industry, land owners, protected area administrations, educational institutions, NGOs, interest groups, general public

NO.	TITLE	OBJECTIVE	ACTORS
3.10.4.7	Adjustment in the design of public and private open spaces in residential areas to the objectives of nature conservation and the effects of climate change	Creation of areas of retreat for animal and plant species (including rare and threatened species), improvement of the local climate in populated areas, increase in water retention, adjustment of the design of green spaces to climate change (e.g., selection of species and varieties).	Building owners, municipalities, architectural firms, garden owners, real estate developers, parks departments, educational institutions, environmental consultants, "Action Nature in Gardens", BMASGK (formerly BMGF), BMNT (formerly BMLFUW)
3.10.4.8	Strengthening of threatened populations and species	Reducing the hazardous situation of species threatened by climate change through restocking or ex-situ conservation (including seed and gene banks).	Land users, associations, conservation departments, protected area administrations, universities, botanical gardens, Environment Agency Austria
3.10.4.9	Maintaining and improving the embedding and networking of protected areas and habitats	Facilitating the networking of habitats and protected areas through the integration of buffer zones and corridors to increase the probability of survival of populations and species, and conservation of the natural value of protected areas under conditions of climate change.	BMNT (formerly BMLFUW), BMBWF (formerly BMWFW), state governments (nature conservation departments), protected area administrations, land owners, NGOs, interest groups, district agricultural authorities, ÖAW, academic and non-academic research institutions, Environment Agency Austria, NGOs, spatial planning authorities
3.10.4.10	Protection of wetland habitats by ensuring the quality and quantity of groundwater and by raising the water storage and retention capacity of landscapes	Protection of wetland habitats by ensuring adequate groundwater quality and quantity under conditions of climate change, and increasing water storage and retention capability through runoff-retarding measures.	BMNT (formerly BMLFUW), state governments, land owners, energy producers, water suppliers, interest groups, agricultural authorities, spatial planning, NGOs, ÖBf, academic and non-academic research institutions
3.10.4.11	Promotion of restoration of waters, reinforcement of integrated watershed management, and prevention of substantial warming of water bodies	Combined flood and biodiversity protection through restoration and a comprehensive view of water bodies, as well as the prevention of their substantial warming.	BMNT (formerly BMLFUW), BMVIT, state governments (nature conservation departments), land owners, energy producers, water management associations, industry, interest groups (e.g., fisheries), NGOs, BOKU, Environment Agency Austria, state hydraulic engineering departments, Via Donau
3.10.4.12	Conservation of ecosystem services in sustainable land use and nature conservation	Raising awareness about ecosystem services (e.g., contribution to water retention, flood control, biodiversity, drinking water generation, CO_2 fixation, etc.) to promote sustainable land use supporting sustainable development, including improvement of biological diversity.	Federal and state governments (nature conservation departments), interest groups/associations, land users, NGOs, agricultural and forestry authorities
3.10.4.13	Consideration of ecosystems/biodiversity issues in a global context	Reduction of indirect negative effects on biodiversity worldwide	Federal and state governments, ADA, municipalities, industry, Global Responsibility – Platform for Development and Humanitarian Aid, ANRICA (Austrian Natural Resources Management and International Cooperation Agency)

Transport Infrastructure Including Aspects of Mobility

NO.	TITLE	OBJECTIVE	ACTORS

NO.	TITLE	OBJECTIVE	ACTORS
3.11.4.1	Further expansion of information and early warning systems	Implementation of the precautionary principle for transportation infrastructure in the case of extreme weather events.	Federal and state governments, municipalities, operators of transportation infrastructure, university and non-university research institutions, universities of applied science, meteorological institutions and companies (e.g., ZAMG, AustroControl)
3.11.4.2	Safeguarding a functional transportation system	Adaptation of transportation infrastructure to secure a functioning and climate-friendly transportation system and to secure the provision of supplies to the general public under changed climate conditions (in particular extreme precipitation events and changed potentials for natural hazards) as well as avoidance of disruptions/interruptions of services and the resulting follow-on effects (losses of time in passenger traffic, interruptions of production due to disruptions of freight traffic).	Federal and state governments, Federal Transport Agency, municipalities, operators of transportation infrastructure, planning firms, developers, businesses
3.11.4.3	Ensuring thermal comfort by reducing thermal loads in public transport stations and their vicinity	Reduction of thermal loads in built-up areas and modes of transport, as well as public transport stations and industrial and commercial buildings.	Transportation service operators, real estate developers, IT planners, device developers, federal and state governments
3.11.4.4	Reduction of potential heat stress for passengers and personnel in public transportation through appropriate air conditioning	Maintaining operational safety and comfort of use in public transport under heat loads.	Federal government, public transport operators, infrastructure providers, educational institutions, state governments, municipalities, manufacturers of public transport vehicles
3.11.4.5	Review and, if necessary, adaptation of legal standards for the construction and operation of transport infrastructure under changed climatic conditions	Adaptation of laws, norms, and guidelines on the impacts of climate change in order to avoid damage to transport infrastructure.	Federal and state governments, standardization authorities, Austrian Institute of Construction Engineering (OIB), Austrian Association for Research on Road – Rail – Transport (FSV)
3.11.4.6	Consideration of micro- and meso-climatic conditions in urban and open space planning	Ensuring thermal comfort through adapted infrastructure planning as part of urban and open space planning.	State governments, municipalities, planning firms, meteorologists, traffic participants
3.11.4.7	Reduction of the increase in permanently sealed surfaces for transportation infrastructure as flood protection	Reduction of excessive sealed surfaces in transportation infrastructure to reduce/prevent local flooding.	Federal and state governments, municipalities, operators of transportation infrastructure, developers, land owners
3.11.4.8	Research on adaptation to the consequences of climate change in the area of transportation infrastructure	Improving the knowledge base with the goal of optimized adaptation to the consequences of climate change.	EU, CEDR (Conference of European Directors of Road), federal government, research funding agencies (e.g., Climate and Energy Fund, FWF – Austrian Science Fund, Austrian Research Promotion Agency (FFG)), academic and non-academic research institutions
3.11.4.9	Pilot projects on transportation infrastructure adapted to climate change	Demonstration of the feasibility of climate-change adapted transportation infrastructure	EU, federal and state governments, research funding agencies (Climate and Energy Fund, FWF – Austrian Science Fund, Austrian Research Promotion Agency (FFG)), academic and non-academic research institutions, innovative real estate developers/builders

NO.	TITLE	OBJECTIVE	ACTORS
3.11.4.10	Improved public information methods	Generating acceptance for necessary actions and dissemination of knowledge on the subject of adaptation to climate change in the transport sector	NGOs, NPOs, federal and state governments, municipalities, schools, universities, interest groups, the media, individuals
3.11.4.11	Training and further education on adaptation to the consequences of climate change in the area of transportation infrastructure	Advancement of knowledge on adaptation to the effects of climate change through the inclusion of relevant information in training and further education	Federal government, training and further education institutions, interest groups (chambers)

Spatial Planning

NO.	TITLE	OBJECTIVE	ACTORS
3.12.4.1	Development and provision of practice-relevant data and information bases, raising awareness and improved networking of actors	Generation, provision, and transfer of improved spatially relevant knowledge about climate impacts and adaptation that is useful and directly usable in spatial planning decision-making processes; Increasing the willingness and ability to act among spatial planning actors and affected citizens in coping with climate change.	Federal and state governments, ÖROK, municipalities, planning and regional associations, interest groups, research institutions, planning firms
3.12.4.2	Establishment and protection of flood retention and drainage zones and clear regulation of zoning prohibitions and restrictions	Protection of built-up areas from floods by securing and recovering natural flood plains and water retention areas; improvement of water retention in the catchment areas of rivers; Protection from flood-related damage by reducing peak flows and slowing waves of floodwater.	ÖROK, state governments, municipalities, planning firms, protective water management (BMNT, formerly BMLFUW), torrent and avalanche control authorities (BMNT, formerly BMLFUW), Federal Waterways Authority (BMVIT), infrastructure operators, viadonau – Österreichische Wasserstraßen GmbH (BMVIT), land owners
3.12.4.3	Reinforced legal links between zoning and hazard-zone planning	Protection of built-up areas and infrastructure from natural hazards, taking changes in the potentials of natural hazards due to climate change into account; Reservation of areas threatened by natural hazards by banning construction and land uses involving high damage potential; Ensuring proactive hazard prevention.	ÖROK, state governments, municipalities, planning firms, protective water management, torrent and avalanche control, land owners
3.12.4.4	Regulations for handling existing zoning and building in hazardous areas	Lowering the damage potential of natural hazard events in risk zones; ensuring proactive hazard prevention.	State governments, municipalities, BMNT, formerly BMLFUW (protective water management, torrent and avalanche control (especially in the role of experts and consultants in individual expert reports)), land and building owners
3.12.4.5	Promotion of intermunicipal cooperation	Protection of intermunicipal “solidarity” areas for flood retention and prevention of natural hazards; Introduction of compensation mechanisms and risk transfer models between municipalities or bodies under public law in accordance with the Water Rights Act WRG (e.g., protective water cooperatives/associations) for balancing out burdens and benefits between upstream and downstream riparian communities.	Federal and state governments, municipalities, planning firms, land owners

NO.	TITLE	OBJECTIVE	ACTORS
3.12.4.6	Protection of fresh/cold air production areas, ventilation paths, and “green” and “blue” infrastructure within residential areas	Improvement of microclimates in densely populated areas, prevention of overheating and heat-island effects, and compensation for increased bioclimatic stress on human health; Securing the supply of fresh/cold air in built-up areas, avoidance of health risks due to heat.	State governments, greater urban regions, municipalities, planning firms, nature conservation (federal states), urban planning, landscape and open space planning, meteorology/microclimatology), land owners
3.12.4.7	Review and (if necessary) adjustment of bioclimatically active measures in development plans	Improvement of microclimates in densely populated areas, prevention of overheating and heat-island effects, and compensation for increased bioclimatic stress on human health; Prevention of heat-related health risks.	State governments (planning and building law, ROG), municipalities, planning firms, urban planning, building authorities, meteorology/microclimatology, developers, land and building owners
3.12.4.8	Increased protection of water resources and improved integration of spatial planning, water management planning, and usage with water demand	Protection of groundwater and drinking-water resources and support for groundwater recharge; Ensuring continuous quantitative and qualitative security of water supply, especially in vulnerable regions.	State governments, municipalities, planning firms, water management (BMNT (formerly BMLFUW), state governments), agriculture, industry, energy industry, tourism Land owners
3.12.4.9	Increased protection of ecologically important open spaces (undeveloped semi-natural areas, habitat corridors, biotope networking) and minimization of further habitat fragmentation	Maintenance and improvement of a functional (even under changing natural conditions) network of protected areas and habitats for animal and plant species; Establishment and maintenance of non-fragmented areas of retreat for animal and plant species, maintenance and improvement of ecological connectivity, and prevention of further habitat fragmentation.	ÖROK, state governments, municipalities, planning firms, nature conservation (state governments), transport and infrastructure planning (BMVIT, state governments, ASFINAG, ÖBB) Land owners
3.12.4.10	Increased cooperation between spatial planning and tourism to promote a climate change-adapted, sustainable tourist infrastructure	Securing and supporting sustainable and climate change-adapted spatial development in tourism.	ÖROK, state governments, municipalities, planning firms (tourism planning, regional development: BMWFJ, state governments, tourism associations, regions, municipalities, cable-car industry, torrent and avalanche control)
3.12.4.11	Promotion of energy-optimized spatial structures	Strengthening of the spatial dimension of the energy system; Reducing energy consumption and improving energy efficiency Improved achievement of climate change mitigation objectives through reduction in greenhouse gas emissions; Increasing the contribution of renewable energy sources in the regional fulfillment of energy demand.	Federal government, ÖROK, state governments, municipalities, planning firms, energy suppliers, energy agencies, energy institutes, regional associations, farmers, forest owners, regional management, Climate and Energy Fund
3.12.4.12	“Climate proofing” spatial plans, development concepts, procedures, and projects with spatial impacts	Systematic consideration and review of the impacts of climate change and questions of adaptation in spatial development strategies, formal and informal planning instruments, projects, and planning processes; securing the long-term resilience and adaptability of spatial development in the face of current and future impacts of climate change.	BMNT (formerly BMLFUW), ÖROK, state governments, municipalities, planning firms, academic and non-academic research institutions

NO.	TITLE	OBJECTIVE	ACTORS
3.12.4.13	Promotion of quantitative soil protection and consideration of soil quality in land use decisions	Consideration of functions of the soil in spatial planning procedures to secure the soil's ecosystem services and to maintain adaptive capacity; reduction of soil losses and additional land use due to building and sealing for settlements and transportation.	Federal and state governments, municipalities, ÖROK, b4 Corporate Soil Competence (AGES, Environment Agency Austria, BFW, BOKU (IBF), IKT), academic and non-academic research institutions, spatial planners

Business/Industry/Trade

NO.	TITLE	OBJECTIVE	ACTORS
3.13.4.1	Securing of supply, transport networks, and production through differentiated supply networks, regional clusters and production close to the market	Ensuring security of supply, e.g., with agricultural products through regionally and seasonally differentiated supply networks; reducing the risk of failure in the supply chain; Reducing the risk of failure and/or fluctuations in price/amount (availability) □in the supply chain through the regionalization and diversification of sub-supplier relationships; Securing the transportation routes in the supply and distribution networks, reducing the risk of interruptions along the transportation network, ensuring the quality of, for example, agricultural and forestry products or food.	Businesses; federal and state governments (food authorities), AGES, municipalities, interest groups (Chambers, trade associations)
3.13.4.2	Securing supply and production through long-term contracts and expansion of stock held in warehouses	Maintenance of freight flow processes along the value chain through long-term contracts and the expansion of existing contracts, reducing the risk of losses, for example of agricultural delivery products, ensuring the quality of agricultural advance services; Reducing the risk of failure and/or fluctuations in price/amount (availability) in the supply chain by expanding inventory and avoiding supply shortages.	Businesses; Chamber of Commerce, federal and state governments
3.13.4.3	Measures to increase the resilience of production, sales, and operational infrastructure	Maintenance of the production process, ensuring adequate conditions of storage, preventing quality deterioration due to impaired storage, functioning logistics under conditions of higher outdoor temperatures and during periods of drought, and protection of operational infrastructure during floods and other extreme weather events (storms, hail, snow load).	Businesses, federal and state governments, municipalities, interest groups (Chamber of Commerce, trade associations, Federation of Austrian Industry
3.13.4.4	Increased energy security by promoting alternative/energy efficient technologies to increase resilience to the impacts of climate change	Increasing energy security by saving energy, measures to increase efficiency, increased usage of renewables, diversification of energy sources, grid expansion, and businesses generating their own energy in order to reduce their vulnerability to the impacts of climate change.	Companies, federal and state governments, energy industry
3.13.4.5	Development of climate-friendly and adaptive products, technical processes and services	Increasing resilience (ability to resist and regenerate) through innovative products, technical procedures, and services.	Companies (supply and demand side), public sector (demand side)

NO.	TITLE	OBJECTIVE	ACTORS
3.13.4.6	Promotion of appropriate future scenario-based risk assessments, cooperation with R & D, monitoring of scientific results	Development of new risk assessment methods for the entire insurance industry taking climate scenarios and transformation risks into account; improved bases for risk assessment for companies.	Insurers, academic and non-academic research institutions
3.13.4.7	Raising public awareness about preventing damage and reinforcing the individual responsibility of insured people	Strengthening of private preparedness measures resulting from insurers proactively informing their customers as well as public institutions and the general public about risks and changed potentials for natural hazards due to climate change, so that they are in a position to take precautionary measures and avoid damage.	Insurers, public institutions
3.13.4.8	Better risk diversification for insurers, with resulting increase in the insurability of climate- and weather-induced damage	Introduction of insurance against natural catastrophes (NatCat insurance).	Insurers, federal government (lawmakers)
3.13.4.9	Providing services to customers after claims	Support for damage repair as well as professional damage management in order to limit follow-on damages and to strengthen the resilience to future events.	Insurers, other service providers

Cities – Urban Green and Open Spaces

NO.	TITLE	OBJECTIVE	ACTORS
3.14.4.1	Adaptation of the water management strategy for green and open spaces	Ensuring the water supply and retention functions of green and open spaces under changing climatic conditions.	Municipal departments, parks departments, water suppliers
3.14.4.2	Adaptation of soil management in urban green and open spaces	Maintenance of soil functions, especially their water storage and water filtration functions.	State governments, municipal departments, parks departments, planning firms, individuals
3.14.4.3	Conservation and promotion of biodiversity in urban green and open spaces	Maintenance of ecosystem services and species diversity in urban green and open spaces.	BMNT (formerly BMLFUW), state governments, municipal departments, parks departments, planning firms, urban planning, spatial planning, garden centers, horticulture
3.14.4.4	Adaptation of planning strategies for urban green and open spaces	Consideration of climate change in urban planning instruments.	State governments, municipal departments, urban development and planning, parks departments, spatial planning, planning firms, micrometeorologists
3.14.4.5	Adaptation of open space planning and maintenance	Consideration of climate change in the design, implementation, and maintenance of urban green and open spaces.	Municipal departments, parks departments, planning firms, micrometeorologists
3.14.4.6	Promotion and adaptation of green and open spaces for recreation and leisure uses under changing climatic conditions	Conditions preservation and creation of green and open spaces as recreational and leisure area to promote human well-being under changing climatic conditions (especially during heat waves).	Municipal departments, parks departments, planning firms, micrometeorologists
3.14.4.7	Raising awareness, improved networking, and adaptation of the training and further education of actors (public and private)	Advancement of knowledge and improvement of networking among affected actors.	Municipal administrations, Association of Austrian Cities and Towns
3.14.4.8	Improvement of the knowledge base through inter- and transdisciplinary research on urban green and open spaces	With a view to adapting urban green and open spaces to climate change, issues must be explored at various levels and prepared in an interdisciplinary fashion for implementation.	Federal government (research programs), academic and non-academic research institutions, municipal administrations, planning firms, micrometeorologists.

RESOURCE REQUIREMENTS IN THE COURSE OF ADAPTATION TO CLIMATE CHANGE

16 RESOURCE REQUIREMENTS IN THE COURSE OF ADAPTATION TO CLIMATE CHANGE

Even though no reliable conclusions can yet be drawn regarding the costs of adaptation, as more specific information is required, it can be assumed with some certainty that the costs of action for coping with climate change (including climate change mitigation and adaptation measures) will be much lower than the medium- to long-term costs of inaction. (EC 2009a).

For several years already, national and international studies (especially at the EU level) have been working intensively on the development of a method for presenting the net costs of adaptation.

Economic analysis can contribute substantial arguments to the discussion of priorities within the adaptation process and to the consideration of possible measures. The particular challenge here is that not the absolute figures or costs are directly relevant, but rather calculations that take the following factors (among others) into account:

- Activities that are initiated without a direct reference to climate change adaptation,
- Potential damage costs or economically assessable benefits resulting from climate change that would/could take place without timely countermeasures
- Additional benefits of adaptation measures.

Studies and research projects that address this topic should therefore choose an integrated, cross-sectoral, and holistic approach, by which the environmental costs caused by the deterioration of physical and biological systems are internalized. This is currently being pursued intensively in international research.

Building on the COIN project, which identified the costs of climate change for Austria (see Chapter 1.1.3 of the Action Plan and the summary of key statements in the areas of action), two projects are currently working on behalf of the Climate Fund and in consultation with the BMNT (formerly BMLFUW) on the cost of adaptation to unavoidable consequences of climate change. PACINAS[84] is analyzing in particular by means of case studies the costs and benefits for public sector budgets, and PATCH:ES[85] is focusing on private adaptation to climate change, concentrating on the areas space heating/air conditioning, private flood control, winter tourism and agriculture. The aim of the project is to make a contribution by developing criteria for avoiding maladaptation and working out concrete recommendations for promoting adaptation among individuals.

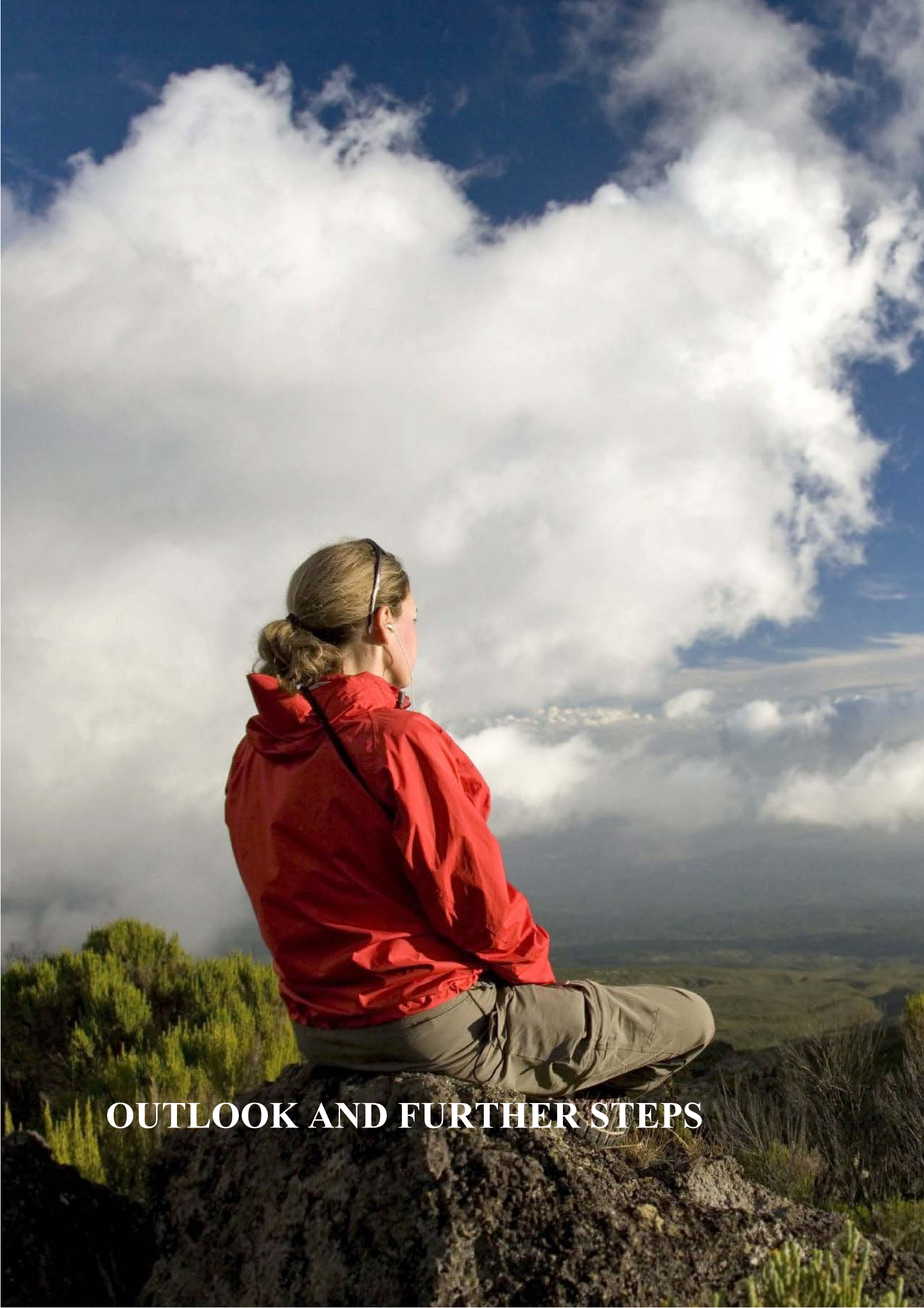
In many areas, it is obvious that aspects of climate change adaptation can be integrated into existing regulatory and private-law provisions (or those currently under development or in revision) without incurring additional financial costs.

[84] *Link: http://anpassung.ccca.at/pacinas/*
[85] *Link: http://anpassung.ccca.at/patches/*

No direct normative measures are connected as yet with the current Austrian Adaptation Strategy, and therefore the provisions of § 14 BHG (Federal Budget Act) regarding the presentation of the financial effects of these measures do not apply. However, the discussion of this topic deserves greater attention and will be addressed in a stepwise approach (see Chapter 17: Outlook and further steps).

In general, the following premises apply for the implementation of the Austrian Adaptation Strategy:

- **The implementation of the recommendations must be achieved within the existing jurisdictions of all governmental authorities.**
- **All recommendations listed in the adaptation strategy are to be covered by the resources available in the applicable financial frameworks of the public sector.**
- **The costs of implementing the recommendations are to be covered by prioritization and shifting within the available budget in line with political objectives regarding climate. In many cases, implementation of the recommendations will require the cooperation of various actors in the public sector (federal, state, local) and the private sector. To ensure fair burden sharing, cooperation within the public sector and between the public and private sectors is recommended and expedient.**



OUTLOOK AND FURTHER STEPS

17 OUTLOOK AND FURTHER STEPS

In the coming years and decades, Austria will gradually have to adapt to climate change. The present adaptation strategy provides an appropriate framework for this process. For its successful implementation, the best possible cooperation between all actors concerned will be essential. The development of the national adaptation strategy was therefore designed from the outset as an iterative process in which all interested parties at the national and federal state levels, interest groups, NGOs, and other institutions challenged with the implementation were very closely involved. This approach will continue to be followed consistently.

Adaptation to climate change is a process that must begin immediately, but extend over extended time horizons. Continuous improvement in the state of knowledge and experience with implementation will provide the basis for constant learning and be the prerequisite for appropriate success.

The particular challenge in the process that leads from strategic considerations to concrete implementation is its high level of complexity, which arises from among other things the variety of concerned parties, the different decision-making levels, the cross-cutting interactions and dependencies, and the multiplicity of key actors. Unlike the field of climate change mitigation, for which a clear target for reducing the emission of greenhouse gases serves as the focal point, adaptation to the consequences of climate change sets out to achieve a long-term objective that is not clearly definable can only be sketched out: to reduce the vulnerability of natural, social, and economic systems, to maintain or increase their adaptive capacity, and to make the best possible use of any new opportunities that may arise. When planning and implementing res, ex ante quality assurance must be observed in order to ensure effectiveness and avoid maladaptation.

The progress report (BMNT, formerly BMLFUW 2015) adopted by the federal and state governments (see Chapter 1.1.2 of the Action Plan and the summary of key statements in the areas of action) provides a reliable basis for further substantiating the need for action and driving implementation forward. It can be deduced from this that, in principle, numerous measures for climate change adaptation have already been initiated in Austria. However, given the dimension of the problem, these can only be a first step.

It appears to be of vital importance that the potential consequences of climate change are farsightedly and systematically taken into account in all relevant planning and decision-making processes from the national to the local level, by government agencies, in the private sector, and by individuals.

At any rate, the European Commission has a clear mandate that will have to be met in the coming years.

Many decisions with long-term impacts, whether in flood protection or in the area of infrastructure, must be made in such a way that they already reflect climate change-related developments as robustly as possible. Through the support of research activities, the federal government will continue to see seek to strengthen the underlying scientific basis for decision-making and for successfully implementing its climate change adaptation strategy. In particular, there is still need for research into questions of the quality control of adaptation measures, regarding for example the development of guiding criteria. Research programs such as StartClim[86] and ACRP (Austrian Climate Research Program[87]) of the Climate and Energy Fund will make a

[86] *Link: www.startclim.at*
[87] *Link: https://www.klimafonds.gv.at/*

substantial contribution to this effort. In this context, ACRP will also play a supporting role in terms of monitoring and implementation research.

Enhanced coordination will also be sought with the Climate Change Centre Austria (CCCA), which was founded in June 2011 as a coordinating body for the promotion of climate research in Austria. To this end, by establishing good contact between science and politics, new research results will be made immediately available for concrete environmental policy decisions.

The impact of climate change is often particularly strong at the local level, which is why the importance of the municipalities as actors in climate change adaptation is steadily increasing. Many measures must therefore be specified and implemented together with the municipalities. Carrying on appropriate dialogue with the Austrian municipalities, offering support and positioning climate change adaptation more strongly at this level will also be a concrete task of the federal and state governments in the coming months and years. Concrete tools for this are already being planned or implemented.

Adaptation to climate change is a long-term effort; however, it requires immediate action. It must also be based on the most up-to-date scientific knowledge and concrete requirements, as well as regularly subjected to a systematic performance review. A five-year cycle is envisaged for this evaluation, in line with the views of other European countries and on the basis of the experiences reported in the first progress report. Accordingly, the second progress report is thus planned for 2020.

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19 TABLE OF FIGURES

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