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Austrian Assessment Report Climate Change 2014 (AAR14)

Summary for Policymakers
and
Synthesis

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Foreword

At my inauguration after re-election in 2010, I addressed the challenge of climate change and acknowledged Austria's responsibility to contribute to the solution of this global problem. Since then, in a three-year joint and gratuitous effort, over 200 scientists in Austria have brought together their knowledge across disciplinary boundaries, to jointly paint a comprehensive and scientifically sound picture of climate change in Austria for the public and for decision makers.

Complementary to the global view of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the Austrian Assessment Report Climate Change (AAR14) of the Austrian Panel on Climate Change (APCC) now summarizes what is known about climate change in Austria, its current and possible future impacts as well as adaptation and mitigation measures. It draws the conclusion that Austria has not sufficiently fulfilled its responsibility to date. But the report also shows that there are many options for action, many of which would be beneficial quite independent of climate change.

The scientific community has impressively demonstrated that they take climate change seriously. Hopefully their work will trigger increased political efforts for climate protection in Austria and strengthen civil society and the wider public in their (growing) engagement for a livable future.

Austrian Assessment Report Climate Change 2014

Summary for Policymakers

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Introduction

Over the course of a three-year process, Austrian scientists researching in the field of climate change have produced an assessment report on climate change in Austria following the model of the IPCC Assessment Reports. In this extensive work, more than 200 scientists depict the state of knowledge on climate change in Austria and the impacts, mitigation and adaptation strategies, as well as the associated known political, economic and social issues. The Austrian Climate Research Program (ACRP) of the *Klima- und Energiefonds* (Climate and Energy Fund) has enabled this work by financing the coordinating activities and material costs. The extensive and substantial body of work has been carried out gratuitously by the researchers.

This summary for policy makers provides the most significant general statements. First, the climate in Austria in the global context is presented; next the past and future climate is depicted, followed by a summary for Austria on the main consequences and measures. The subsequent section then provides more detail on individual sectors. More extensive explanations can be found – in increasing detail – in the synthesis report and in the full report (Austrian Assessment Report, 2014), both of which are available in bookstores and on the Internet.

The uncertainties are described using the IPCC procedure where three different approaches are provided to express the uncertainties depending on the nature of the available data and on the nature of the assessment of the accuracy and completeness of the current scientific understanding by the authors. For a qualitative evaluation, the uncertainty is described using a two-dimensional scale where a relative assessment is given on the one hand for the quantity and the quality of evidence (i. e. information from theory, observations or models indicating whether an assumption or assertion holds true or is valid), and on the other hand to the degree of agreement in the literature. This approach uses a series of self-explanatory terms such as: high / medium / low evidence, and strong / medium / low agreement. The joint assessment of both of these dimensions is described by a confidence level using five qualifiers from „very high confidence“ to „high", „medium“, „low“ and „very low confidence“. By means of expert assessment of the correctness of the underlying data, models or analyses, a **quantitative** evaluation of the uncertainty is provided to assess the likelihood of the uncertainty pertaining to the outcome of the results using eight degrees of probability from „virtually certain“ to „more unlikely than likely“. The probability refers to the assessment of the likelihood of a well-defined result which has occurred or will occur in the future. These can be derived from quantitative analyses or from expert opinion. For more detailed information please refer to the Introduction chapter in AAR14. If the description of uncertainty pertains to a whole paragraph, it will be found at the end of it, otherwise the uncertainty assessment is given after the respective statement.

The research on climate change in Austria has received significant support in recent years, driven in particular by the *Klima- und Energiefonds* (Climate and Energy Fund) through the ACRP, the Austrian Science Fund (FWF) and the EU research programs. Also own funding of research institutions has become a major source of funding. However, many questions still remain open. Similar to the process at the international level, a periodic updating of the Austrian Assessment Report would be desirable to enable the public, politicians, administration, company managers and researchers to make the best and most effective decisions pertaining to the long-term horizon based on the most up-to-date knowledge.

The Global Context

With the progress of industrialization, significant changes to the climate can be observed worldwide. For example, in the period since 1880 the global average surface temperature has increased by almost 1 °C. In Austria, this warming was close to 2 °C, half of which has occurred since 1980. These changes are mainly caused by the anthropogenic emissions of greenhouse gases (GHG) and other human activities that affect the radiation balance of the earth. The contribution of natural climate variability to global warming most likely represents less than half of the change. That the increase in global average temperature since 1998 has remained comparatively small is likely attributed to natural climate variability.

Without extensive additional measures to reduce emissions one can expect a global average surface temperature rise of 3–5 °C by 2100 compared to the first decade of the 20th century (see Figure 1). For this increase, self-reinforcing processes (feedback loops), such as the ice-albedo feedback or additional release of greenhouse gases due to the thawing of permafrost in the Arctic regions will play an important role (see Volume 1, Chapter 1; Volume 3, Chapter 1)[1].

[1] The full text of the Austrian Assessment Report AAR14 is divided into three volumes, which are further divided into chapters. Information and reference to the relevant section of the AAR14 is provided with the number of the volume (Band) and the respective chapter (Kapitel) where more detailed information can be found pertaining to the summary statements.

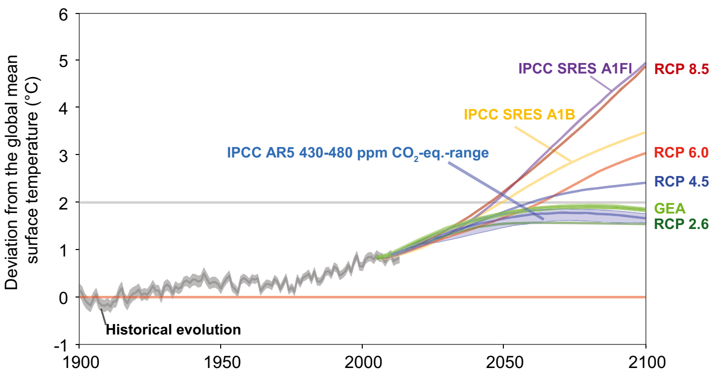

Figure 1 Global mean surface temperature anomalies (°C) relative to the average temperature of the first decade of the 20th century, historical development, and four groups of trends for the future: two IPCC SRES scenarios without emission reductions (A1B and A1F1), which show temperature increases to about 5 °C or just over 3 °C to the year 2100, and four new emission scenarios, which were developed for the IPCC AR5 (RCP8, 5, 6.0, 4.5 and 2.6), 42 GEA emission reduction scenarios and the range of IPCC AR5 scenarios which show the temperature to stabilize in 2100 at a maximum of +2 °C. Data sources: IPCC SRES (Nakicenovic et al. 2000), IPCC WG I (2014) and GEA (2012)

Climate change and the associated impacts show large regional differences. For example, the Mediterranean region can expect a prominent decrease in precipitation as well as associated water availability (see Volume 1, Chapter 4). While, considering the highest emission scenario of a rise in mean sea level of the order 0.5–1 m by the end of the century compared to the current level, poses considerable problems in many densely populated coastal regions (see Volume 1 Chapter 1).

Since the consequences of unbridled anthropogenic climate change would be accordingly serious for humanity, internationally binding agreements on emissions reductions are already in place. In addition, many countries and groups including the United Nations („Sustainable Development Goals"), the European Union, the G-20 as well as cities, local authorities and businesses have set further-reaching goals. In the Copenhagen Accord (UNFCCC Copenhagen Accord) and in the EU Resolution, a goal to limit the global temperature increase to 2 °C compared to pre-industrial times is considered as necessary to limit dangerous climate change impacts. However, the steps taken by the international community on a voluntary basis for emission reduction commitments are not yet sufficient to meet the 2 °C target. In the long-term, an almost complete avoidance of greenhouse gas emissions is required, which means converting the energy supply and the industrial processes, to cease deforestation, and also to change land use and lifestyles (see Volume 3, Chapter 1; Volume 3, Chapter 6).

The likelihood of achieving the 2 °C target is higher if it is possible to achieve a turnaround by 2020 and the global greenhouse gas emissions by 2050 are 30–70 % below the 2010 levels. (see Volume 3, Chapter 1; Volume 3, Chapter 6). Since industrialized countries are responsible for most of the historical emissions – and have benefited from them and hence are also economically more powerful – Article 4 of the UNFCCC suggests that they should contribute to a disproportionate share of total global emission reduction. In the EU „Roadmap for moving to a competitive low-CO_2 economy by 2050" a reduction in greenhouse gas emissions by 80–95 % compared to the 1990 level is foreseen. Despite of the fact that no emission reduction obligations were defined for this period for individual Member States, Austria can expect a reduction commitment of similar magnitude.

Climate Change in Austria: Past and Future

In Austria, the temperature in the period since 1880 rose by nearly 2 °C, compared with a global increase of 0.85 °C. The increased rise is particularly observable for the period after 1980, in which the global increase of about 0.5 °C is in contrast to an increase of approximately 1 °C in Austria (virtually certain, see Volume 1, Chapter 3).

A further temperature increase in Austria is expected (very likely). In the first half of the 21st century, it equals approximately 1.4 °C compared to current temperature, and is not greatly affected by the different emission scenarios due to the inertia in the climate system as well as the longevity of greenhouse gases in the atmosphere. The temperature development thereafter, however, is strongly dependent on anthropogenic greenhouse gas emissions in the years ahead now, and can therefore be steered (very likely, see Volume 1, Chapter 4).

The development of precipitation in the last 150 years shows significant regional differences: In western Austria, an increase in annual precipitation of about 10–15 % was recorded, in the southeast, however, there was a decrease in a similar order of magnitude (see Volume 1, Chapter 3).

In the 21st century, an increase of precipitation in the winter months and a decrease in the summer months is to be expected (likely). The annual average shows no clear trend signal, since Austria lies in the larger transition region between two zones with opposing trends – ranging from an increase in

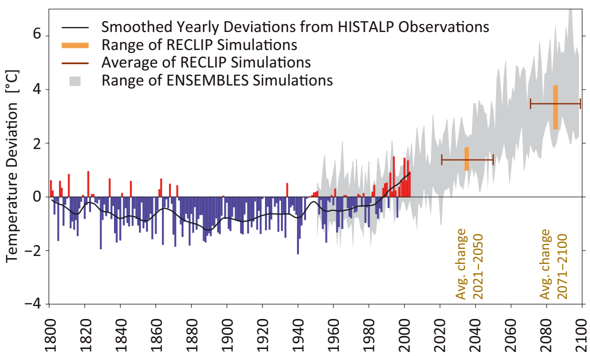

Figure 2 Mean surface air temperature (°C) in Austria from 1800 to 2100, expressed as a deviation from the mean temperature for the period 1971 to 2000. Measurements to the year 2010 are illustrated in color, model calculations for one of the IPCC emissions scenarios with higher GHG emissions (IPCC SRES A1B scenario) in gray. Reproduced are annual means (columns) and the 20-year smoothed curve (line). You can see the temperature drop just before 1900 and the sharp rise in temperature (about 1 °C) since the 1980s. In this scenario, by the end of the century, a rise in temperature of 3.5 °C can be expected (RECLIP simulations). Source: ZAMG

North Europe to a decrease in the Mediterranean (likely, see Volume 1, Chapter 4).

In the last 130 years, the annual sunshine duration has increased for all the stations in the Alps by approximately 20 % or more than 300 hours. The increase in the summer half of the year was stronger than in the winter half of the year (virtually certain, see Volume 1, Chapter 3). Between 1950 and 1980 there was an increase in cloud cover and increased air pollution, especially in the valleys, and therefore a significant decrease in the duration of sunshine hours in the summer (see Volume 1, Chapter 3).

The duration of snow cover has been reduced in recent decades, especially in mid-altitude elevations (approximately 1 000 m above sea level) (very likely, see Volume 2, Chapter 2). Since both the snow line, and thus also the snowpack, as well as the snowmelt are temperature dependent, it is expected that a further increase in temperature will be associated with a decrease in snow cover at mid-altitude elevations (very likely, see Volume 2, Chapter 2).

All observed glaciers in Austria have clearly shown a reduction in surface area and in volume in the period since 1980. For example, in the southern Ötztal Alps, the largest contiguous glacier region of Austria, the glacier area of 144.2 km² in the year 1969 has decreased to 126.6 km² in 1997 and to 116.1 km² in 2006 (virtually certain, see Volume 2, Chapter 2). The Austrian glaciers are particularly sensitive in the retraction phase to summer temperatures since 1980, therefore a further decline of the glacier surface area is expected (very likely). A further increase in the permafrost elevation is expected (very likely, see Volume 2, Chapter 4).

Temperature extremes have changed markedly, so that for example, cold nights are rarer, but hot days have become more common. In the 21st century, this development will intensify and continue, and thus the frequency of heat waves will also increase (very likely, see Volume 1, Chapter 3; Volume 1, Chapter 4,). For extreme precipitation, no uniform trends are detectable as yet (see Volume 1, Chapter 3). However, climate models show that heavy and extreme precipitation events are likely to increase from autumn to spring (see Volume 1, Chapter 4). Despite some exceptional storm events in recent years, a long-term increase in storm activity cannot be detected. Also for the future, no change in storm frequency can be derived (see Volume 1, Chapter 3; Volume 1, Chapter 4).

Summary for Austria: Impacts and Policy Measures

The economic impact of extreme weather events in Austria are already substantial and have been increasing in the last three decades (virtually certain, see Volume 2, Chapter 6). The emergence of damage costs during the last three decades suggests that changes in the frequency and intensity of such damaging events would have significant impacts on the economy of Austria.

The potential economic impacts of the expected climate change in Austria are mainly determined by extreme events and extreme weather periods (medium confidence, see Volume 2, Chapter 6). In addition to extreme events, gradual temperature and precipitation changes also have economic ramifications, such as shifts in potential yields in agriculture, in the energy sector, or in snow-reliability in ski areas with corresponding impacts on winter tourism.

In mountainous regions, significant increases in landslides, mudflows, rockfalls and other gravitational mass movements will occur (very likely, high confidence). This is due to changes in rainfall, thawing permafrost and retreating glaciers, but also to changes in land use (very likely, high confidence). Mountain flanks will be vulnerable to events such as rockfall (very likely, high confidence, see Volume 2, Chapter 4) and landslides (likely, medium confidence, see Volume 2, Chapter 4), and debris masses that were previously fixed by permafrost will be mobilized by debris flows (most likely high confidence, see Volume 2, Chapter 4).

The risk of forest fires will increase in Austria. The risk of forest fires will increase due to the expected warming trend and the increasing likelihood of prolonged summer droughts (very likely, high confidence, see Volume 2, Chapter 4).

Changes to sediment loads in river systems are noticeable. Due to changes in the hydrological and in the sediment regimes (mobilization, transport and deposition) major changes can be expected in mountain torrents and in large river systems (very likely, high confidence, see Volume 2, Chapter 4). The decisive factor here is to distinguish between changes due to climate change and due to human impact.

Due to the currently foreseeable socio-economic development and climate change, the loss potential due to climate change in Austria will increase for the future (medium confidence, see Volume 2, Chapter 3; Volume 2, Chapter 6). A variety of factors determine the future costs of climate change: In addition to the possible change in the distribution of extreme events and gradual climate change, it is mainly socio-economic and demographic factors that will ultimately determine the damage costs. These include, amongst others, the age structure of the population in urban areas, the value of exposed assets, the development of infrastructure for example in avalanche or landslide endangered areas, as well as overall land use, which largely control the vulnerability to climate change.

Without increased efforts to adapt to climate change, Austria's vulnerability to climate change will increase in the decades ahead (high confidence, see Volume 2, Chapter 6). In Austria climate change particularly influences the weather-dependent sectors and areas such as agriculture and forestry, tourism, hydrology, energy, health and transport and the sectors that are linked to these (high confidence, see Volume 2, Chapter 3). It is to be expected that adaptation measures can somewhat mitigate the negative impacts of climate change, but they cannot fully offset them (medium confidence, see Volume 3, Chapter 1).

In 2012 Austria adopted a national adaptation strategy specifically in order to cope with the consequences of climate change (see Volume 3, Chapter 1). The effectiveness of this strategy will be measured principally by how successful individual sectors, or rather policy areas, will be in the development of appropriate adaptation strategies and their implementation. The criteria for their evaluation, such as a regular survey of the effectiveness of adaptation measures, as other nations have already implemented, are not yet developed in Austria.

In 2010 the greenhouse gas emissions in Austria amounted to a total of approximately 81 Mt CO_2-equivalents (CO_2-eq.) or 9.7 t CO_2-eq. per capita (very high confidence, see Volume 1, Chapter 2)**.** These figures take into account the emission contribution of land-use changes through the carbon uptake of ecosystems. The Austrian per capita emissions are slightly higher than the EU average of 8.8 t CO_2-eq. per capita per year and significantly higher than those for example of China (5.6 t CO_2-eq. per capita per year), but much lower than those of the U.S. (18.4 t CO_2-eq. per person per year) (see Volume 1, Chapter 2). Austria has made commitments in the Kyoto Protocol to reduce its emissions. After correcting for the part of the carbon sinks that can be claimed according to the agreement, the emissions for the commitment period 2008 to 2012 were 18.8 % higher than the reduction target of 68.8 M CO_2-eq. per year (see Volume 3, Chapter 1).

By also accounting for the Austrian consumption-related CO_2-emissions abroad, the emission values for Austria are almost 50 % higher (high confidence Volume 3, Chapter 5). Austria is a contributor of emissions in other nations. Incorporating these emissions on the one hand, and adjusting for the Austrian export-attributable emissions on the other hand, one arrives at the „consumption-based" emissions of Austria. These are significantly higher than the emissions reported in the previous paragraph, and in the UN statistics reported for Austria, and this tendency is increasing (in 1997 they were 38 % and in 2004 they were 44 % higher than those reported). From the commodity flows it can be inferred that Austrian imports are responsible for emissions particularly from south Asia and from east Asia, specifically China, and from Russia (see Figure 3).

The national greenhouse gas emissions have increased since 1990, although under the Kyoto Protocol Austria has committed to a reduction of 13 % over the period 2008 to 2012 compared to 1990 (virtually certain, see Volume 3, Chapter 1; Volume 3, Chapter 6). The Austrian goal was set relatively high compared to other industrialized countries. Formally compliance with this reduction target for 2008 to 2012 was achieved through the purchase of emission rights abroad amounting to a total of about 80 Mt CO_2-eq. for roughly € 500 million (very high confidence, see Volume 3, Chapter 1).

In Austria, efforts are underway to improve energy efficiency and to promote renewable energy sources; however, the objectives pertaining to renewables and energy efficiency are not sufficiently backed by tangible measures to make them achievable. Thus, in 2010 an energy strategy was released which proposes that the final energy consumption in 2020 should not exceed the level of 2005; an amount of 1 100 PJ. However, this has not yet been implemented with adequate measures. Austria's Green Electricity Act (*Ökostromgesetz*) stipulates that an additional power generation of 10.5 TWh (37.8 PJ) per year up to 2020 should be from renewable sources. The energy

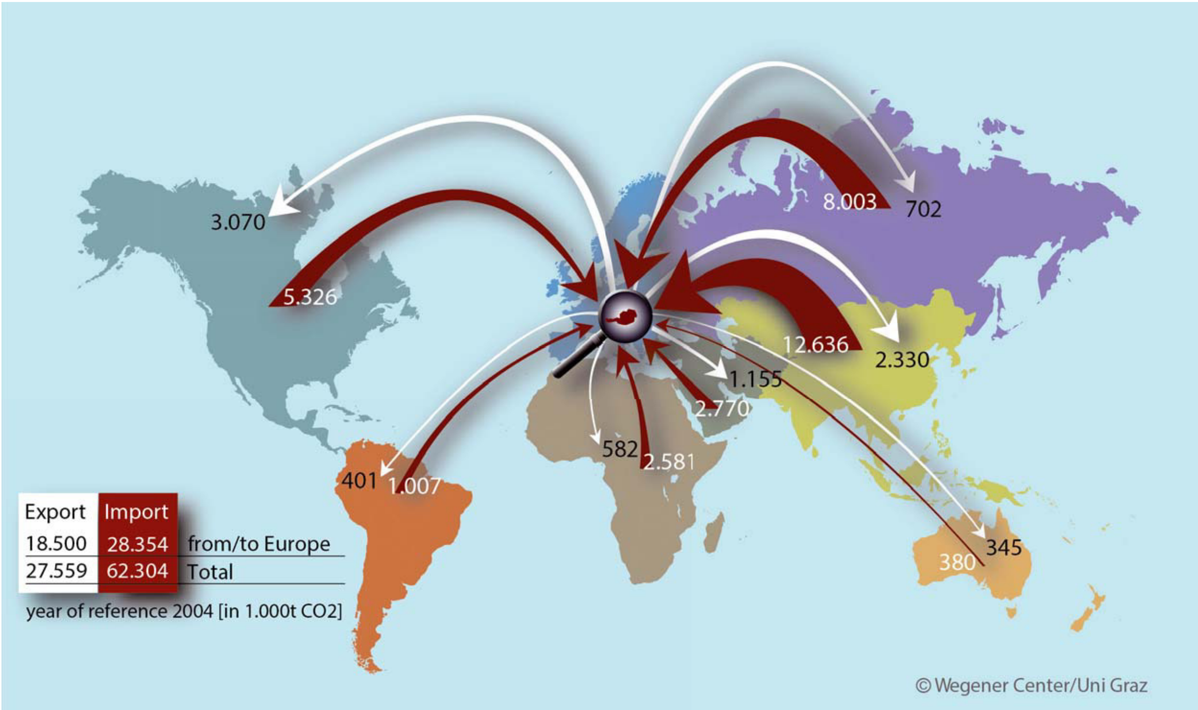

Figure 3 CO_2 streams from the trade of goods to/from Austria according to major world regions. The emissions implicitly contained in the imported goods are shown with red arrows, the emissions contained in the exported goods, attributed to Austria, are shown with white arrows. Overall, south Asia and east Asia, particularly China, and Russia, are evident as regions from which Austria imports emission-intensive consumer- and capital- goods. Source: Munoz and Steininger (2010)

sector and the industry are largely regulated under the „EU ETS“, the further development of which is currently negotiated. In particular, the transport sector currently lacks effective measures.

Austria has set only short-term reduction targets for its climate and energy program, namely for the period up to 2020 (see Volume 3, Chapter 1; Volume 3, Chapter 6). This corresponds to the binding EU targets, but to adequately tackle the problem other countries have set longer-term GHG reduction targets. For example, Germany has set a reduction target of 85 % to 2050. The UK intends to achieve a reduction of 80 % by 2050 (see Volume 3, Chapter 1).

The measures taken so far are insufficient to meet the expected contribution of Austria to achieve the global 2 °C target (high confidence, see Volume 3, Chapter 1; Volume 3, Chapter 6). The actions specified by Austria are based on the objectives for the year 2020; the goals for developing renewable energy sources in Austria are not sufficiently ambitious and are likely to be achieved well before 2020. It is unlikely that an actual change in emission trends will be achieved in the industrial and transport sectors, while the turnaround that has already taken place for space heating is likely to be insufficient (see Volume 3, Chapter 3; Volume 3, Chapter 5). The expected greenhouse gas emissions savings due to the replacement of fossil fuels with biofuels are increasingly being called into question (see Volume 3, Chapter 2).

Institutional, economic, social and knowledge barriers slow progress with respect to mitigation and adaptation. Measures to eliminate or overcome these barriers include a reforming of administrative structures with respect to relevant tasks at hand, such as the pricing of products and services according to their climate impact. A key factor in this regard includes an abolition of environmentally harmful financing and subsidies; for example, for the exploration of new fossil reserves, or the commuter support which favors the use of the cars, or housing subsidies for single-family homes in the urban vicinity. Also, having a strong involvement of civil society and of science in the decision-making processes can accelerate necessary measures. Relevant knowledge gaps should be addressed because they also delay further action, however they do not belong to the most important factors (high confidence, see Volume 3, Chapter 1; Volume 3, Chapter 6).

According to scenario simulations, emission reductions of up to 90 % can be achieved in Austria by 2050 through additional implementation measures (high confidence, see Volume 3, Chapter 3; Volume 3, Chapter 6). These scenarios are obtained from studies that focus on the energy supply and demand. However, currently there is a lack of clear commitment on the part of the decision-makers to emission reductions of such a magnitude. In addition, so far there is no clear perception pertaining to the financial or other economic and social framework conditions on how the listed objectives could be achieved. In addition to technological innovations, far-reaching economic and socio-cultural changes are required (e. g. in production, consumption and lifestyle).

According to the scenarios, the target set by the EU can be achieved by halving the energy consumption in Austria by 2050. It is expected that the remaining energy demand can be covered by renewable energy sources. The economically available potential of renewable resources within Austria is quantified at approximately 600 PJ. As a comparison, the current final energy consumption is 1 100 PJ per year (see Volume 3, Chapter 3). The potential to improve energy efficiency exists, particularly in the sectors of buildings, transportation and production (high confidence, see Volume 3, Chapter 3; Volume 3, Chapter 5).

Striving for a swift and serious transformation to a carbon-neutral economic system requires a cross-sectoral closely coordinated approach with new types of institutional cooperation in an inclusive climate policy. The individual climate mitigation strategies in the various economic sectors and related areas are not sufficient. Other types of transformations should also be taken into account, such as those of the energy system, because decentralized production, storage and control system for fluctuating energy sources and international trade are gaining in importance (medium confidence, see Volume 3, Chapter 3). Concurrently, numerous small plant operators with partially new business models are entering the market.

An integrative and constructive climate policy contributes to managing other current challenges. One example is economic structures become more resistant with respect to outside influences (financial crisis, energy dependence). This means the intensification of local business cycles, the reduction of international dependencies and a much higher productivity of all resources, especially of energy (see Volume 3, Chapter 1).

The achievement of the 2050 targets only appears likely with a paradigm shift in the prevailing consumption and behavior patterns and in the traditional short-term oriented policies and decision-making processes (high confidence, see Volume 3, Chapter 6). Sustainable development approaches which contribute both to a drastic departure from historical trends as well as individual sector-oriented strategies and business models can contribute to the required GHG reductions (probably, see Volume 3, Chapter 6). New integrative approaches in terms of sustainable development require not necessarily novel technological solutions, but most importantly a conscious reorientation of established, harmful lifestyle habits and in the behavior of economic stakeholders. Worldwide, there are initiatives for transformations in the direction of sustainable development paths, such as the energy turnaround in Germany (*Energiewende*), the UN initiative „Sustainable Energy for All", a number of „Transition Towns" or the „Slow Food" movement and the vegetarian diet. Only the future will show which initiatives will be successful (see Volume 3, Chapter 6).

Demand-side measures such as changes in diet, regulations and reduction of food losses will play a key role in climate protection. Shifting to a diet based on dominant regional and seasonal plant-based products, with a significant reduction in the consumption of animal products can make a significant contribution to greenhouse gas reduction (most likely, high confidence). The reduction of losses in the entire food life cycle (production and consumption) can make a significant contribution to greenhouse gas reduction. (very likely, medium confidence).

The necessary changes required to attain the targets include the transformation of economic organizational forms and orientations (high confidence, see Volume 3, Chapter 6). The housing sector has a high need for renewal; the renovation of buildings can be strengthened through new financing mechanisms. The fragmented transport system can be further developed into an integrated mobility system. In terms of production, new products, processes and materials can be developed that also ensure Austria is not left behind in the global competition. The energy system can be aligned along the perspective of energy services in an integrated manner.

In a suitable political framework, the transformation can be promoted (high confidence, see Volume 3, Chapter 1; Volume 3, Chapter 6). In Austria, there is a willingness to change. Pioneers (individuals, businesses, municipalities, regions) are implementing their ideas already, for example in the field of energy services, or climate-friendly mobility and local supply. Such initiatives can be strengthened through policies that create a supportive environment.

New business and financing models are essential elements of the transformation. Financing instruments (beyond the subsidies primarily used so far) and new business models relate mainly to the conversion of the energy selling enterprises to specialists for energy services. The energy efficiency can be significantly increased and made profitable, legal obligations can drive building restoration, collective investments in renewables or efficiency measures can be made possible by adapting legal provisions. Communication policy and regional planning can facilitate the use of public transport and emission-free transport, such as is the case for example in Switzerland (see Volume 3, Chapter 6). Long-term financing models (for buildings for example for 30 to 40 years), which are especially endowed by pension funds and insurance companies can facilitate new infrastructure. The required transformation has global dimensions, therefore efforts abroad, showing solidarity, should be discussed, including provisions for the Framework Convention Climate Fund.

Major investments in infrastructure with long lifespans limit the degrees of freedom in the transformation to sustainability if greenhouse gas emissions and adaptation to climate change are not considered. If all projects had a „climate-proofing“ subject to consider integrated climate change mitigation and appropriate adaptation strategies, this would avoid so-called „lock-in effects“ that create long-term emission-intensive path dependencies (high confidence, see Volume 3, Chapter 6). The construction of coal power plants is an example. At the national level this includes the disproportionate weight given to road expansion, the construction of buildings, which do not meet current ecological standards – that could be met at justifiable costs – and regional planning with high land consumption inducing excessive traffic.

A key area of transformation is related to cities and densely settled areas (high confidence, see Volume 3, Chapter 6). The potential synergies in urban areas that can be used in many cases to protect the climate are attracting greater attention. These include, for example, efficient cooling and heating of buildings, shorter routes and more efficient implementation of public transport, easier access to training or education and thus accelerated social transformation.

Climate-relevant transformation is often directly related to health improvements and accompanied by an increase in the quality of life (high confidence, see Volume 3, Chapter 4; Volume 3, Chapter 6). For the change from car to bike, for example, a positive-preventive impact on cardiovascular diseases has been proven, as have been further health-improving effects, that significantly increase life expectancy, in addition to positive environmental impacts. Health supporting effects have also been proven for a sustainable diet (e. g. reduced meat consumption).

Climate change will increase the migration pressure, also towards Austria. Migration has many underlying causes. In the southern hemisphere, climate change will have particularly strong impacts and will be a reason for increased migration mainly within the Global South. The IPCC estimates that by 2020 in Africa and Asia alone 74 million to 250 million people will be affected. Due to the African continent being particularly impacted, refugees from Africa to Europe are expected to increase (Volume 3, Chapter 4).

Climate change is only one of many global challenges, but a very central one (very high confidence, see Volume 2, Chapter 6; Volume 3, Chapter 1; Volume 3, Chapter 5). A sustainable future also deals with for example issues of combating poverty, a focus on health, social human resources, the availability of water and food, having intact soils, the quality of the air, loss of biodiversity, as with ocean acidification and overfishing (very high confidence, see Volume 3, Chapter 6). These questions are not independent of each other: climate change often exacerbates the other problems. And therefore it often affects the most vulnerable populations the most severely. The community of states has triggered a UN process to formulate sustainable development goals after 2015 (Sustainable Development Goals). Climate change is at the heart of these targets and many global potential conflict areas. Climate mitigation measures can thus generate a number of additional benefits to achieve further global objectives (high confidence, see Volume 3, Chapter 6).

Impacts on Sectors and Measures of Mitigation and Adaptation

Soils and Agriculture

Climate change leads to the loss of humus and to greenhouse gas emissions from the soil. Temperature rise, temperature extremes and dry periods, more pronounced freezing and thawing in winter as well as strong and long drying out of the soil followed by heavy precipitation enhance certain processes in the soil that can lead to an impairment of soil functions, such as soil fertility, water and nutrient storage capacity, humus depletion causing soil erosion, and others. This results in increased greenhouse gas emissions from soil (very likely, see Volume 2, Chapter 5).

Human intervention increases the area of soils with a lower resilience to climate change. Soil sealing and the consequences of unsuitable land use and management such as compaction, erosion and loss of humus further restrict soil functions and reduce the soil's ability to buffer the effects of climate change (very likely, see Volume 2, Chapter 5).

The impacts of climate change on agriculture vary by region. In cooler, wetter areas – for example, in the northern foothills of the Alps – a warmer climate mainly increases the average potential yield of crops. In precipitation poorer areas north of the Danube and in eastern and south-eastern Austria, increasing drought and heat-stress reduce the long term average yield potential, especially of non-irrigated crops, and increase the risk of failure. The production potential of warmth-loving crops, such as corn or grapes, will expand significantly (very likely, see Volume 2, Chapter 3).

Heat tolerant pests will propagate in Austria. The damage potential of agriculture through – in part newly emerging – heat tolerant insects will increase. Climate change will also alter the occurrence of diseases and weeds (very likely, see Volume 2, Chapter 3).

Livestock will also suffer from climate change. Increasing heat waves can reduce the performance and increase the risk of disease in farm animals (very likely, see Volume 2, Chapter 3).

Adaptation measures in the agricultural sector can be implemented at varying rates. Within a few years measures such as improved evapotranspiration control on crop land (e. g. efficient mulch cover, reduced tillage, wind protection), more efficient irrigation methods, cultivation of drought- or heat-resistant species or varieties, heat protection in animal husbandry, a change in cultivation and processing periods as well as crop rotation, frost protection, hail protection and risk insurance are feasible (very likely, see Volume 3, Chapter 2).

In the medium term, feasible adaptation measures include soil and erosion protection, humus build up in the soil, soil conservation practices, water retention strategies, improvement of irrigation infrastructure and equipment, warning, monitoring and forecasting systems for weather-related risks, breeding stress-resistant varieties, risk distribution through diversification, increase in storage capacity as well as animal breeding and adjustments to stable equipment and to farming technology (very likely, see Volume 3, Chapter 2).

The shifts caused by a future climate in the suitability for the cultivation of warmth-loving crops (such as grain corn, sunflower, soybean) is shown in Figure 4 for the example of grapes for wine production. Many other heat tolerant crops such as corn, sunflower or soybean show similar expansions in areas suitable for their cultivation in future climate as is shown here for the case of wine (see Volume 2, Chapter 3).

Agriculture can reduce greenhouse gas emissions in a variety of ways and enhance carbon sinks. If remaining at current production volume levels, the greatest potentials lie in the areas of ruminant nutrition, fertilization practices, reduction of nitrogen losses and increasing the nitrogen efficiency (very likely, see Volume 3, Chapter 2). Sustainable strategies for reducing greenhouse gas emissions in agriculture require resource-saving and efficient management practices involving organic farming, precision farming and plant breeding whilst conserving genetic diversity (probably, see Volume 3, Chapter 2).

Forestry

A warmer and drier climate will strongly impact the biomass productivity of Austrian forests. Due to global warming, the biomass productivity increases in mountainous areas and in regions that receive sufficient precipitation. However, in eastern and northeastern lowlands and in inner-alpine basins, the productivity declines, due to more dry periods (high agreement, robust evidence, see Volume 2, Chapter 3; Volume 3, Chapter 2).

In all of the examined climate scenarios, the disturbances to forest ecosystems are increasing in intensity and in frequency. This is particularly true for the occurrence of heat-tolerant insects such as the bark beetle. In addition, new types of damage can be expected from harmful organisms that have been imported or that have migrated from southern regions. Abiotic disturbances such as storms, late and early frosts, wet snow events or wildfires could also cause greater damages than before (high uncertainty). These disturbances can also trigger outbreaks and epidemics of major forest pests, such as the bark beetle. Disturbances lead to lower revenues for wood production. The protective function of the forests against events such as rockfalls, landslides, avalanches as well as carbon storage decrease (high agreement, robust evidence, see Volume 2, Chapter 2; Volume 3, Chapter 2).

For decades Austria's forests have been a significant net sink for CO_2. Since approximately 2003, the net CO_2 uptake of the forest has declined and in some years has come to a complete standstill; this is due to higher timber harvests, natural disturbances and other factors. In addition to the GHG impacts of increased felling, a comprehensive greenhouse gas balance of different types of forest management and use of forest products requires considering the carbon storage in long-lived wood products as well as the GHG savings of other emission-intensive products that can be replaced by wood (e. g. fossil fuel, steel, concrete) as well. A final assessment of the systemic effects would require more accurate and comprehensive analyzes than those that currently exist (see Volume 3, Chapter 2).

The resilience of forests to risk factors as well as the adaptability of forests can be increased. Examples of ad-

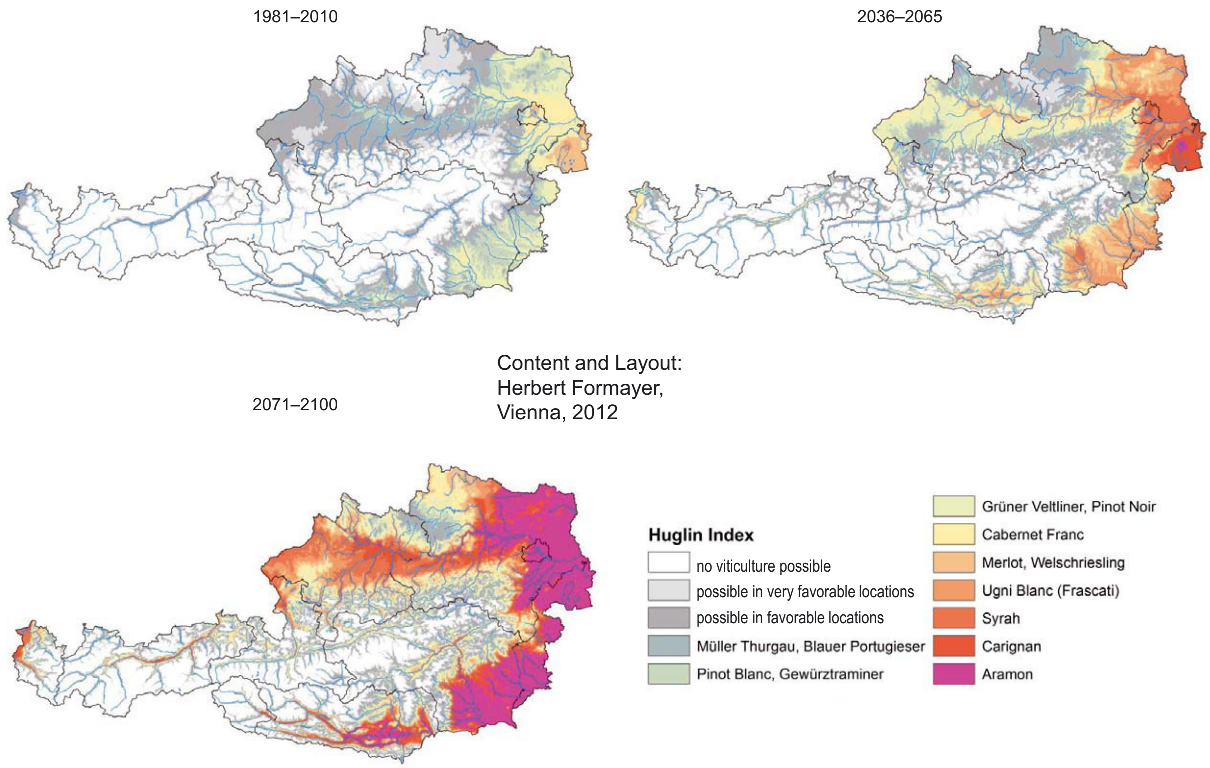

Figure 4 Evolution of the climatic suitability for the cultivation of different varieties, taking into account the optimum heat levels and rainfall in Austria in the past climate (observed) and a climate scenario until the end of the 21st century (modelled). The color shades from blue to yellow to purple indicate increasing heat amounts exclusively based on the corresponding variety classification. One can clearly see the increasing suitability for red wines, towards the end of the century as there are extremely heat-loving varieties. Source: Eitzinger and Formayer (2012)

aptation measures are smaller scale management structures, mixed stands adapted to sites, and ensuring the natural forest regeneration in protected forests through adapted game species management. The most sensitive areas are the spruce stands in mixed deciduous forest sites located in lowlands, and spruce monocultures in mountain forests serving a protective function. The adaptation measures in the forest sector are associated with considerable lead times (high agreement, robust evidence, see Volume 3, Chapter 2).

Biodiversity

Ecosystems that require a long time to develop, as well as alpine habitats located above the treeline are particularly impacted by climate change (high agreement, robust evidence, see Volume 2, Chapter 3). Bogs and mature forests require a long time to adapt to climate change and are therefore particularly vulnerable. Little is known about the interaction with other elements of global change, such as land use change or the introduction of invasive species. The adaptive capacity of species and habitats has also not been sufficiently researched.

In alpine regions, cold-adapted plants can advance to greater heights and increase the biodiversity in these regions. Cold-adapted species can survive in isolated microniches in spite of the warming (high agreement, robust evidence). However, increasing fragmentation of populations can lead to local extinctions. High mountains native species that have adapted to lower peripheral regions of the Alps are particularly affected (medium agreement, medium evidence, see Volume 2, Chapter 3).

Animals are also severely affected. In the animal kingdom, changes in the annual cycles are already documented, such as the extension of activity periods, increased successions of generations, earlier arrival of migratory birds, as well as shifts in distribution ranges northward or to higher elevations of individual species. Climate change will further advantageous for some animal species, especially generalists, and fur-

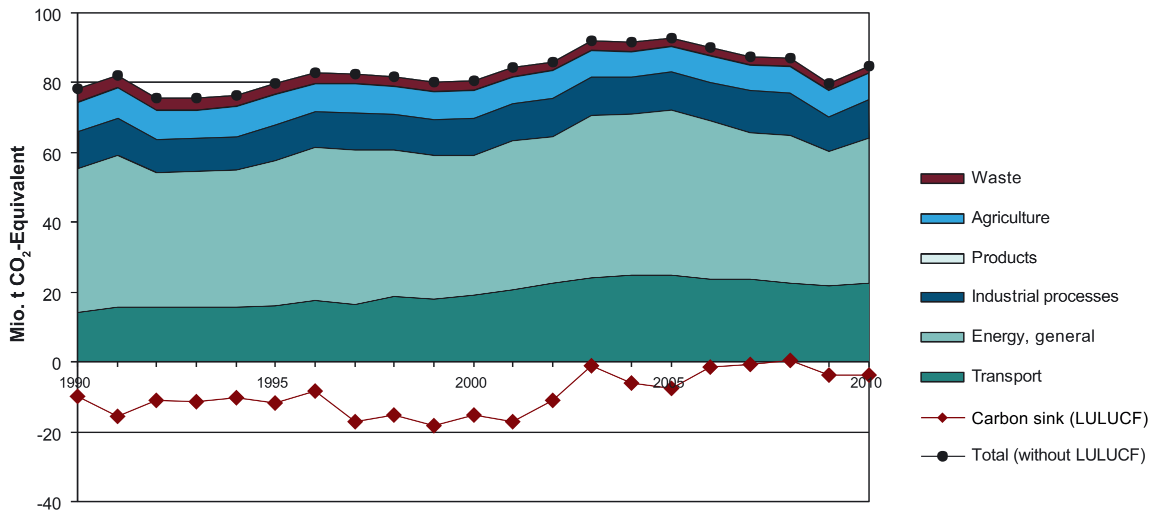

Figure 5 Officially reported greenhouse gas emissions in Austria (according to the IPCC source sectors with especially defined emissions for the Transport sector). The brown line that is mainly below the zero line represents carbon sinks. The sector „Land use and land use change" (LULUCF) represents a sink for carbon and is therefore depicted below the zero line. In recent years, this sink was significantly smaller and no longer present in some years. This was mainly a result of higher felling; and changes to the survey methods contributed to this as well. Source: Anderl et al. (2012)

ther endanger others, especially specialists (medium evidence, see Volume 2, Chapter 3). The warming of rivers and streams leads to a theoretical shift in the fish habitat by up to 30 km. For brown trout and grayling for example, the number of suitable habitats will decline (high agreement, robust evidence, see Volume 2, Chapter 3).

Energy

Austria has a great need to catch up on improvements in energy intensity. In the last two decades, unlike the EU average, Austria has made little progress in terms of improvements to energy intensity (energy consumption per GDP in Euro, see Figure 6). Since 1990, the energy intensity of the EU-28 decreased by 29 % (in the Netherlands by 23 %, Germany by 30 % and in the UK by 39 %). In Germany and the UK, however some of these improvements are due to the relocation of energy-intensive production abroad. In terms of emission intensity (GHG emissions per PJ energy) the improvements in Austria since 1990 are a reflection of the strong development of renewables; here, Austria along with The Netherlands, counts among the countries with the strongest improvements. These two indicators together determine the greenhouse gas emission intensity of the gross domestic product (GDP), which in Austria as well as in the EU-28 has also declined since 1990. Greenhouse gas emissions have increased more slowly than GDP. However, in comparison with the EU-28 it becomes evident that Austria must make major strides to catch up in reducing energy intensity (see Volume 3, Chapter 1).

The potential renewable energy sources in Austria are currently not fully exploited. In Austria, the share of renewable energy sources in the gross final energy consumption has increased from 23.8 % to 31 % between 2005 and 2011, primarily due to the development of biogenic fuels, such as pellets and biofuels. In the future, wind and photovoltaics can make a significant contribution. The target for 2020, for a 34 % share in end energy use of renewable energies can be easily achieved with the current growth rates. However, for the required medium-term conversion to a greenhouse gas neutral energy system by 2050, a coverage of the entire energy demand with renewable energy sources is necessary. To avoid a mere shifting of the problem, before any further future expansion of hydroelectric power or increased use of biomass takes place, it is important to examine the total greenhouse gas balances as well as to take into account indirect and systemic effects. Other environmental objectives do not lose their importance in an effort to protect the climate (see Volume 3, Chapter 3; Volume 3, Chapter 6).

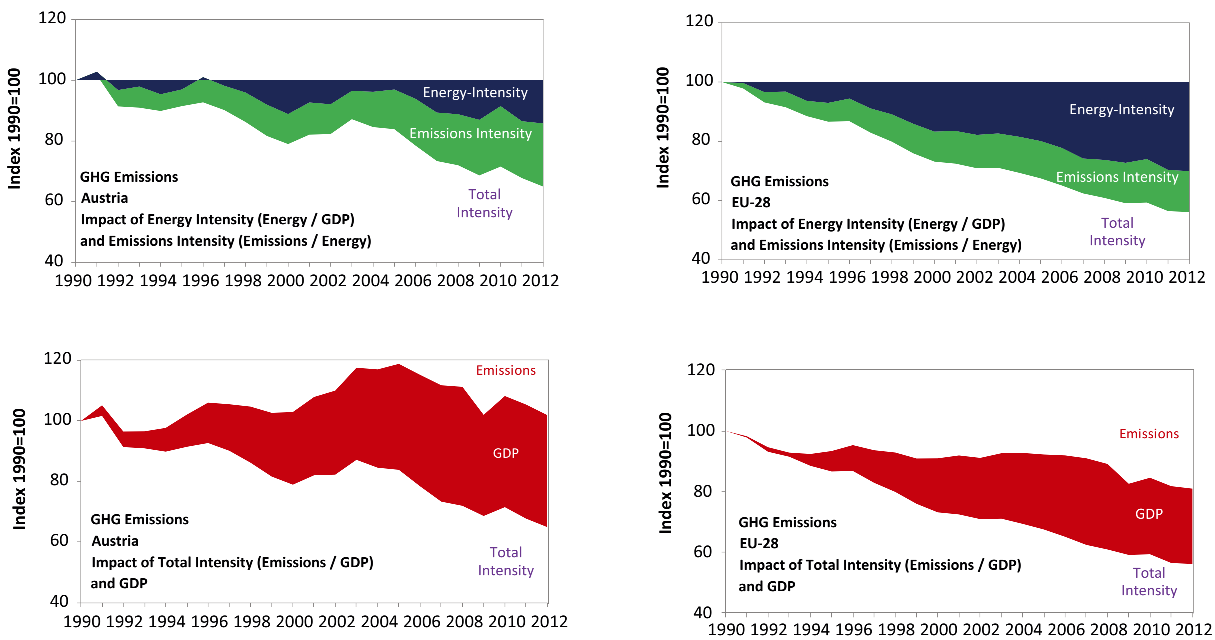

Figure 6 Development of GHG intensity of GDP and the subdevelopments of energy intensity (energy consumption per GDP in Euro) and emission intensity of energy (greenhouse gas emissions per PJ of energy) over time for Austria and for the EU-28 (upper panel). The development of greenhouse gas emission intensity in conjunction with rising GDP (lower panel) leads to rising greenhouse gas emissions for Austria (+5%), and declining emissions for the EU-28 (−18%) during this period; Source: Schleicher (2014)

Transport and Industry

Of all sectors, the greenhouse gas emissions increased the most in the last two decades in the transport sector by +55 % (very high confidence, see Volume 3, Chapter 3). Efficiency gains made in vehicles were largely offset by heavier and more powerful vehicles as well as higher transport performance. However, the limitations of CO_2 emissions per kilometer driven for passenger cars and vans are beginning to bear fruit (see Volume 3, Chapter 3). Public transportat supply changes and (tangible) price signals have had demonstrable effects on the share of private vehicle transport in Austria.

To achieve a significant reduction in greenhouse gas emissions from passenger transport, a comprehensive package of measures is necessary. Keys to achieving this are marked reductions in the use of fossil-fuel energy sources, increasing energy efficiency and changing user behaviour. A prerequisite is improved economic- and settlement- structures in which the distances to travel are minimized. This may strengthen the environmentally friendly forms of mobility used, such as walking and cycling. Public transportation systems are to be expanded and improved, and their CO_2 emissions are to be minimized. Technical measures for car transport include further, massive improvements in efficiency for vehicles or the use of alternative power sources (Volume 3, Chapter 3) – provided that the necessary energy is also produced with low emissions.

Freight transportation in Austria, measured in tonne-kilometers, increased faster in the last decades than the gross domestic product. The further development of transport demand can be shaped by a number of economic and social conditions. Emissions can be reduced by optimizing the logistics and strengthening the CO_2 efficiency of transport. A reduction in greenhouse gas emissions per tonne-kilometer can be achieved by alternative power and fuels, efficiency improvements and a shift to rail transportation (see Volume 3, Chapter 3).

The industry sector is the largest emitter of greenhouse gases in Austria. In 2010, the share of the manufacturing sector's contribution to the total Austrian energy-consumption as well as to greenhouse gas emissions was almost 30 %, in both cases. Emission reductions in the extent of about 50 % or more cannot be achieved within the sector through continuous, gradual improvements and application of the relevant state of the art of technology. Rather, the development of climate-friendly new procedures is necessary (radical new technologies and products with a drastic reduction of energy consumption), or the necessary implementation of procedures for the storage of the greenhouse gas emissions (carbon capture and storage,

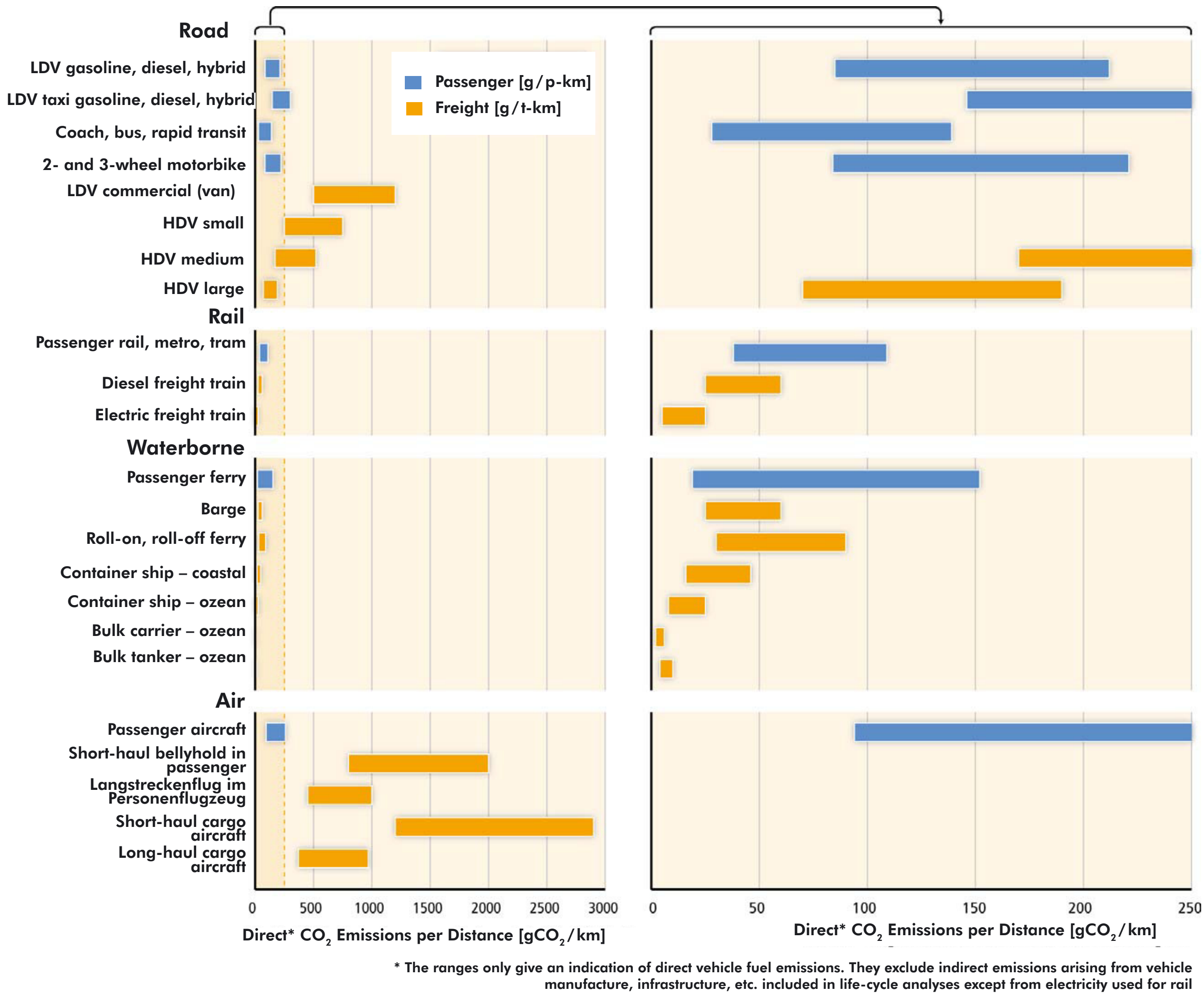

Figure 7 A comparison of characteristic CO_2 emissions per passenger-kilometer and ton-kilometer for different transport modes that use fossil energy and thermal electricity generation in case of electric railways. Source: IPCC (2014)

for example as in the EU scenarios for Energy Roadmap 2050) (very likely, see Volume 3, Chapter 5).

Tourism

Winter tourism will come under pressure due to the steady rise in temperature. Compared to destinations where natural snow remains plentiful, many Austrian ski areas are threatened by the increasing costs of snowmaking (very likely, see Volume 3, Chapter 4).

Future adaptation possibilities with artificial snowmaking are limited. Although currently 67 % of the slope surfaces are equipped with snowmaking machines, the use of these is limited by the rising temperatures and the (limited) availability of water (likely, see Volume 3, Chapter 4). The promotion of the development of artificial snow by the public sector could therefore lead to maladaptation and counterproductive lock-in effects.

Tourism could benefit in Austria due to the future very high temperatures expected in summer, in the Mediterra-

nean (very likely). However, even with equally good turnout and capacity utilization in the summer, the value added lost in winter cannot be regained with an equal gain in visitor numbers in summer (see Volume 3, Chapter 4).

Losses in tourism in rural areas have high regional economic follow-up costs, since the loss of jobs often cannot be compensated by other industries. In peripheral rural areas, which already face major challenges due to the demographic change and the increasing wave of urbanization, this can lead to further resettlement (see Volume 3, Chapter 1; Volume 3, Chapter 4).

Urban tourism may experience set-backs in midsummer due to hot days and tropical nights (very likely). Displacements of the stream of tourists in different seasons and regions are possible and currently already observable (see Volume 3, Chapter 4).

Successful pioneers in sustainable tourism are showing ways to reduce greenhouse gases in this sector. In Austria there are flagship projects at all levels – individuals, municipalities and regions – and in different areas, such as hotels, mobility, and lucrative offers for tourists. Due to the long-term investment in infrastructure for tourism, lock-in effects are particularly vulnerable (see Volume 3, Chapter 4).

Infrastructure

Energy use for heating and cooling buildings and their GHG emissions can be significantly reduced (high agreement, see Volume 3, Chapter 5). A part of this potential can be realized in a cost-effective manner. To further reduce the energy demand of existing buildings, high-quality thermal renovation is necessary. For energy supply, mainly alternative energy sources, such as solar thermal or photovoltaic are to be used for the reduction of greenhouse gas emissions. Heat pumps can only be used in the context of an integrated approach which ensures low CO_2 power generation, thereby contributing to climate protection. Biomass will also be important in the medium term. District heating and cooling will become less important in the long term due to reduced demand. A significant contribution to future greenhouse gas neutrality in buildings can also be provided by building construction standards, which the (almost) zero-energy and plus-energy houses promote. These are foreseen to occur across the EU after 2020. Given the large number of innovative pilot projects, Austria could assume a leadership role in this area also before. Targeted construction standards and renovation measures could significantly reduce the future cooling loads. Specific zonal planning and building regulations can ensure denser designs with higher energy efficiency, especially also beyond the inner urban settlement areas (see Volume 3, Chapter 5).

Forward planning of infrastructure with a long service life under changing conditions can avoid poor investments. Against the background of continuously changing post-fossil energy supply conditions, infrastructure projects in urban locations, in transport and energy supplies should be reviewed to ensure their emission-reducing impacts as well as their resilience to climate change. The structure of urban developments can be designed so that transport and energy infrastructures are coordinated and built (and used) efficiently with low resource consumptions (see Volume 3, Chapter 5).

A decentralized energy supply system with renewable energy requires new infrastructure. In addition to novel renewables with stand-alone solutions (e. g. off-grid photovoltaics) there are also new options for integrating these onto the network. Local distribution networks for locally produced biogas as well as networks for exploiting local, mostly industrial, waste heat (see Volume 3, Chapter 1; Volume 3, Chapter 3) require special structures and control. „Smart Grids“ and „Smart Meters“ enable locally produced energy (which is fed into the grid, e. g. from co- and poly-generation or private photovoltaic systems) to contribute to improved energy efficiency and are therefore discussed as elements of a future energy system (see Volume 3, Chapter 5). However, there are concerns of ensuring network security as well as data protection and privacy protection; these issues are not yet sufficiently defined or regulated by law.

Extreme events can increasingly impair energy and transport infrastructures. Longer duration and more intense heat waves are problematic (very likely), more intense rainfall and resulting landslides and floods (probably), storms (possible) and increased wet-snow loads (possible, see Volume 1, Chapter 3; Volume 1, Chapter 4; Volume 1, Chapter 5; Volume 2, Chapter 4) pose potential risks for infrastructure related to settlement, transportation, energy and communications. If an increase in climate damages and costs are to be avoided, the construction and expansion of urban areas and infrastructure in areas (regions) that are already affected by natural hazards should be avoided. Moreover, when designating hazard zones, the future development in the context of climate change should be taken as a precautionary measure. Existing facilities can provide increased protection through a range of adaptation measures, such as the creation of increased retention areas against flooding.

The diverse impacts of climate change on water resources require extensive and integrative adaptation measures.

Both high- and low-water events in Austrian rivers can negatively impact several sectors, from the shipping industry, the provision of industrial and cooling water, to the drinking water supply. The drinking water supply can contribute to adaptation measures through the networking of smaller supply units as well as the creation of a reserve capacity for source water (high agreement, robust evidence, see Volume 3, Chapter 2).

Adaptation measures to climate change can have positive ramifications in other areas. The objectives of flood protection and biodiversity conservation can be combined through the protection and expansion of retention areas, such as floodplains (high agreement, much evidence). The increase in the proportion of soil organic matter leads to an increase in the soil water storage capacity (high agreement, robust evidence, see Volume 2, Chapter 6) and thus contributes to both flood protection and carbon sequestration, and therefore to climate protection (see Volume 3, Chapter 2).

Health and Society

Climate change may cause directly- or indirectly- related problems for human health. Heat waves can lead to cardiovascular problems, especially in older people, but also in infants or the chronically ill. There exists a regional-dependent temperature at which the death rate is determined to be the lowest; beyond this temperature the mortality increases by 1–6 % for every 1 °C increase in temperature (very likely, high confidence, see Volume 2, Chapter 6; Volume 3, Chapter 4). In particular, older people and young children have shown a significant increase in the risk of death above this optimum temperature. Injuries and illnesses that are associated with extreme events (e. g. floods and landslides) and allergies triggered by plants that were previously only indigenous to Austria, such as ragweed, also add to the impacts of climate change on health.

The indirect impacts of climate change on human health remains a major challenge for the health system. In particular, pathogens that are transferred by blood-sucking insects (and ticks) play an important role, as not only the agents themselves, but also the vectors‘ (insects and ticks) activity and distribution are dependent on climatic conditions. Newly introduced pathogens (viruses, bacteria and parasites, but also allergenic plants and fungi such as, e. g. ragweed (*Ambrosia artemisiifolia*) and the oak processionary moth (*Thaumetopoea processionea*)) and new vectors (e. g., „tiger mosquito", *Stegomyia albopicta*) can establish themselves, or existing pathogens can spread regionally (or even disappear). Such imported cases are virtually unpredictable and the opportunities to take counter-measures are low (likely, medium confidence, see Volume 2, Chapter 6).

Health-related adaptations affect a myriad of changes to individual behavior of either a majority of the population or by members of certain risk groups (likely, medium agreement, see Volume 3, Chapter 4). Several measures of adaptation and mitigation that are not primarily aimed at improving human health may have significant indirect health-related benefits, such as switching from a car to a bike (likely, medium agreement, see Volume 3, Chapter 4).

The health sector is both an agent and a victim of climate change. The infrastructure related to the health sector requires both mitigation and adaptation measures. Effective mitigation measures could include encouraging the mobility of employees and patients as well as in the procurement of used and recycled products (very likely, high agreement, see Volume 3, Chapter 4). For specific adaptation to longer-term changes there is a lack of medical and climate research, however some measures can be taken now – such as in preparing for heat waves.

Vulnerable groups generally are more highly exposed to the impacts of climate change. Usually the confluence of several factors (low income, low education level, low social capital, precarious working and living conditions, unemployment, limited possibilities to take action) make the less privileged population groups more vulnerable to climate change impacts. The various social groups are affected differently by a changing climate, thus the options to adapt are also dissimilar and are also influenced by differing climate policy measures (such as higher taxes and fees on energy) (likely, high agreement, see Volume 2, Chapter 6)

Climate change adaptation and mitigation lead to increased competition for resource space. This mainly affects natural and agricultural land uses. Areas for implementing renewable energy sources, or retention areas and levees to reduce flood risks are often privileged at the expense of agricultural land. Increasing threats of natural hazards to residential areas may lead to more resettlements in the long term (high confidence, see Volume 2, Chapter 2; Volume 2, Chapter 5). In order to facilitate the adaptation of endangered species to climate change by allowing them to migrate to more suitable locations and in order to better preserve biodiversity, conservation areas must be drawn up and networked with corridors (high confidence, see Volume 3, Chapter 2). There is no regional planning strategy for Austria that can provide necessary guidelines for relevant decisions (see Volume 3, Chapter 6).

Transformation

Although in all sectors significant emission reduction potentials exist, the expected Austrian contribution towards achieving the global 2 °C target cannot be achieved with sector-based, mostly technology-oriented, measures. Meeting the 2 °C target requires more than incrementally improved production technologies, greener consumer goods and a policy that (marginal) increases efficiency to be implemented in Austria. A transformation is required concerning the interaction of the economy, society and the environment, which is supported by behavioral changes of individuals, however these changes also have to originate from the individuals. If the risk of unwanted, irreversible change should not increase, the transformation needs to be introduced and implemented rapidly (see Volume 3, Chapter 6).

A transformation of Austria into a low-carbon society requires partially radical structural and technical renovations, social and technological innovation and participatory planning processes (medium agreement, medium evidence, see Volume 3, Chapter 6). This implies experimentation and experiential learning, the willingness to take risks and to accept that some innovations will fail. Renewal from the root will be necessary, also with regards to the goods and services that are produced by the Austrian economy, and large-scale investment programs. In the assessment of new technologies and social developments an orientation along a variety of criteria is required (multi-criteria approach) as well, an integrative socio-ecologically oriented decision-making is needed instead of short-term, narrowly defined cost-benefit calculations. To be of best effectiveness, national action should be agreed upon internationally, both with the surrounding nations as well as with the global community, and particularly in partnership with developing countries (see Volume 3, Chapter 6).

In Austria, a socio-ecological transformation conducive to changes in people's belief-systems can be noticed. Individual pioneers of change are already implementing these ideas with climate-friendly action and business models (e. g. energy service companies in real estate, climate-friendly mobility, or local supply) and transforming municipalities and regions (high agreement, robust evidence). At the political level, climate-friendly transformation approaches can also be identified. If Austria wants to contribute to the achievement of the global 2 °C target and help shape a future climate-friendly development at a European level and internationally, such initiatives need to be reinforced and supported by accompanying policy measures that create a reliable regulatory landscape (high agreement, medium evidence, see Volume 3, Chapter 6).

Policy initiatives in climate mitigation and adaptation are necessary at all levels in Austria if the above objectives are to be achieved: at the federal level, at that of provinces and that of local communities. Within the federal Austrian structure the competences are split, such that only a common and mutually adjusted approach across those levels can ensure highest effectiveness and achievement of objectives (high agreement; strong evidence). For an effective implementation of the – for an achievement necessarily – substantial transformation a package drawing from the broad spectrum of instruments appears to be the only appropriate one (high agreement, medium evidence).

Figure Credits

Figure 1 Issued for the AAR14 adapted from: IPCC, 2013: In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor,S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (Eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.; IPCC, 2000: Special Report on Emissions Scenarios [Nebojsa Nakicenovic and Rob Swart (Eds.)]. Cambridge University Press, UK.; GEA, 2012: Global Energy Assessment - Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.

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Figure 4 Issued for the AAR14. Source: ZAMG

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