

Austrian Assessment Report Climate Change 2014 (AAR14)

Synopsis – Main Findings



Austrian Panel on Climate Change (APCC)
Austrian Assessment Report 2014 (AAR14)





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Introduction

In a three-year process, Austrian scientists working 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, the impacts, mitigation and adaptation strategies, as well as the associated 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 with generous support of their respective research institutions.

This synopsis provides the most significant findings in simple terms. It gives information on the global context, the past and future climate in Austria and a summary of the main impacts and responses. Like the IPCC reports, the Austrian assessment is based on contributions that have already been published and aims to be policy-relevant without being policy-prescriptive. More extensive explanations can be found – in increasing detail – in the synthesis report and in the full report (Austrian Assessment Report, 2014) that are available in bookstores and on the Internet (www.apcc.at).

Uncertainties are described following the IPCC terminology that uses three different approaches. The choice of approach depends on the nature of the available data and on the authors' assessment of the accuracy and completeness of the current scientific understanding. For more detailed information please refer to the introductory chapter in AAR14 (in German) or the relevant IPCC documents (in English). If the description of uncertainty relates to a whole paragraph, it will be found as a footnote at the end of that paragraph. Otherwise the footnote is inserted after the statement in question.

The Global Context

The progress of industrialization has caused significant changes to the climate that 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, about half of which 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. The comparably small

increase in global average temperature since 1998 is likely an example of natural climate variability.

Without extensive additional measures to reduce emissions a global average surface temperature rise of 3–5 °C by 2100 compared to the first decade of the 20th century (see Figure 1) is to be expected. Self-reinforcing processes (positive feedback loops), such as the ice-albedo feedback¹ or additional release of greenhouse gases due to the thawing of permafrost in the Arctic regions play an important role.

Climate change and the associated impacts show large regional differences. For example, the Mediterranean region can expect a significant decrease in precipitation as well as an associated reduction of water availability. In coastal areas, especially when densely populated, climate change induced sea level rise will cause problems: For the highest emission scenario a rise in mean sea level of the order 0.5–1 m compared to the current level is likely by the end of this century.

The serious consequences of unbridled anthropogenic climate change for humanity have led to internationally binding agreements on emissions reductions. 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 committed to far-reaching goals. In the UNFCCC Copenhagen Accord and in the EU resolutions, a goal to limit the global temperature increase to 2 °C compared to pre-industrial levels is considered as necessary to limit dangerous climate change impacts. However, the voluntary emission reduction pledges made by the international community to date are not sufficient to meet the 2 °C target. In the long-term, almost complete avoidance of greenhouse gas emissions is required. This means converting the energy supply and industrial processes, stopping deforestation, and changing land use and lifestyles.

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. Since industrialized countries are responsible for most of the historical emissions – and have benefited from them and since they are also economically stronger – Article 4 of the UNFCCC suggests that they should make a more than proportionate contribution to total global emission reductions.

¹ The ice-albedo feedback is a positive feedback mechanism based on the radiative properties of ice and snow: due to warming ice and snow melt, uncovering dark land or ocean surfaces that absorb more solar radiation than the highly reflective ice and snow. The dark surfaces warm more strongly and therefore lead to more melting. Negative feedback mechanisms do not lead to reinforcements – they stabilise the climate.

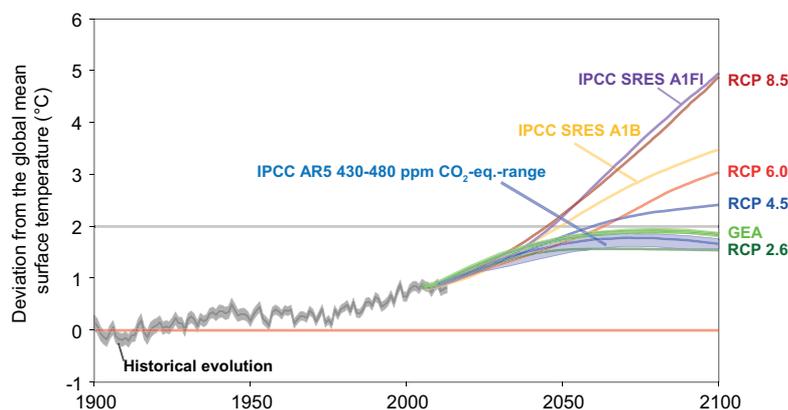


Figure 1 Global mean surface temperature anomalies (°C) relative to the average temperature of the first decade of the 20th century, historical development, and four groups of trends for the future: two IPCC SRES scenarios without emission reductions (A1B and A1F1), which show temperature increases to 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)

In its „Roadmap for moving to a competitive low-carbon economy by 2050“ the EU intends to reduce greenhouse gas emissions by 80–95 % compared to 1990 levels. Although 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, temperature rose by nearly 2 °C in the period since 1880, compared with a global increase of 0.85 °C. The increase can be observed particularly in the period after 1980, during which time global temperatures rose approximately 0.5 °C, compared to an increase of approximately 1 °C in Austria².

A further temperature increase in Austria is expected³. In the first half of the 21st century temperature will increase by approximately 1.4 °C compared to current temperature (see Figure 2). This increase 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, and is therefore dependant on the scenario and can be influenced to a high degree⁴.

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 of a similar order of magnitude.

In the 21st century an increase of precipitation in the winter months and a decrease in the summer months is to be expected⁵. The annual average however, shows no clear trend signal, since Austria lies in the larger transition region between two zones with opposing trends – ranging from an increase in Northern Europe to a decrease in the Mediterranean⁶.

In the last 130 years, the annual sunshine duration has increased for all Alpine stations by approximately 20 %, or more than 300 hours. The increase in the summer half of the year was stronger than in the winter⁷. Between 1950 and 1980 increased cloud cover and higher air pollution levels, especially in the valleys, caused a clear decrease in the duration of sunshine hours in the summer.

The duration of snow cover in the past decades, particularly at intermediate altitudes (approximately 1 000 m above sea level) **has decreased⁸.** As both the altitude of snowfall – and therefore snow depth – and snow melt are temperature-sensitive, a decrease in snow depth is expected in intermediate altitudes due to the continued increase in temperature⁹.

All observed glaciers in Austria have significantly declined in surface area and in volume in the period since 1980. For example, in the southern Ötztal Alps, the largest conti-

² virtually certain

³ very likely

⁴ very likely

⁵ likely

⁶ likely

⁷ virtually certain

⁸ very likely

⁹ very likely

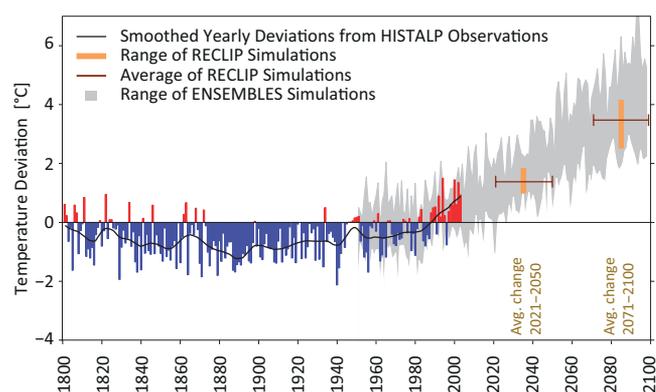


Figure 2 Mean surface air temperature (°C) in Austria from 1800 to 2100, expressed as a deviation from the mean temperature for the period 1971 to 2000. Measurements to the year 2010 are illustrated in color, model calculations for one of the IPCC emissions scenarios with higher GHG emissions (IPCC SRES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

gious 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 2006¹⁰. The Austrian glaciers are particularly sensitive to summer temperatures in the retraction phase since 1980, therefore a further decline of the glacier surface area is expected¹¹. A further rise of the altitudes of permafrost occurrence is expected¹².

Temperature extremes have changed markedly, 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 increase¹³. For extreme precipitation, no uniform trends are detectable as yet. However, climate models show that in future heavy and extreme precipitation events are likely to increase from autumn to spring. 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 determined.

Summary for Austria: Impacts and Strategic Policy Measures

The economic impacts of extreme weather events in Austria are already substantial and have been increasing in the last three decades¹⁴. These damage costs due to extreme events suggest that changes in the frequency and intensity of such damaging events could have a significant impact on the economy of Austria.

The potential economic impacts of the expected climate change in Austria are mainly determined by extreme events

¹⁰ virtually certain

¹¹ very likely

¹² very likely

¹³ very likely

¹⁴ virtually certain

and weather periods¹⁵. In addition to extreme events, gradual temperature and precipitation changes also have economic ramifications, through, for example, changes of yields in agriculture, supply and demand in the energy sector, or snow-reliability in ski areas with corresponding impacts on winter tourism.

In mountainous regions, significant increases in landslides, mudflows, rock falls and other gravitational mass movements will occur¹⁶. This is due to changes in rainfall, thawing permafrost and retreating glaciers, but also to changes in land use¹⁷. Mountain flanks will be vulnerable to events such as rock fall¹⁸ and landslides¹⁹. Climate-induced decrease in permafrost and the shrinking of glaciers could lead to an enhanced danger of mudslides and rock falls as unsecured material becomes uncovered²⁰.

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 droughts²¹.

Climate change leads to the loss of humus and to greenhouse gas emissions from the soil. Extreme weather conditions can lead to an impairment of soil functions, such as soil fertility, water and nutrient storage capacity, humus depletion causing soil erosion, and others. Human intervention increases the area of soils with a lower resilience to climate change²².

The impacts of climate change on agriculture and forestry vary by region; disturbances to forest ecosystems increase in intensity and in frequency in all of the examined climate scenarios. In the agricultural sector some adaptation

¹⁵ medium confidence

¹⁶ very likely, high confidence

¹⁷ very likely, high confidence

¹⁸ very likely, high confidence

¹⁹ likely, medium confidence

²⁰ very likely, high confidence

²¹ very likely, high confidence

²² very likely

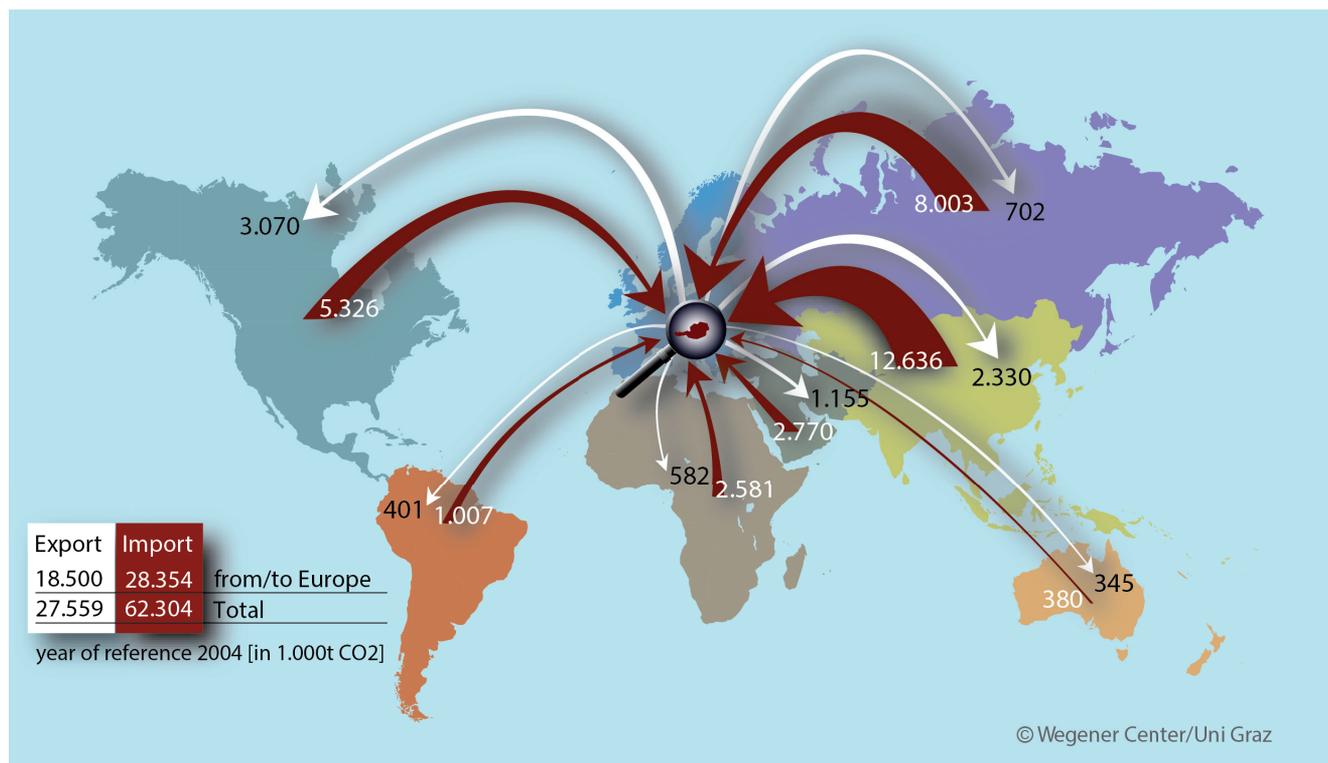


Figure 3 CO₂ streams from the trade of goods to/from Austria according to major world regions. The emissions implicitly contained in the imported goods are shown with red arrows, the emissions contained in the exported goods, attributed to Austria, are shown with white arrows. Overall, southern and eastern Asia, particularly China, and Russia, are evident as regions from which Austria imports emission-intensive consumer- and capital- goods. Source: Munoz and Steining (2010)

measures can be implemented on the short term²³, in forestry adaptation measures generally have long lead times²⁴.

Winter tourism will come under pressure due to the steady rise in temperature. Compared to destinations where natural snow is plentiful, many Austrian ski areas are threatened by the increasing costs of snowmaking²⁵ and the limitations imposed by rising temperatures and the (limited) availability of water²⁶. 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.

Due to the currently foreseeable socio-economic developments and climate change, climate-induced damage potential in Austria will increase in future²⁷. 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 ahead²⁸. In Austria climate change particularly influences the weather-dependent sectors such as agriculture and forestry, tourism, hydrology, energy, health and transport and the sectors that are linked to these²⁹. Adaptation measures can mitigate the negative impacts of climate change, but they cannot fully offset them³⁰.

In 2012 Austria adopted a national adaptation strategy to cope with the consequences of climate change. 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

²³ very likely

²⁴ high agreement, strong support

²⁵ very likely

²⁶ probable

²⁷ medium confidence

²⁸ high confidence,

²⁹ high confidence

³⁰ medium confidence

a regular survey of the effectiveness of adaptation measures, as other nations have already implemented, are only in development in Austria.

In 2010 the greenhouse gas emissions in Austria amounted to a total of approximately 81 Mt CO₂-equivalents (CO₂-eq.) or 9.7 t CO₂-eq. per capita, taking account of the carbon uptake of ecosystems (mainly forests)³¹. The Austrian per capita emissions are slightly higher than the EU average of 8.8 t CO₂-eq. per capita per year and significantly higher than those for example of China (5.6 t CO₂-eq. per capita per year), but much lower than those of the U.S. (18.4 t CO₂-eq. per person per year).

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 1990³². After correcting for the part of the carbon sinks that can be claimed according to the international agreement, the emissions for the commitment period were 18.8 % higher than the reduction target of 68.8 Mt CO₂-eq. per year. 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 around 80 Mt CO₂-eq. of international certificates at a cost of around € 500 million³³.

If the emissions caused by Austrian consumption abroad are included, emission figures in Austria are almost 50 % higher³⁴. Austria contributes to the emissions of other countries. 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 flows of goods (see Figure 3) it can be inferred that Austrian imports are responsible for emissions particularly in southern and eastern Asia, specifically China, and Russia.

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. In this context an energy strategy was released in 2010, which proposes that final energy consumption in 2020

should not exceed the 2005 level of 1 100 PJ. However, adequate measures have not yet been implemented. Austria's Green Electricity Act (*Ökostromgesetz*) stipulates that renewable sources should generate additional 10.5 TWh (37.8 PJ) per year up to 2020. The energy and industry sectors are largely regulated under the „EU ETS“, the refinement of which is currently still being 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. This corresponds to the binding EU targets, but to tackle the problem adequately other countries have set longer-term GHG reduction targets. For example, Germany has set a reduction target of 85 % by 2050. The UK intends to achieve reductions of 80 % by 2050 .

The measures taken so far are insufficient to meet the expected contribution of Austria to achieve the global 2 °C target³⁵. The actions specified by Austria are based on the objectives for the year 2020 – however, the goals for developing renewable energy sources in Austria are not sufficiently ambitious to achieve the Austrian contribution to the 2 °C goal 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, and the turnaround that has already taken place for space heating is likely to be insufficient. The expected greenhouse gas emissions savings due to the replacement of fossil fuels with biofuels are increasingly being called into question.

Institutional, economic, social and knowledge barriers slow progress with respect to mitigation and adaptation. Approaches to overcome these barriers include a comprehensive administrative reform with a view to the challenges at hand or pricing products and services according to their climate impacts. A key factor in this regard includes an abolition of environmentally harmful financing and subsidies; for example, for the exploration of new fossil reserves, commuter tax breaks which favor the use of cars, or housing subsidies for single-family homes in the urban vicinity. Also, 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 factors³⁶. **According to scenario simulations, emission reductions of up to 90 % can be achieved in Austria by 2050 through additional measures**³⁷. These scenarios are obtained from stu-

³¹ very high confidence

³² virtually certain

³³ very high confidence

³⁴ high confidence

³⁵ high confidence

³⁶ high confidence

³⁷ high confidence

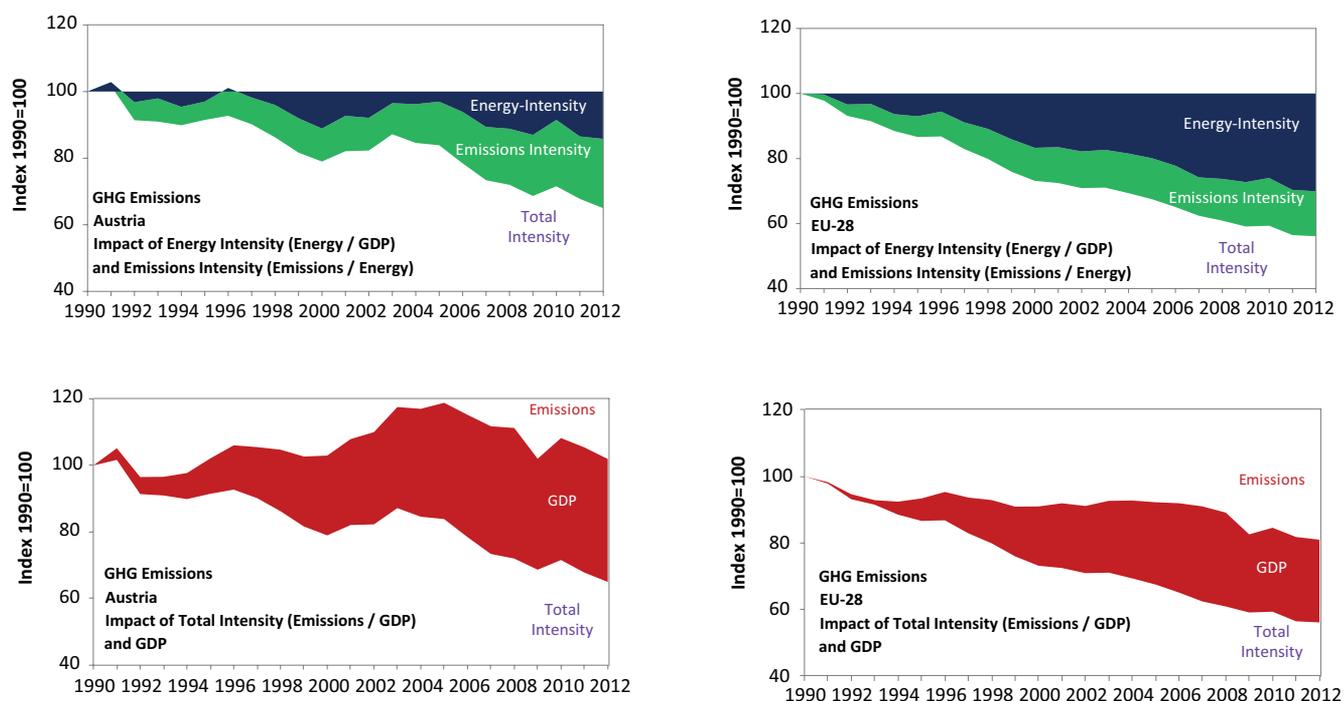


Figure 4 Development of GHG intensity of GDP and the developments of the components energy intensity (energy consumption per GDP in Euro) and emission intensity of energy (greenhouse gas emissions per PJ of energy) over time for Austria and for the EU-28 (upper panel). The development of greenhouse gas 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), based on Eurostat

dies that focus on 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 magnitude. Austria has a considerable need to catch up regarding improvements in energy intensity, which in the EU-27 has improved by around 29% since 1990 but remained relatively static in Austria (see Figure 4).

According to scenario calculations, the target set by the EU for 2050 can be achieved by halving the energy consumption in Austria. 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. The potential to improve energy efficiency exists, particularly in the buildings, transportation and production sectors³⁸.

Striving for a swift and serious transformation to a carbon-neutral economic system requires a closely coordinated approach across sectors 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 transfor-

mation should also be taken into account, such as those of the energy system, because decentralized production, storage and control systems for fluctuating energy sources and international trade are gaining in importance³⁹. 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. Economic structures, for example, become more resistant with respect to outside influences (financial crises, energy dependence) when local business cycles are intensified, international dependencies are reduced and productivity of all resources, especially energy, is significantly increased.

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 processes⁴⁰. Sustainable development approaches which contribute to both a drastic departure from historical trends as well as individual sector-oriented strategies and business models can contribute to the required GHG reductions⁴¹. New integrative approaches in

³⁸ high confidence

³⁹ medium confidence

⁴⁰ high confidence

⁴¹ likely

terms of sustainable development do not necessarily require novel technological solutions, but rather conscious reorientation of established, harmful lifestyle habits and of the behavior of economic stakeholders. Worldwide, there are initiatives for transformations in the direction of sustainable development paths, such as the energy transition in Germany (*Energiewende*), the UN initiative „Sustainable Energy for All“, a number of „Transition Towns“ or the „Slow Food“ movement and vegetarian diets. Only the future will show which initiatives will be successful.

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 predominantly on regional and seasonal plant-based products, with a significant reduction in the consumption of animal products can make an important contribution to greenhouse gas reduction⁴². The reduction of losses in the entire food life cycle (production and consumption) can make a significant contribution to greenhouse gas reduction⁴³.

The changes required to reach the targets include the transformation of forms of economic organisation and orientation⁴⁴. There is a strong need for renewal in the housing sector; renovations and new buildings can be accelerated by new financing mechanisms. The fragmented transport system can be developed into an integrated mobility system. In terms of production, new products, processes and materials can also ensure that Austria is not left behind in global competition. The energy system can be realigned in an integrated manner with energy services as a starting point.

Suitable political framework conditions can promote transformation⁴⁵. In Austria, there is a willingness to change. Pioneers (individuals, businesses, municipalities, regions) are already implementing their ideas, 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 converting energy selling enterprises to specialists for energy services. 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 and emission-free transport, as Switzerland has shown. Long-term financing (for example 30 to 40 years in the case of buildings) that is 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 UNFCCC Climate Fund.

Major investments in infrastructure with long lifespans limit the degree of freedom in the transformation to sustainability, if greenhouse gas emissions and adaptation to climate change are not considered. If all projects were subjected to „climate-proofing“, which considers integrated climate change mitigation and appropriate adaptation strategies, this would avoid so-called „lock-in effects“, which create long-term emission-intensive path dependencies⁴⁶. The construction of coal power plants is one 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 relates to cities and densely settled areas⁴⁷. 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 life⁴⁸. Shifting from car- to bike-use, for example, has a proven positive-preventive impact on cardiovascular diseases and other health-improving effects that significantly increase life expectancy, in addition to positive environmental impacts. Health supporting effects have also been proven for sustainable diets (e. g. reduced meat consumption).

Climate change will increase migration towards Austria. Migration has many underlying causes. In the southern hemisphere, climate change will have particularly strong impacts and will be a driver of increased migration mainly within the global south. The IPCC estimates that by 2020 some 74 million to 250 million people will be affected in Africa and Asia alone. Due to the particular impact of climate change on the

⁴² very likely, high confidence

⁴³ very likely, medium confidence

⁴⁴ high confidence

⁴⁵ high confidence

⁴⁶ high confidence

⁴⁷ high confidence

⁴⁸ high confidence

African continent, refugee flows from Africa to Europe are expected to increase.

Climate change is only one of many global challenges, but a very central one⁴⁹. A sustainable future also deals with e.g. issues of combating poverty, health, societal human capital, the availability of water and food, intact soils, air quality, loss of biodiversity, as well as ocean acidification or over-fishing⁵⁰. These questions are not independent of each other: climate change often exacerbates other problems. The international community has triggered a UN process to formulate Sustainable Development Goals after 2015. Climate change is at the heart of these targets, since climate protection – because of the interdependency of global challenges – can generate a number of additional benefits that help to achieve other global objectives⁵¹.

Policy initiatives in climate mitigation and adaptation are necessary at all levels in Austria: at the federal and provincial levels and the level of local communities. Within the Austrian federal structure competences are split, such that only a common, concerted approach across these levels can ensure highest possible effectiveness and achievement of objectives. To effectively implement the substantial transformation that is necessary, a broad spectrum of instruments also needs to be implemented.

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.

Figure 2 Issued for the AAR14 adapted from: Auer, I., Böhm, R., Jurkovic, A., Lipa, W., Orlik, A., Potzmann, R., Schöner, W., Ungersböck, M., Matulla, C., Briffa, K., Jones, P., Efthymiadis, D., Brunetti, M., Nanni, T., Maugeri, M., Mercalli, L., Mestre, O., Moisselin, J.-M., Begert, M., Müller-Westermeier, G., Kveton, V., Bochnicek, O., Stastny, P., Lapin, M., Szalai, S., Szentimrey, T., Cegnar, T., Dolinar, M., Gajic-Capka, M., Zaninovic, K., Majstorovic, Z., Nieplova, E., 2007. HISTALP – historical instrumental climatological surface time series of the Greater Alpine Region. *International Journal of Climatology* 27, 17–46. doi:10.1002/

joc.1377; ENSEMBLES project: Funded by the European Commission's 6th Framework Programme through contract GOCE-CT-2003-505539; reclip:century: Funded by the Austrian Climate Research Program (ACRP), Project number A760437

Figure 3 Muñoz, P., Steining, K.W., 2010: Austria's CO₂ responsibility and the carbon content of its international trade. *Ecological Economics* 69, 2003–2019. doi:10.1016/j.ecolecon.2010.05.017

Figure 4 Schleicher, St., 2014: Tracing the decline of EU GHG emissions. Impacts of structural changes of the energy system and economic activity. Policy Brief. Wegener Center for Climate and Global Change, Graz. Based on data of Eurostat.

⁴⁹ very high confidence

⁵⁰ very high confidence

⁵¹ high confidence

Although there is no “Austrian Atmosphere” which is affected by climate change, the global changes in climate do have their effect on Austria in a particular way: the increase in temperature in Alpine areas has exceeded global temperature changes by more than double, the increase in sunshine hours of more than 20% is also considerably higher than in many other regions. Global changes do not occur in an even way across the globe. Due to changing weather patterns different areas are affected in significantly different ways for e.g. temperature, cloud cover or precipitation. Therefore, it is necessary to look at all studies and investigations on the climate of Austria undertaken during the past years and to summarise and evaluate in detail the scientific basis of meteorology, climatology, hydrology and the biosciences. As the other chapters of AAR14 show, vulnerability to climate change in Austria is very high. An adequate understanding of the natural science scientific basis is a necessary prerequisite of any study on economic and societal impacts, which in turn should form the basis for the strategic decisions to be taken in the near future.

Dr. Michael Staudinger Executive Director of Central Meteorological Institute (ZAMG), Vienna

Not only climate is subject to change. The scientific foundations of climate change have to be constantly reflected and exposed to continuous quality control regarding the identified statements. The AAR14 offers a snap shot of the current scientific understanding in terms of climate change and its impact on Austria. The deducible mitigation, adaptation and action options form the basis for further discussion on relevant decision making levels in economy and politics. This could uncover that it needs more than climate politics looking into long-term solutions of effective changes. All political sectors relevant to our wellbeing, from housing to mobility, might offer new opportunities to contribute to climate benefits. The AAR14 represents an ideal starting point.

Univ.-Prof. Dr. Stefan Schleicher Professor at the Wegener Center for Climate and Global Change of the University of Graz and Scientific Consultant at the Austrian Institute of Economic Research (WIFO)

The AAR14 assesses and interprets the best available knowledge to provide policy-relevant information on how to achieve policy measures necessary for a sustainable future in Austria and in the surrounding regions. This is the first scientific assessment conducted for Austria and Alpine regions that not only presents the climate change impacts resulting from human activities, with their socio-economic and environmental consequences, but also identifies the transformative paths forward. Central to this transformation is the mitigation of greenhouse gases and especially the decarbonisation of the energy system. The AAR14 goes beyond national emissions accounting and includes emissions embodied in imports and exports of goods and services. This is an essential step toward developing a true cradle-to-grave understanding of deep emissions reductions needed to stabilize global temperature change below 2°C.

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The Austrian Assessment Report 2014 (AAR14) was conceived as a national counterpart to the periodically compiled assessment reports of the Intergovernmental Panel on Climate Change (IPCC). Whereas the IPCC reports focus on the global and regional levels, the AAR14 focuses on the situation in Austria. Hence, the AAR14 was compiled by Austrian scientists working in the field of climate change over a three-year period and was modelled after the IPCC assessment report process. The report depicts the state of knowledge on climate change in Austria: the impacts, mitigation, and adaptation strategies, as well as the associated political, economic, and social issues. AAR14 presents a coherent and consistent report i) on historically observed climate change and its impacts on the environment and society; and ii) on potential future trends and options in the areas of adaptation and mitigation in Austria. In doing so, it takes country-specific natural, societal, and economic characteristics into account. It provides much needed knowledge about regional manifestations of global climate change. The report also indicates gaps in knowledge and understanding. Like the IPCC reports, AAR14 is based on contributions that have already been published and aims to be policy-relevant without being policy-prescriptive.

<http://hw.oeaw.ac.at/7699-2>