

This country profile was compiled by the OECD Secretariat and reflects information available as of June 2013. Further information and analysis can be found in the publication: OECD (2013) *Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters*, OECD Studies on Water, OECD Publishing. <http://dx.doi.org/10.1787/9789264200449-en>. Country profiles for all OECD member countries are available for download at: www.oecd.org/env/resources/waterandclimatechange.htm. These profiles will be regularly updated and it is planned to expand coverage over time to include key partner countries.

Norway

Climate change impacts on water systems

Observed changes and trends	<ul style="list-style-type: none"> Annual mean temperature for mainland Norway has increased by about 0.8 °C over the past hundred years. Annual precipitation has increased by slightly less than 20% since 1900. Much of the precipitation increase has occurred after 1980. The observed temperature increase has generally resulted in increased stream flow during winter and spring. There has been a trend towards earlier snowmelt, resulting earlier spring floods in recent years. Southeastern Norway has had longer periods with low stream flow in the summer. At the same time, floods from heavy rainfall have become more frequent since 1987. Shorter snow season in most locations during the 20th century. Rapid warming of permafrost in the Norwegian alpine areas. Temperature measurements performed since 1999 show the rate of warming at around 0.3 °C per decade at a depth of 25 meters. 				
Projected impacts	<ul style="list-style-type: none"> Warming in all parts of Norway and during all seasons. Annual mean temperature is estimated to increase by 3.4 °C. Temperature increase in the northern part of Norway could be 5.4 °C towards the end of the century. Increase in average annual precipitation during this century by 5%, 18% and 31% by the year 2100 for low, medium and high climate projections respectively. The national average for the medium projection shows an increase in precipitation of around 20% in the autumn, winter and spring and 10% in the summer. Increase in annual runoff, although regional differences can be expected. In general, an increase in runoff in the autumn and winter and a reduction in runoff in most places in summer. In glacial areas, an increase in runoff is also expected in summer. Shorter snow season throughout the country towards the end of this century. The change will probably be greatest in lower lying areas. Climate change will add to the challenges that the water supply and sewerage sector are currently facing as well as pose new challenges. Increase in temperature and precipitation may result in more loose organic material in the water, such as pollution from agricultural activity, resulting in a change in the amount of light that penetrates lakes. Summer stratification period in lakes will be longer and more distinct, favouring cyanobacterial blooms. Flood projections are uncertain, as local variations are large. In general, floods due to rainfall can be expected to increase, whereas the probability of large snowmelt floods will be reduced. Earlier onset of spring floods, due to higher temperatures. Increase in floods in late autumn and winter. In particular, more intense local precipitation will create problems in small, steep rivers and streams and in densely populated areas. Reduction in stream flow and increase in soil moisture deficit due to higher temperatures and somewhat lower precipitation during the summer season, resulting in more serious summer droughts. The changes are expected to be substantial towards the end of the century, particularly in southern Norway. 				
Primary concerns	Water quantity	Water quality	Water supply and sanitation	Extreme weather events	Ecosystems
				✓	✓
Key vulnerabilities	<ul style="list-style-type: none"> Arctic land areas have experienced more warming than any other region of the earth over the last 20 to 30 years. The climate changes seen in the Arctic have already led to major impacts on the environment and on economic activities. If the climate warming continues as projected, these impacts are likely to increase. Changed distribution of freshwater species, which can spread towards areas at high altitude and latitude. Lakes in these areas are particularly sensitive to variations in climate and species respond rapidly to changes in the ice regime. Some species of fish and crustaceans may be unable to migrate to alternative habitats due to isolation between freshwater systems. Water temperature can rise above critical levels for important fish species like salmon, trout and charr in some areas, with rivers in southern Norway and regulated rivers with low minimum water flow at highest risk. Increased levels of particulate organic matter will decrease light conditions in lakes and along with changes in vertical stratification in lakes will affect phytoplankton and other organisms. Increased flooding during autumn and winter and in small water streams can increase pollution. Extreme weather conditions increase risk for avalanches and landslides. Increased need for maintenance and improvement of water and sanitation systems. Old and under dimensioned water and drainage systems are put under pressure when precipitation increases. Outdoor recreation and tourism related to freshwater and fishing may need adaptation. Due to extreme weather events, floods in smaller river streams are expected to be a more important challenge in the future. 				

Sources: Norwegian Ministry of the Environment (2010), *Adapting to a Changing Climate*, Official Norwegian Reports NOU 2010:10, www.regjeringen.no/pages/36782608/PDFS/NOU201020100010000EN_PDFS.pdf (accessed 10 July 2012); Norwegian Ministry of the Environment (2009) *Norway's Fifth National Communication under the Framework Convention on Climate Change*, http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/4903.php (accessed 21 June 2012).

Key policy documents

Document	Reference to water?	Type	Year	Responsible institution
National Adaptation Programme		National adaptation programme	2009	Ministry of the Environment
Official Norwegian Report (NOU) on Climate Change Adaptation ¹		National vulnerability assessment	2010	Expert Committee
White Paper on flood and landslides (Meld. St. 15, 2011-12)			2012	Ministry of Petroleum and Energy
White Paper on Climate Adaptation in Norway (Meld. St. 33, 2012-13)		National adaptation strategy ²	2013	Ministry of the Environment

1. Included a background study by Hanssen-Bauer et al. (2009), "Climate in Norway 2100", in order to provide a joint scientific basis for assessments of vulnerability and adaptation needs.
2. Will be discussed in Parliament on 17 June 2013.

Policy instruments

Areas	Policy mix	Regulatory instruments	Economic instruments	Information and other instruments
Water quantity		<ul style="list-style-type: none"> • Water Regulation: Implements the EU Water Framework Directive. • Planning and Building Act. • Nature Diversity Act. • Pollution Control Act. • Water Resources Act. 		<ul style="list-style-type: none"> • Clearing house for climate change adaptation: Climate Adaptation Norway (Klimatilpasning Norge): Launched in 2009, this portal facilitates exchange of information and experience on climate change adaptation. Developed to meet the specific needs of regional and local spatial planners, it also serves a wider audience – researchers, businesses, administrative bodies, www.regjeringen.no/en/dep/md/kampanjer/engelsk-forside-for-klimatilpasning.html?id=539980. • Maps of climate in Norway in 2050 and 2100: Show future changes in temperature and precipitation in Norway in 2050 and 2100. The maps can be used as a tool in the municipalities' planning for future climate changes (e.g. risk and vulnerability analyses, spatial planning, etc.), www.regjeringen.no/en/dep/md/kampanjer/engelsk-forside-for-klimatilpasning/temperature-and-precipitation-changes-in.html?id=609105. • "Cities of the Future": Collaboration between the Government, Norway's 13 largest cities and three private sector organisations for business and finance to reduce GHG emission and adapt to current and future climate change. The programme runs from 2008-14,¹ www.regjeringen.no/en/sub/framtidsbyer/cities-of-the-future.html?id=548028. • The national mapping of flood and landslide risks takes account of expected climate change effects. The results are used in the spatial planning at district level. Climate change effects are also taken into account in the dimensioning of flood and landslide measures.
Water quality		<ul style="list-style-type: none"> • Water Regulation: Implements the EU Water Framework Directive. • Planning and Building Act. • Nature Diversity Act. • Pollution Control Act. • Water Resources Act. 		
Water supply and sanitation				
Extreme weather events		<ul style="list-style-type: none"> • Planning and Building Act. • Pollution Control Act. • Water Resources Act. 		
Ecosystems		<ul style="list-style-type: none"> • Water Regulation: Implements the EU Water Framework Directive. • Planning and Building Act. • Nature Diversity Act. • Pollution Control Act. • Water Resources Act. 		

1. See additional information under "Highlights and innovative initiatives".

Main research programmes

- Programme on climate change and impacts in Norway (NORKLIMA): A 10 year research programme directed by the Norwegian Research Council. It aims to generate new knowledge about the climate system, about climate trends in the past, present and future, and about the direct and indirect impacts of climate change on the natural environment and society, to provide a basis for informing adaptive responses, www.forskningsradet.no/prognost-norklima/Home_page/1226993599851.
- NorClim project: Provides information on future climate development to governmental bodies, decision and policy makers, researchers, businesses, NGOs and the general public. The project involves a large number of scientists from leading research institutes, www.norclim.no (in Norwegian).
- Report on "Hydrological projections for floods in Norway under a future climate": Published by the Norwegian Water Resources and Energy Directorate in 2011, www.nve.no/Global/Publikasjoner/Publikasjoner%202011/Report%202011/report5-11.pdf.

Principal financing mechanisms and investment programmes

Highlights and innovative initiatives

- **"Cities of the Future"** is a collaboration between the Government, the business sector and the 13 largest cities in Norway. The purpose of the programme is to help and encourage the cities: To reduce their greenhouse gas emissions through urban planning and housing development, to counteract negative effects of climate change and to improve the urban environment. The program is divided in four focused areas: Land use and transport; energy in buildings; consumption and waste and adaptation to climate change. National and local government officials and politicians meet regularly to discuss how to meet challenges separately and together, share experiences and examples, develop new policies and strategies based on lessons learned and develop common knowledge and methods. The cities present common political statements to national policy processes such as the National transportation plan, the white paper of climate policies, white paper of waste management, and the white paper on climate change mitigation. The programme demonstrates that the dialog between the national and local authorities is necessary in order to get a more goal-oriented development for policy instruments in different sectors. At the same time, it is important to have a coherent city development where environmental, social and cultural initiatives work together to achieve good results.
- **"The Midgard Snake"** project of Oslo Water and Wastewater Department. Increased urban development, together with the increasing precipitation due to climate change has led to more pressure on the water mains and increased risks of flooding and water damage. "The Midgard Snake" will function as an interruptive drainage system, preventing polluted water from reaching the Oslo Fjord. This tunnel (with a capacity of 50 000 m³) will function as both a transport route and a retention reservoir, where water can be stored if the Purifying Plant lacks capacity. The project will improve water quality in the Fjord, address climate change impacts and reduce energy consumption because the water is not being transported as far as it was previously. Estimated at NOK 1 billion, the project will be finished in 2013-14, www.regjeringen.no/en/sub/framtidensbyer/the-participating-cities-/oslo/the-midgard-snake-in-oslo-.html?id=574174.