



**NVE's  
STRATEGY FOR  
CLIMATE CHANGE  
ADAPTATION  
2015-2019  
(SUMMARY)**





# SUMMARY

A changed climate will create both challenges and opportunities within NVE's areas of responsibility. Norway covers a large geographical area with a varied topography. The changes will therefore manifest themselves differently throughout the country.

The climate projections do not provide a clear-cut answer, as there is uncertainty attached to them, especially for the situation up to 2100.

However, the basic trends are clear, giving us enough information to act now.

Gabestad foss, Rakkestadelva Photo: © Arne T. Hamarsland/NVE







## THE MAIN CLIMATE AND CLIMATE-RELATED CHANGES THAT WILL AFFECT NVE'S AREAS OF RESPONSIBILITY:

- Temperatures will increase, especially in the winter and in Northern Norway.
- The average annual precipitation will generally increase throughout most of the country. Whether there is an increase, no change or a slight decline will vary according to the season and region. There is uncertainty associated with the regional distribution.
- There will be more frequent local, extreme precipitation events, more rapid onset floods in small rivers and more flooding in densely populated and urban areas.
- River flow in the winter months will generally increase, while river flow in the summer months will generally decrease.
- Flood probabilities in the autumn and winter, and flood magnitudes caused by rain will generally increase.
- Snowmelt floods will gradually decrease.
- More summer droughts are expected (less soil moisture and lower ground water levels, and longer periods of low flow in the rivers) mainly due to increased evapotranspiration.
- The sea level will rise along the entire coast, but will be offset to a varying degree by post-glacial rebound.
- The glacial areas will be reduced and glacial melt and discharge from the glaciers will increase in the short term but decrease in the long term as the glaciers melt away.
- The risk of dry snow avalanches will be reduced towards the end of the century, while the risk of wet snow avalanches and slush avalanches will increase in areas still covered by snow.

Climate change entails a need for continuous climate change adaptation in order to prevent unwanted incidents that may endanger human life and affect key infrastructure and societal functions. From an international perspective, Norway is well equipped to handle the direct effects of climate change. NVE has instruments that separately or in combination are suitable to reach the necessary climate adaptation within NVE's areas of responsibility.

NVE conducted targeted climate change adaptation work in the period 2010–2014. The general awareness within NVE regarding climate challenges has increased, and relevant knowledge has been incorporated in guidelines and form letters. For example, how to take climate change into

consideration is included in the Dam Safety Guidelines, particularly sensitive dams have been identified, and protection against flood and landslide hazards in a changing climate is discussed in the guideline «Flaum og skredfare i arealplanar» (Floods and landslides in land use plans). The knowledge basis has been improved through updated hydrological projections and flood analyses, and the work related to a new version of Klima i Norge 2100<sup>1</sup> (Climate in Norway 2100) for the Norwegian Centre for Climate Services (NCCS).

Climate adaptation can include both physical measures and measures designed to produce sufficient knowledge about climate change to provide a sound foundation for decisions.

The rate of climate change will vary, and the impacts will be different throughout the country. NVE's decisions have different time horizons. The climate adaptation strategy must reflect this, to enable NVE to act correctly at the right time. In order to do this, the strategy must be dynamic and adaptable to new knowledge.

## A DYNAMIC STRATEGY FOR CLIMATE CHANGE ADAPTATION IS BASED ON THE FOLLOWING PRINCIPLES:

- Measures/decisions with a short operating time will be assessed based on the current climate.
- For measures/decisions with a long operating time, an assessment will be made as to whether they should be built to withstand expected climate change during their lifespan, or whether they should be based on the current climate, but be prepared for reinforcement/change.
- The measures/decisions should be climate robust; in other words they should function as intended, even if the climate develops somewhat differently than projected.
- Climate change adaptation that contributes to goal achievement in several areas is “win-win” adaptation, and should be given high priority.

NVE must focus on those management areas where climate change is expected to have particularly serious consequences. This may include changes or specification of requirements in guidelines, such as requirements regarding maintenance, modernisation, security and emergency preparedness related to power supply, and dam safety. It can also include assistance with flood and landslide protection, and advice on land use that prevents danger and damages.

<sup>1</sup> Hanssen-Bauer, I., Fjørland, E.J., Haddeland, I., Hisdal, H., Mayer, S., Nesje, A., Nilsen, J.E.Ø., Sandven, S., Sandø, A.B., Sorteberg, A. og Ådlandsvik, B. (Eds.) (2015) «Klima i Norge 2100 - Kunnskapsgrunnlag for klimatilpasning» (Climate in Norway 2100: Background material on climate change adaptation), updated 2015, Norwegian Centre for Climate Services report No. 2/2015 (NCOS report no. 2/2015), Oslo

Both through its own work and activities organised by the Norwegian Centre for Climate Services (NCCS), NVE helps increase knowledge in society on climate change, its consequences, and how to adapt to a future climate. NCCS was established in 2011, and is managed by the Norwegian Meteorological Institute, with NVE, the Bjerknes Centre and Uni Research as partners. The Centre supplies climate and hydrological data for work with climate adaptation in Norway.

In order to contribute to efficient climate change adaptation, NVE must have specialist expertise, map the need for adaptation and relevant adaptation measures, and ensure that other actors have sufficient knowledge about climate change and adaptation. This will be achieved by NVE analysing needs, providing guidance and assistance, and communicating the requirements for adaptation. NVE's climate change adaptation will be based on dialogue and collaboration with relevant actors in the public and private sector as well as in research.

In order to ensure that NVE has updated knowledge about climate change and how it affects our areas of responsibility, NVE must maintain a focus on monitoring of hydrology and R&D.

#### **LANDSLIDE AND FLOOD HAZARDS**

Climate adaptation must be integrated in NVE's different areas of work. Advice/requirements/measures with a short operating time will be based on historical climate data. Climate projections will be applied to longer operating times. Mapping and protection measures will be prioritised based on assessments of risk and cost/benefit. The observed climate development calls for measures to protect against landslides, floods and erosion in small, steep, mass-transporting rivers with a large potential for damage to be given greater priority. NVE will as far as possible, contribute to ensuring that climate change is considered in land use planning.

#### **WATERCOURSE LICENCES**

Licences for hydropower installations and renewal of old licences is a means to adapting facilities and their operations to climate change. Decisions are made on a case-by-case basis. When revising the terms of watercourse licences, climate-related terms and adequate legal authorisation will be included, to adapt these to climate change.

#### **ENERGY LICENCES**

Power grids, wind power plants and hydropower plants are affected by the climate in several ways. Climate adaptation measures will reduce the plants vulnerability to the effects of climate change. New plants should be built in such a way that they are adapted to the effects of future climate change.



#### **DAM SAFETY**

Climate change affects dam safety, and there must be a focus on following up the requirement of flood calculation and reassessment every 15 years. Priority should be given to obtaining more knowledge about how climate change affects e.g. ice pressure and to identify which geographical areas, dam types and spillways that are most at risk. The dam owner's planning and execution of necessary maintenance and modernisation must be adapted to climate change. The Dam Safety Guidelines include requirements regarding the emergency preparedness of dam owners related to situations involving a risk of damage. If the risk increases because of climate change, this must be reflected in the dam owner's planning.

#### **ENVIRONMENTAL SUPERVISION**

When supervising installations and internal control systems, emphasis is placed on licensees having taken relevant climate change into account.

#### **ENERGY SUPPLY**

NVE and other actors need to have the best possible knowledge about how a changed climate will affect energy supply, especially grids and production. Climate change will be a particularly important focus area in licence processes, impact and power system assessments, and when assessing preparedness to conduct repairs and the vulnerability of the power supply in relation to climate variables.

#### **POWER DEMAND**

NVE must have a good understanding of the development of energy use for different energy carriers, and the factors that affect this development. This includes conducting analyses on energy use, further developing and updating statistics for stationary energy use and facilitate development of relevant instruments.



## HYDROLOGY

To monitor the effect of climate change on hydrology, it is important to have a quality-controlled reference data set with long time series. A high level of R&D activity on the effect of climate change on hydrology and the cryosphere must be maintained. There is a general need to reduce the uncertainty of the climate and hydrological projections and to assess the effect of the climate changes on floods. It is also important to develop methods to quantify the uncertainty, communicate these results, and make decisions under increased uncertainty.

## MEASURES

The most important individual measures NVE will implement during the 2015–2019 strategy period in order to address climate change are:

- Maintain a high-quality reference data set to monitor the effect of climate change on hydrology and the cryosphere.
- Analyse long time series to monitor changes in hydrology and the cryosphere in Norway.
- Contribute and ensure that the management plans and action programmes for the water regions consider climate change when measures to achieve the environmental goals are set.
- Adapt the hazard mapping to a different risk situation caused by climate change by keeping climate change in mind when prioritising mapping between different types of landslide and flood hazards and when choosing areas for mapping landslide and flood hazards.
- In rivers where regional climate projections show an expected increase in the 200-year-flood of over 20% during the next 20–100 years, ensure this information is applied to NVE's flood inundation maps (both new mapping and updating of existing maps).
- Work proactively towards the municipalities related to municipal plans to integrate climate adaptation. NVE will hold the municipalities more accountable in their

work to include flood and landslide hazard in local development plans.

- Recommend to the municipalities that for areas at risk of material damage caused by flooding and where a 20% increase or more in 200-year floods can be expected in the next 20–100 years, that this information will be applied when assessing the risk of flooding for new building development.
- Focus particularly on floods in streams and small steep rivers in land use planning. Increase the emphasis on development of expertise and knowledge in municipalities and further develop the guidelines on flood and landslide risk mapping in streams and small steep rivers in urban/developed areas with a large potential for damage.
- Organise meetings and seminars on land use planning and climate change adaptation for municipalities and contribute actively at similar meetings organised by others.
- Ensure that the Directorate for Civil Protection and Emergency Planning's guide «Havnivåstigning i kommunal planlegging» (Rising sea levels and municipal planning) is used in connection with land use plans in areas exposed to river floods and storm surges.
- In areas where regional climate projections show an increase in flood peaks (200-year floods) of more than 20% in the next 20–100 years, ensure this information will be included for the design of protection measures and in cost-benefit analyses.
- Determine whether there is a need to modernise old flood protection measures so that they will provide protection against hazards of a chosen probability, also in a future climate.
- Ensure that dam owners comply with the requirements in the Dam Safety Guidelines regarding new flood estimates and review of the dams with the greatest potential for damage every 15 years, and that flood estimates take climate change into account.



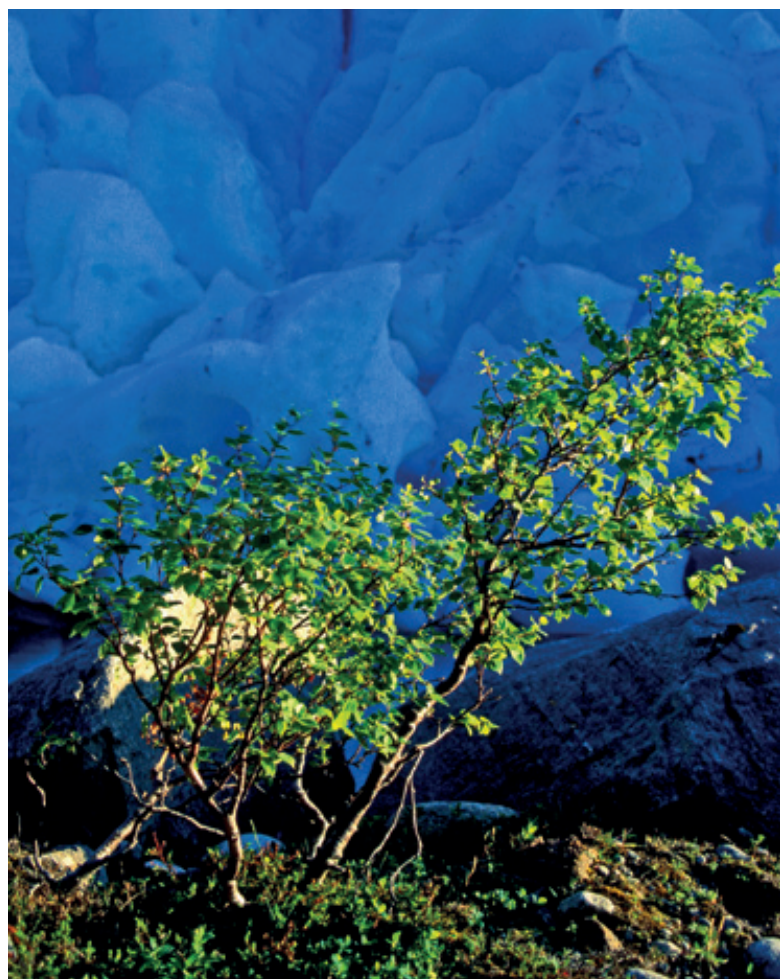
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Photo (Left)  
City of Bodø and Sandhornet, Bodø municipality.  
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Photo (Top Right)  
Glomma spring flood, Åsnes municipality.  
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Photo (Bottom Right)  
Enga Glacier, Meløy municipality.  
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- Map/analyse which dams/dam types that are most vulnerable to climate change.
- Adapt the licence terms for hydropower to a changed river flow pattern and changed operation of the power plants/reservoirs.
- Increase the consideration to climate and climate-related events such as increased landslide probability and ice accretion when choosing power line paths.
- Control that licensees have taken relevant climate change into account in their internal control systems.
- Map and follow up the power industry's attitudes and actions regarding climate change.
- Evaluate the effect of the climate change on the energy sector as a whole.
- Keep a major focus on R&D related to the effect of climate change on hydrology and NVE's management areas.
- Require that climate and climate change are adequately covered in applications NVE processes pursuant to the energy and water resources legislation.
- Incorporate climate change adaptation when revising guidelines.





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