

Work programme

2014–2023

Large-scale programme
Large-scale programme on Climate Research – KLIMAFORSK



Large-scale Programmes

The RCN initiative
to meet national
research priorities

Work programme

2014–2023

Large-scale programme

Large-scale programme on Climate Research (KLIMAFORSK)

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1. Introduction

This work programme comprises a steering document for the Large-scale Programme on Climate Research (KLIMAFORSK). Large-scale programmes are broad-based, long-term research programmes designed to expand knowledge of national and international importance in the longer term. The KLIMAFORSK programme continues the activities of the programme on Climate Change and Its Impacts in Norway (NORKLIMA), which was concluded in 2013.

The KLIMAFORSK programme builds on a thorough, up-to-date overview of the state-of-the-art of Norwegian climate research and analyses of future needs relating to knowledge and the organisation of research activities in this field. The most important document underpinning this work programme is a 2012 document outlining the knowledge basis for a new climate research initiative at the Research Council. The recommendations set out there form the foundation for the thematic and strategic priorities of the KLIMAFORSK programme.

Primary objective

The KLIMAFORSK programme will promote outstanding climate research to the benefit of society.

Secondary objectives

The KLIMAFORSK programme will:

- Increase knowledge about natural and anthropogenic climate change;
- Improve knowledge about the impacts of climate change on nature and society;
- Enhance knowledge about the transition to a low-emission society and adaptation to climate change.

Strategic secondary objectives

The KLIMAFORSK programme will work to:

- Achieve integrated climate research;
- Promote climate research projects within an open thematic framework;
- Encourage boldness in scientific thinking and scientific innovation in research projects;
- Enhance the international profile and contribution of Norwegian research groups;
- Foster the development of a new generation of climate researchers;
- Expand expertise and applicable knowledge in trade and industry and the public administration;
- Facilitate dynamic, targeted communication activities;
- Increase the use of available data and research infrastructure.

The funding announcements issued by the programme will be based on the work programme as well as the national budget and subsequent allocation letters from the funding ministries. Analyses of the KLIMAFORSK project portfolio and relevant national and international programmes and funding instruments will also shape the framework for funding announcements.

At start-up, the KLIMAFORSK programme has a budget of roughly NOK 143 million per year. The programme has a broad scientific scope, and it will not be possible to cover all of the thematic areas adequately under the current budget framework. Furthermore, future evaluations and portfolio analyses may lead to some changes in priorities. Any changes to the budget may lead to adjustments in the programme's level of ambition.

2. Background

2.1 Strategic perspectives

Climate change is one of the greatest societal challenges of our time. Nature and society alike are experiencing impacts such as rising temperatures, changing wind and precipitation patterns, sea-level rise and increasingly intense extreme weather events. Addressing the complex issues we are facing will require an integrated approach, both nationally and internationally. Norway has both the responsibility and the capacity to make a substantial contribution to the global effort to reduce greenhouse gas emissions, facilitate the transition to a low-emission society and deal with the impacts of climate change. More knowledge is essential. We need to understand the processes related to climate change and their impacts on the natural environment and society. We also need knowledge about the forms of societal transformation needed to deal with challenges, develop useful innovations and promote other positive elements of social change.

The Large-scale Programme on Climate Research (KLIMAFORSK) is one of the Research Council's large-scale programmes and continues the activities of the programme on Climate Change and Its Impacts in Norway (NORKLIMA), which was concluded in 2013. Large-scale programmes are a funding instrument employed in national priority areas that are of key importance in the context of research policy and society, where the Research Council's activities will lead to added value. In recent years, the Norwegian authorities have focused considerable attention on climate change, as evidenced by a number of white papers, reports and strategies.¹ The establishment of a new large-scale programme signals that the Research Council gives priority to climate as a research area.

Addressing the complex research questions raised by climate change will require an integrated, broad-based approach across disciplines and thematic areas. While targeted research within the individual thematic areas is still needed, activities must be integrated between thematic areas as well. It is essential to strengthen social sciences and humanities subjects to gain a better understanding of human influence on the climate system and the risk climate change poses for the socio-ecological system. More research incorporating components across the social sciences, humanities and natural sciences is also needed in order to find effective, sustainable solutions.

The KLIMAFORSK programme will generate knowledge that can be used to achieve key targets of climate policy, including the transition to a low-emission society and a society adapted to climate change.

A wide range of activities and programmes at the Research Council are currently carrying out climate-relevant research. Effective coordination and synthesis across these programmes are essential to achieving synergies between them. Large-scale programmes are an excellent tool for ensuring adequate breadth as well as integration, interaction and synthesis between research activities.

Establishment

This work programme is the culmination of a comprehensive process involving research groups, the public administration, trade and industry, and other stakeholders. A document outlining the knowledge basis for a new climate research initiative at the Research Council was drawn up in the course of 2011

¹ Report No. 30 (2008–2009) to the Storting, Climate for Research; Klimakur 2020 – Tiltak og virkemidler for å nå norske klimamål mot 2020 (Measures and instruments for achieving Norwegian climate targets towards 2020. In Norwegian); Official Norwegian Reports (NOU 2010:10): Adapting to a changing climate; Meld. St. 21 (2011–2012) Norwegian Climate Policy, white paper from the Ministry of the Environment; Meld. St. 7 (2011–2012) The High North: Visions and strategies, white paper from the Ministry of Foreign Affairs; Report No. 39 (2008–2009) to the Storting, Klimautfordringene – landbruket en del av løsningen (Climate challenges – agriculture part of the solution. Summary in English); Meld. St. 33 (2012–2013) Climate change adaptation in Norway, white paper from the Ministry of the Environment; Meld. St. 18 (2012–2013) Long-term perspectives – knowledge provides opportunity, white paper from the Ministry of Education and Research.

and 2012.² Activities also included a thorough evaluation of Norwegian climate research³ and mapping of research and knowledge needs in Norway. Together, these processes have provided an up-to-date overview of the *state-of-the-art* of climate research in Norway and society's future *needs* relating to knowledge and the organisation of research activities in this field. The recommendations set out in the document outlining a new climate research initiative at the Research Council form the foundation for the thematic and strategic framework of the objectives of the KLIMAFORSK programme.

Primary users

The programme targets Norwegian research institutes, universities, university colleges and other research environments, in addition to users in the public administration, public and private sectors, and society at large. The programme will encompass basic research, applied research and innovation activities of relevance to the climate field. Key users of the programme's research findings will include researchers in other fields, the public administration, trade and industry, and the general public. One of the programme's aims is therefore to generate knowledge that is relevant and applicable. Further, the programme will seek to disseminate and utilise knowledge and results in the best possible manner and work to raise the general level of knowledge about climate research among users and society at large.

At start-up, the programme has received allocations from the Ministry of Climate and Environment, the Ministry of Education and Research, the Ministry of Agriculture and Food, the Ministry of Trade, Industry and Fisheries, and cross-sectoral funding from the Ministry of Education and Research.⁴

All large-scale programmes are subject to a mid-term evaluation and a final evaluation. Work programmes may be revised during the programme period. The KLIMAFORSK work programme may be revised in response to the results of the mid-term evaluation.

2.2 Scientific perspectives

The climate system involves complex physical-chemical-biological interactions between various components (the atmosphere, hydrosphere, cryosphere, lithosphere and biosphere) and human activity. These interactions may amplify or diminish feedback effects, which in turn may affect the climate and climate change at all scales of time and space. Feedback effects may also be social in nature, and these may lead to social tipping points that create a new vulnerability or open up new opportunities for societal transformation. Understanding these complex interactions poses great challenges. Long time series and a global perspective are often necessary for enhancing knowledge about anthropogenic and natural climate forcings and changes in the climate system and for understanding the influence of the climate on nature and society.

Climate change represents a major global challenge. Climate policy, strategies and measures at the national, institutional and individual level to reduce greenhouse gas emissions and increase carbon uptake must therefore be viewed in the context of international climate policy. Because the physical climate system is global, changes in one part of the world will influence changes in others. In addition, the impacts on natural and human systems and transformation needs will share many common features that make international research efforts and studies on a global scale useful sources for national knowledge as well. At the same time, climate change will have different impacts in different places. Knowledge about local conditions is therefore essential to understanding local climate change and its impacts and for facilitating optimal adaptation.

The KLIMAFORSK programme will help to meet Norwegian society's need for knowledge about global, national and local climate change, impacts and instruments, global climate agreements and the

² Kunnskapsgrunnlag for ny klimasatsing i Forskningsrådet (2012) (In Norwegian).

³ Norwegian climate research. An evaluation (2012).

⁴ Cross-sectoral funding from the Ministry of Education and Research has replaced funding from the yield from the former Fund for Research and Innovation.

transformation necessary for achieving a low-emission society. Addressing these issues will require a global perspective, research cooperation and integrated research activities across disciplines, sectors and national boundaries. At the same time, there is a need for research on conditions that are specific to Norway and in areas in which Norwegian research groups have particular strengths and competitive advantages. This includes, for example, research on climate processes in the North Atlantic Ocean, the Arctic and the Antarctic, ecosystems that exist near the limits of the climatic conditions they tolerate, and societies that base their economy on activities affected by weather and climate, such as the energy, transport, marine and agriculture sectors and other natural resource-based industries. Norway also has extensive experience with a wide range of policy instruments and technologies for reducing greenhouse gas emissions and facilitating transformation. In Norway, it will be critical to achieve the transition to a low-emission society while maintaining the Norwegian welfare state. The KLIMAFORSK programme will help to compile and analyse the results and experience from climate policy, thereby providing a basis for a knowledge-based policy for the transition to a low-emission society nationally and internationally.

Although a lot is known about the direction in which climate change is moving, the future climate still comprises one of various elements of uncertainty in policy development and social planning. The KLIMAFORSK programme will encourage research that identifies various sources of uncertainty and quantifies and reduces uncertainty, while supporting optimal decision-making under uncertainty.

Poor countries are the most vulnerable to climate change and will be most seriously affected. However, a global economy and increased mobility dictate that no-one will remain untouched. This applies in particular to coming generations. Norway's national interests and global responsibility both indicate that we must do our part to promote a global understanding of the climate system, the impacts of climate change and transformation mechanisms. The KLIMAFORSK programme will enable Norway to take an active role in the shared international research effort, with the aim of better equipping the global society to deal with global societal challenges.

A significant amount of research has been conducted in the climate field in Norway in recent decades, giving Norwegian research groups a relatively prominent position in international climate research. This applies in particular to research on the climate system, studies on the impacts of climate change on the natural environment, studies on the use of policy instruments and technological development, as well as to certain areas of research on social conditions. The KLIMAFORSK programme will help Norway to maintain its position, while at the same time taking active steps to make Norwegian climate research more scientifically innovative.

There is a great need for an up-to-date knowledge base for climate services. This will be important for research on the climate system and the impacts of climate change, as well as for fulfilling society's need for information on adaptation and mitigation. The KLIMAFORSK programme will lay the foundation for targeted, research-based development of climate services in Norway.

3. Objectives of the programme

Primary objective

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Secondary objectives

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- Foster the development of a new generation of climate researchers;
- Expand expertise and applicable knowledge in trade and industry and the public administration;
- Facilitate dynamic, targeted communication activities;
- Increase the use of available data and research infrastructure.

4. Scientific priorities

The KLIMAFORSK programme is intended to meet a substantial proportion of Norway's research needs concerning all components of the climate system. These include an understanding of natural variability and human influence on the climate system, the impacts of climate change on nature and society, and climate change adaptation and instruments and measures for mitigation of climate change. The scientific and social challenges involved in this work can only be resolved if scientific progress is made both within single and across disciplines. To achieve this will require reliable long-term funding. Climate change poses risks to both nature and society, but will also open up opportunities for innovation and societal change. This will in turn expand the knowledge base and improve the prospects of finding solutions to major societal challenges at the local, regional and global level.

The scientific priorities of the KLIMAFORSK programme are divided into three broad thematic research areas. While much of the research can be carried out within each of these separate areas, the programme should also encourage projects that extend across traditional dividing lines. In addition, it is important to seek an integrated approach to the major challenges facing human society at the national and global level. These cut across national borders, and their scale is such that no country can deal with them on its own. Norway has both a responsibility and the capacity to make a substantial contribution to the global community by generating knowledge and building up expertise.

Human activity and greenhouse gas emissions are resulting in changes in the climate system. These include changes in temperature, precipitation, wind and current patterns and in the content of CO₂ and other greenhouse gases in the atmosphere and oceans. The changes have both direct and indirect impacts on species and ecosystems through their influence on natural cycles such as the hydrological cycle and various biogeochemical cycles. Changes in these cycles can in turn have feedback effects on the climate system. Both climate change itself and the impacts of climate change on natural systems may have major consequences for people and society. Our climate change adaptation and mitigation efforts influence both natural and human systems and can thus have direct and indirect effects on greenhouse gas emissions.

Research on the climate system provides a basis for studies of the impacts of climate change and society's response. The role of the research community is to generate new knowledge and to identify possible choices and their consequences for the climate and for nature and society.

4.1 The climate system and climate change

Objective: To increase knowledge about natural and anthropogenic climate change
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Knowledge about the climate system forms the basis for all climate research and is critical for making the right choices when designing measures and instruments to mitigate climate change. Our ability to

make climate predictions depends on an understanding of and the ability to model the interactions between natural and anthropogenic variability and climate change. Good observation data are an essential basis for describing and understanding the historical and present climate. Such data are also vital for developing good models and will thus reduce uncertainty in the climate models and make it possible to produce better climate projections.

The KLIMAFORSK programme is intended to combine observations, theory and modelling to improve understanding of interactions between different components of the climate system, including feedback effects and possible climate thresholds. The programme will also include closer studies of the interactions between natural and anthropogenic climate change and the further development of methods and models to improve understanding of seasonal and longer-term variability. Activities will include the development of decadal forecasts and climate projections, and a qualitative understanding and quantitative description of their uncertainty.

Natural and anthropogenic climate variability and change can only be understood on the basis of knowledge of the components of the climate system and the interactions between them. The KLIMAFORSK programme will therefore focus on processes in the atmosphere, hydrosphere, cryosphere and biosphere and their role in the climate system. At present, there are both quantitative and qualitative uncertainties in our understanding of how the different components interact. The programme will encourage research to improve understanding of variability and uncertainty factors in the climate models, and of changes in the climate system.

Studies of the impacts of climate change on natural and human systems and of climate change adaptation require good local and regional data. The KLIMAFORSK programme will therefore also support the development and use of new methods of regionalising climate data using dynamical and statistical downscaling methods, including models that couple together regional data for the atmosphere, ocean, ice and land surface. These models should be possible to use both for Norway's land areas and adjacent waters, and for developing countries where both exposure and vulnerability to climate are higher.

The focus on higher-resolution output will include temporal as well as spatial variability. Extreme weather events can have major consequences for nature and society. Understanding of historical patterns of extreme weather, particularly precipitation, temperature and wind, should be improved. There is a pressing need to expand the capacity to project changes in extreme weather patterns and the implications they will have for natural hazards as the climate changes. The KLIMAFORSK programme is designed to make a contribution here.

Research tasks in the thematic area "the climate system and climate change" are listed below. This is not an exhaustive list, and must not be considered in isolation from the other two thematic priority areas. Research on the climate system provides a basis for studies of the impacts of climate change and the need for transformation.

Research needs

1. Observations and understanding of processes

- Making use of the observational basis to understand the climate system and climate evolution in Norwegian land areas and adjacent waters at high northern and southern latitudes.
- Making use of existing observation data, both long time series and data collected during intensive monitoring periods, including satellite data, to improve understanding of processes in the climate system and their interactions.
- Building up knowledge on mass, energy and gas fluxes between the atmosphere, snow/ice, oceans and land at all temporal and spatial scales.

- Improving understanding of the role of the Arctic in the global climate system, including northward transport of heat and water in the atmosphere and ocean, southward transport of cold freshwater, and influences on more southerly regions.
- Building up knowledge about the drivers of climate variability in the North Atlantic and Arctic Ocean and their effects on the climate system.
- Building up knowledge about extreme weather events and the processes that result in such events.
- Building up knowledge about climate variability and climate change in parts of the world that play a particularly significant role in global climate evolution or that are particularly vulnerable to change.

2. *Climate variability and climate change*

- Improving understanding of the role the Earth's surface, including permafrost, snow, soils and vegetation, plays in the climate system, and how landscape change influences the climate.
- Improving understanding of biogeochemical processes in the climate system.
- Improving understanding of the chemistry of greenhouse gases and aerosols, including cycling, transformation and degradation.
- Improving understanding of the role of short-lived climate forcers (such as soot, particles and tropospheric ozone) and methane in the climate system.
- Improving understanding of interactions between air pollution, ocean acidification and climate change.
- Building up knowledge of the dynamics and mass balance of glaciers and ice caps, feedback between them and the climate system, and their influence on sea level.
- Building up knowledge about changes in the hydrological cycle, including changes in the occurrence of extreme weather events such as drought and flooding.
- Improving understanding of natural climate variability (both externally and internally forced) and how this interacts with anthropogenic climate change.
- Building up knowledge about possible climate thresholds and the consequences of exceeding them.

3. *Modelling climate evolution at the global and national level*

- Further developing earth system models to improve simulation of climate evolution, with a particular emphasis on high northern latitudes.
- Further developing dynamical and statistical downscaling methods for regionalising climate data.
- Improving descriptions of physical processes and coupled biogeochemical cycles in climate models and earth system models.
- Studying predictability and developing methods and models for decadal climate forecasting.
- Studying climate sensitivity.
- Improving the utilisation of results from available climate simulations (for example from global or regional databases) to quantify and reduce uncertainty.
- Developing scenarios in which pathways for anthropogenic climate drivers include options for emissions reductions, carbon uptake and adaptation.
- Building up knowledge of the opportunities and risks of interventions to moderate climate change, for example geoengineering.
- Developing regional climate data for land and sea for use in research, impact assessments, planning and capacity building at the national and international level.
- Developing local climate data, including better techniques for downscaling global climate models, bias corrections and handling uncertainty, in order to provide better climate services.

4.2 The impacts of climate change on nature and society

Objective: To improve knowledge about the impacts of climate change on nature and society

The climate plays a crucial role in physical, chemical and biological patterns and processes in nature and for people's living conditions and livelihoods. Climate change will therefore have consequences for geological and hydrological processes and natural hazards, and for biodiversity, ecology, and ecosystem functions and services. The resulting changes may in turn threaten basic human needs related to nutrition, health and safety, economic activity, infrastructure including buildings, and the environment. Generating knowledge about the impacts of climate change on nature and society contributes to overall knowledge development, and will also provide a key part of the knowledge base for nature and land-use management. Knowledge is also an essential basis for designing mitigation and adaptation instruments, and makes it possible to take sound research-based decisions as regards transformation in response to climate change.

The KLIMAFORSK programme will promote a focus on complex research questions and an integrated approach to research on the impacts of climate change. The physical and biotic environments form part of complex socio-ecological systems, in which strong feedback effects are expected. Climate change is combined with the action of other drivers of change, including land-use change, changes in settlement patterns, pollution and alien species. It is a difficult task to develop an understanding of the combined effects of all these simultaneous processes of change. Land-use change can affect the vulnerability and resilience of ecosystems to both direct and indirect impacts of climate change, which in turn may influence the risk of natural hazard damage. Activities under the research programme will therefore be targeted towards improving understanding of physical and biotic systems, human society and the links between them.

More research is needed on the degree to which different sectors are taking the effects of climate change into account or seeking to compensate for them. Climate change has implications for natural resource-based industries such as agriculture, fisheries and the energy industry at all stages of the value chain (production, marketing and consumption). Moreover, it has consequences for nature management, land-use planning, transport and work on natural hazards (mapping, measures to prevent natural hazard damage, monitoring, warning and emergency planning). Society's response to climate change also has environmental effects, which may be positive or negative for biodiversity or other ecological goods and services. Research on such impacts of climate change is therefore important.

Long time series and large data sets are invaluable in research on the impacts of climate change. The KLIMAFORSK programme will facilitate effective use of existing and new physical, ecological and social data sets and relevant high-quality time series by the research community and the public administration. Furthermore, the programme is intended to encourage research that not only demonstrates the impacts of climate change on isolated phenomena in natural or human systems, but also improves understanding of underlying factors and fundamental mechanisms, processes and interactions at all levels.

Research tasks in the thematic area "the impacts of climate change on nature and society" are listed below. This is not an exhaustive list, and must not be considered in isolation from the other two thematic priority areas. Studies of the impacts of climate change will provide important motivation and ensure the legitimacy of research both on the climate system and on transformation.

Research needs

1. *Impacts of climate change on the physical and chemical environment, including hydrological and geological processes*
 - Building up knowledge about impacts on hydrological processes and the hydrological cycle, including flooding, drought, water flow, water in the unsaturated zone groundwater and sediment transport.

- Studying the impacts on snow, ice, glaciers, frozen ground and ice conditions in rivers, lakes and the sea, including changes in mean values and in spatial and temporal variability.
 - Building up knowledge about physical processes in general, including the frequency, seasonal distribution and severity of landslides and avalanches, and the impacts of changes in hydrological conditions, frost conditions and snow cover on these processes.
 - Investigating the impacts on hydrobiogeochemical processes.
 - Studying the impacts of climate change on ocean acidification and in the next instance on marine ecosystems and biological production.
 - Developing local data on natural hazards such as flooding, drought, landslides and avalanches, including improvements in modelling and handling uncertainty, in order to improve the knowledge base for climate services.
2. *The underlying processes that govern how ecosystems respond to climate change*
- Investigating underlying processes and key functions that govern or influence the response of ecosystems at different levels (individual, population, species, community, ecosystem), including ecosystem dynamics, physiological processes and adaptive capacity (plasticity and selection).
 - Studying the consequences and probability of major changes in ecosystems as a result of climate change: to include functional change, indirect effects, thresholds/tipping points, match/mismatch between different trophic levels and impacts on life stages that are critical for species distribution and population dynamics.
 - Intensifying efforts to couple biophysical, ecosystem and energy flow models, including developing new scenarios.
3. *Spatial and temporal variability in the response of ecosystems to climate change*
- Comparing responses between and within ecosystems (marine, limnic and terrestrial) and along regional climate gradients to reveal their variability and consistency, synthesise results and build up an overall understanding.
 - Studying the variability of responses linked to regional and local climate change, and to different components in different ecosystems.
 - Making use of relevant existing data showing spatial and temporal changes in ecosystems, and developing new observation methods where necessary. This may include both field methods of monitoring ecosystem change and the use of databases and new technology (remote sensing, data loggers, underwater observatories, etc.).
 - Investigating the intentional and unintentional consequences of mitigation and adaptation measures on ecosystems.
4. *Interactions between climate change and ecosystem functions and services, feedback effects and interactions with other important drivers of change*
- Improving understanding of impacts on species that have key functions in ecosystems, provide important ecosystem services or are important to society in other ways, and on parasites, pathogens and diseases.
 - Improving understanding of interactions between impacts of climate change and other drivers of change in ecosystems, such as land-use change, harvesting of natural resources, pollution and alien species.
 - Improving understanding of climate regulation by ecosystems through albedo and biogeochemical and hydrological cycles.
 - Developing an integrated understanding of the carbon cycle in ecosystems, including vegetation-climate feedback and how industries and the public authorities can influence ecosystem services related to carbon sequestration, albedo and similar processes.

5. *The consequences of climate change for infrastructure, trade and industry and living conditions*
 - Studying the impacts of climate change on natural resource-based industries, including harvesting of natural resources and production in primary industries (agriculture, forestry, aquaculture and fisheries).
 - Studying the impacts of changes in mean and extreme values, interactions with other process of change, and the impacts of feedbacks between the natural environment, industry and society.
 - Investigating the impacts of climate change on outdoor recreation and tourism.
 - Generating knowledge about the consequences of climate change for infrastructure and physical installations, including roads, railways, water and sewerage systems, power supply infrastructure and buildings. This includes disruption or destruction of infrastructure and changes in risk level as a result of changes in the frequency and intensity of extreme weather events and natural hazard events.
 - Investigating the impacts of climate change on people's living conditions, including impacts on health and society's response.
 - Investigating the impacts of climate change on the living conditions of indigenous peoples and their adaptive capacity.

4.3 Societal transformation in response to climate change

Objective: To increase knowledge about transformation to a low-emission society and climate change adaptation

Transformation in the context of climate change refers to the societal change needed for mitigation and adaptation. The KLIMAFORSK programme is intended to build up more knowledge that can be used to achieve key targets of climate policy in these areas, and thus promote the transition to a low-emission society. Research on transformation includes studies of climate policy, strategies, policy instruments, agreements, barriers and opportunities, attitudes and behaviour and the capacity of society to design and implement change. Research on these issues is based on analyses of the climate system, of the impacts of climate change on nature and society, and of factors that may influence the pace of transformation. Research on transformation means addressing value questions and involves knowledge and understanding of climate change issues and how to share responsibility for taking action.

This thematic priority area will require knowledge generation in all scientific disciplines, with a special focus on interdisciplinary cooperation. The transformation process is not just a question of challenges and costs. It also entails opportunities for technological progress and industrial development, the creation of "green" jobs, changes in norms, more sustainable use of resources and improvement of the local environment. The list of research tasks below is not exhaustive. The research needs in this thematic area must be considered in conjunction with research on the climate system and research on the impacts of climate change.

Research needs

1. Research questions relating to both mitigation and adaptation

Knowledge is needed about general public understanding of climate change and about the need for transformation to a low-emission society and climate change adaptation. This may include the significance of developing an effective climate policy, and interactions with welfare policy, national and global security, and migration. Research topics may include:

- Actors, roles, processes, planning, life cycle assessment, distribution of power and political processes.
- Conditions for eliminating barriers and improving capacity for change in society at the local, national and international level, including the conditions that must be met to enable large-scale collective action, for example to achieve sustainable production and consumption.

- Assessment of the net climate effect and environmental impacts of climate and environmental measures. Conditions for facilitating new technology adoption and, new standards, education and transfer of experience.
- Links between climate policy and key sectors such as energy and transport.
- Communication, norms, valuation, attitudes and lifestyle. The role of the media.
- Gender perspectives in research.

2. Research questions relating to mitigation and sequestration

Knowledge development is needed for Norway to become a low-emission society in the longer term. This includes socio-economic analyses of instruments and measures to mitigate climate change, how such instruments and measures can influence patterns of behaviour, and how “green” jobs can be created and maintained. Knowledge should be based on experience of using policy instruments to date and the characteristics of policy instruments that are considered to be effective. Analyses of the net effect of different measures are also needed. Research may include studies of both stepwise and radical change to reduce emissions and enhance sinks of greenhouse gases. In addition, analyses of different types of climate policy at the national and international level are needed, taking into account public and political support, the legal, economic, social and technological dimensions of different policies, and other considerations that may provide incentives to reduce greenhouse gas emissions. Climate policy should be considered both in a global and in a local perspective, for example by considering urban climate policy and the UN-led negotiations on a new climate agreement. Research topics may include:

- How policy targets and instruments are understood and applied, and their overall effects on the climate system and natural and human systems.
- Interactions between targets, measures, effects, instruments and enforcement mechanisms in climate policy at the local, national and international level.
- Which instruments will be most effective in reducing greenhouse gas emissions from the transport and energy sectors and encouraging the deployment of climate-friendly technology.
- Opportunities and risks associated with interventions to moderate climate change, including the impacts on biodiversity.
- Knowledge about future population growth and how new transport, housing and energy infrastructure and technology in urban areas can contribute to reductions in greenhouse gas emissions.
- Opportunities for and barriers to international cooperation agreements on emissions reductions, including identifying processes and actors that influence the development of international agreements of significance for climate change.
- The implications of climate policy for innovation in trade and industry and green growth.
- Potential synergies between emissions reductions and technological innovation, sustainable resource use, new business opportunities, forest management, local environmental improvements, etc.
- Challenges related to incremental and radical innovation: for example developing, spreading and deploying new technology, path dependence, new infrastructure needs, standards, regulations, and public engagement and participation.
- Individual and comparative studies of climate policy in countries that are major greenhouse gas emitters, such as the US, the EU, China, India, Brazil, Russia, Indonesia and South Africa.

3. Research questions relating to adaptation

There is a growing need for knowledge about how human societies can adapt to, protect themselves against and potentially benefit from climate change on an increasingly large scale. Poor countries are particularly vulnerable to climate change, but Norway and adjacent areas will also be affected. The impacts of climate change are further discussed in Chapter 4.2. Research topics may include:

- Identifying particularly vulnerable areas, population groups, industries and resources, and

needs and opportunities related to climate change adaptation, both in Norway and globally. The need for information, local involvement and access to expertise to deal with vulnerability, including knowledge about local conditions. The implications of social inequalities.

- Handling risk and uncertainty.
- Ethical and legal responsibilities and rights relating to climate change adaptation.
- Comparisons of different climate change adaptation strategies and their effects: barriers, constraints, instruments and comparison of experience from different sectors, industries and countries.
- The impacts of different strategies on biodiversity and landscape diversity.
- Economic consequences of climate change, including cost-benefit analyses of climate change adaptation.
- The development of a knowledge base for climate services and climate change adaptation as a basis for action, including accessible and user-friendly translations of information on weather and climate.

4. Research questions relating to interactions between mitigation and adaptation

Mitigation instruments and measures may have either positive or negative effects on the resilience and vulnerability of natural and human systems to climate change, depending on the types of measures used and the scale of climate change. Research topics may include:

- Synergies and trade-offs between mitigation and adaptation, such as the importance of climate change adaptation for attitudes to mitigation instruments and measures.
- The implications of differences between private and social profitability in the development of policy instruments and strategies.
- The relationship between the situation in the international climate negotiations and different countries' vulnerability, exposure and resource base.
- Ways of achieving synergies between mitigation and adaptation through the use of policy instruments, for example central government economic and legislative instruments, climate change mitigation and energy planning by counties and municipalities and municipal land-use planning.
- Knowledge about the impacts of various mitigation instruments and measures on the resilience and vulnerability of natural and human systems to climate change.

5. Strategic priorities

Norwegian climate research must be expanded to provide society with the knowledge it needs. The KLIMAFORSK programme has formulated eight strategic objectives to promote this development:

1. Achieve integrated climate research

Addressing the complex research questions raised by climate change will require an integrated, broad-based approach across disciplines and thematic areas. In many contexts, the involvement of end-users will be useful for ensuring the relevance of the research and taking advantage of user experience.

At the same time, climate research requires specialist expertise in various subject fields, and many research tasks are best solved through close collaboration between researchers in the same or related fields. The ultimate goal is therefore not to fund as many interdisciplinary projects as possible, but rather to incorporate interdisciplinarity as a natural component of projects where it is called for to address the given research challenges and questions. Many of the research questions in the field will also require new collaborative constellations and innovative ideas.

The KLIMAFORSK programme will actively promote cooperation, constructive task distribution and targeted research activity in the national research landscape.

In response to society's steadily growing interest in knowledge about climate and the expanding scope of climate research, a number of programmes and activities at the Research Council have incorporated a significant climate component into their project portfolios. To maintain an integrated, strategic focus on climate research, the KLIMAFORSK programme will work to ensure effective coordination across the Research Council's programmes. This includes creating a unified structure, identifying knowledge gaps and filling them when necessary, and avoiding duplication and overlap between programmes. The KLIMAFORSK programme will work to achieve coordinated overall administration of climate research activities at the Research Council.

2. Promote climate research projects within an open thematic framework

The KLIMAFORSK programme will provide funding opportunities for research projects within a broadly defined area by issuing funding announcements for independent climate research projects. These will give researchers the opportunity to formulate their own research questions within an open thematic framework. Funding for independent projects is intended to promote innovative climate research of high scientific calibre. Grant proposals will be accepted within all of the thematic priority areas set out in the KLIMAFORSK work programme as well as related thematic areas.

3. Encourage boldness in scientific thinking and scientific innovation in research projects

Importance will be attached to boldness in scientific thinking and scientific innovation in research projects. Boldness in scientific thinking refers to innovative concepts that can help to advance scientific understanding beyond the current research front. In certain cases this may increase the risk of the projects not achieving their objectives.

4. Enhance the international profile and contribution of Norwegian research groups

Addressing climate challenges requires wide-ranging international cooperation and a coordinated effort across national boundaries. Norway is home to a number of research groups of high international calibre. The KLIMAFORSK programme will enhance the international profile and quality of Norwegian research, thereby expanding the ability of Norwegian research groups to take active part in the global knowledge effort. This will comprise an important component of the programme's international activities.

5. Foster the development of a new generation of climate researchers

The KLIMAFORSK programme will work to recruit talented researchers. The programme will also enable younger researchers to be project or work package managers and will attach particular importance to achieving a satisfactory gender balance among project managers.

6. Expand expertise and applicable knowledge in trade and industry and the public administration

While climate change and transformation will entail new limitations and guidelines, they will also pave the way for new opportunities. Information and knowledge about various climate issues will come to be an increasingly important part of the basis for decision-making in trade and industry and the public administration. Society will seek up-to-date information, knowledge and research results that can be quickly applied. The KLIMAFORSK programme will increase the involvement and participation of the public and private sectors in research projects, thereby expanding expertise and the utilisation of knowledge among these stakeholders. The programme will also generate relevant, applicable knowledge for use by trade and industry, the public administration and the general public.

The KLIMAFORSK programme will work to fill knowledge needs and expand the knowledge base to provide high-quality climate services in Norway.

7. Facilitate dynamic, targeted communication activities

The KLIMAFORSK programme will engage in dynamic, targeted communication activities to ensure that research-based knowledge is put to use. The programme will facilitate effective dissemination of research findings and will also ensure that project results have a significant scientific impact both in the field of climate research and in other fields in order to provide society with the best possible basis for decision-making.

8. Increase the use of available data and research infrastructure

All areas of climate research are dependent on satisfactory data, whether the aim is to distinguish anthropogenic pressures from natural pressures on the climate system, identify the impacts of other ecosystem pressures, ascertain the effectiveness of policy instruments, calculate emissions accounts or distinguish the consequences of transformation from other social drivers. Norway has a long tradition of collecting, processing and storing vast amounts of data. The Norwegian research community therefore has an advantage in terms of compiling a research base for the necessary national transformation and competing in the international arena. The KLIMAFORSK programme will facilitate the utilisation and processing of long time series and large data sets for use in research and management and to improve the use of national research infrastructure in areas in which Norway has special advantages, facilities or needs.

The measures in the strategic priority areas will be operationalised in the KLIMAFORSK programme's action plan, which will be revised on annual basis.

6. Integration of climate research into different sectors

Climate change will influence every sector of society in the years ahead. This will limit some options, but there will also be new business opportunities and opportunities for value creation. All stakeholders will be affected, and will have to incorporate climate-related measures and the impacts of climate change into long-term plans and investments. Research should generate knowledge that is as relevant as possible, and all sectors must take this into account when setting research priorities. Transformation to a low-emission society will require knowledge about how emissions can be reduced at the local, regional, national and international level. Knowledge of policy instruments and other types of incentives, for example to speed up deployment of low-carbon technology, is also important. Furthermore, it is necessary to understand how international structures set a framework for national policy in Norway and other countries, and how Norway can use its role in international climate cooperation to best effect. Climate services such as projections and good data on the climate system, downscaling to give local climate predictions, and information on impacts on natural and human systems provide an essential basis for these efforts. Knowledge about the economic, legal, institutional, organisational, social and cultural consequences of climate change will also be of importance.

Research needs within the three thematic priority areas of the KLIMAFORSK programme are described in Chapter 4. This chapter discusses key knowledge needs for various sectors. The list is not exhaustive, and the knowledge needs must be seen in the context of other Research Council programmes and activities.

Transport

Transport is currently the sector that accounts for the largest proportion of Norway's greenhouse gas emissions, and the share emitted by heavy goods vehicles is rising. Emissions from air traffic are also rising, but at a lower rate than the traffic volume. Emissions from domestic maritime transport are stable. Knowledge is needed on topics including transformation pathways for the transport sector, for example shifting heavy freight from road to rail, and optimal planning for population growth around towns. Important measures are expected to include the development of more energy-efficient cars, a more rapid transition to electric and hybrid vehicles, and better availability of sustainable biofuels. For air traffic and shipping, new knowledge is needed on further energy-efficiency measures and the transition to other fuel types (gas, LNG, biofuels). In many parts of Norway, the transport infrastructure will not be very resilient to higher precipitation or more frequent natural hazard events such as flooding, landslides and avalanches, and new knowledge is needed to prevent damage.

Renewable energy

Climate change will affect renewable energy generation and influence energy use. Knowledge is needed about ways of reducing costs and promoting the use of new renewable energy technologies. Together with technological innovation and the development of more efficient solutions for energy use, this is of crucial importance for ensuring transition to more climate-friendly energy supplies. Research is also needed on ways of developing renewable energy supplies while minimising the impacts on biodiversity and other important ecological goods and services. Moreover, more insight is needed into how climate change will affect energy infrastructure and about adaptation needs as regards the siting of and design specifications for energy installations.

The petroleum sector

Greenhouse gas emissions from oil and gas production are closely related to the level of activity on the continental shelf. Emissions rose steeply until 2001, but since then the rise has been slower. The major sources of emissions are gas combustion in turbines during energy production and flaring of gas. Knowledge about climate change will be important in the project planning phase, particularly for activities in the northern areas. Technological innovation in a wide range of disciplines will be needed in order to achieve emissions cuts. Knowledge and technology that result in energy efficiency gains offshore and enable optimal use of electricity generated onshore will be particularly important.

Land-based industry and industrial development

Land-based industry generates both process emissions and emissions from combustion of fossil fuels. Manufacturing industries have successfully reduced their emissions, but research is still needed on topics such as the benefits of phasing in environmental technology and new intermediate inputs, for example biochar in metal manufacturing. There is a general potential for growth in green jobs and for strengthening the competitiveness of the business sector by using new climate-friendly solutions in the fields of environmental technology, renewable energy and energy efficiency.

Agriculture

Emissions from Norway's agricultural sector have remained stable in recent years. The main sources of emissions are the use of mineral fertiliser and livestock production. Emissions from these sources are influenced by factors such as soil management techniques, soil temperature, and which crops are grown. Research is needed to find ways of reducing emissions from manure and from biomass production. Knowledge is also needed on the potential for reducing emissions throughout the production and consumption chain. Climate change in Norway may result in higher yields and allow cultivation of more crops that require a warmer climate, but is also likely to result in more frequent natural hazard damage as a result of higher precipitation, stronger winds, and an increase in plant diseases and pests. Knowledge about cost-effective adaptation strategies will therefore be important.

Forests and forestry

There are substantial carbon stocks in forest ecosystems, and growing forest is an important carbon sink. Logging and combustion release carbon to the atmosphere. More knowledge is needed about how the forestry sector can help to enhance forests as a carbon sink and how forest bioenergy can be used in ways that promote climate change mitigation, while minimising impacts in other priority areas, such as air pollution and biodiversity. Knowledge of the impacts of changes in albedo (reflectivity, or the proportion of sunlight reflected back into the atmosphere) is also needed. Climate change will have consequences for both forests and the forestry sector. The distribution of forested areas will expand, and forest productivity in northern parts of Norway will rise. Adverse effects are also expected, such as damage caused by extreme weather events, spring drought and frost. Knowledge about effective adaptation methods will be of key importance.

Fisheries and aquaculture

Greenhouse gas emissions from fishing vessels have risen in recent years. Emissions can be cut by means of a changeover to gas-powered vessels, energy efficiency measures and more energy-efficient patterns of operation. Emissions from aquaculture vessels can be reduced using the same techniques. Rising sea temperatures generally result in higher productivity, but much more knowledge is needed to

be able to predict the consequences for aquaculture and fisheries. The changing climate is also expected to entail stronger winds, higher precipitation and an increase in wave height, all of which will have impacts on infrastructure such as breakwaters, ports and fish farming cages. Knowledge about how ecosystems respond to climate change and the consequences of extreme weather events will be crucial. There is also a pressing need for knowledge about the impacts of ocean acidification and other pressures on fish resources and their food supplies. For the aquaculture industry, it is particularly important to understand how climate change will affect the environmental standards that need to be met for farmed fish, and how the industry can adapt.

Water supply and sewerage systems

Climate change and the accompanying rise in extreme precipitation and flooding will increase the risk of disruption of water supply and sewerage services. Disruption of water supplies will affect residents and the business sector immediately, while disruption of sewerage systems may have consequences for infrastructure including buildings and for health and the environment. There is a large maintenance backlog in this sector, and a pressing need for research-based knowledge development on the impacts of climate change, for example the effects of extreme precipitation events, and on new technological solutions and alternative forms of stormwater management.

The construction sector

Buildings account for about one third of total energy use in Norway, and the sector needs to develop solutions adapted to different environmental conditions and a changing climate. There is a pressing need for knowledge about how to speed up improvements in energy efficiency and a shift in energy production and use, and about the implications of such a shift for health and the environment. The increase in precipitation and in the frequency and severity of events such as flooding, avalanches and landslides that are expected to accompany climate change will make it necessary for buildings in parts of Norway to withstand more severe conditions. There is a maintenance backlog in the construction sector as well. More knowledge is needed to improve estimates of the consequences of climate change for the built environment, and to identify instruments and measures that can reduce the risk of climate-related damage. Other key topics are generating new knowledge that can be used to develop low-energy and zero-energy housing, and reviewing how energy performance can be improved and energy efficiency measures promoted in existing buildings.

Towns and urban areas

Many of Europe's fastest-growing towns and urban areas are in Norway. Knowledge is needed about how to accomplish a shift to wind, solar, and marine energy, and about transport and land-use policy. The changing climate is expected to bring more frequent flooding, larger volumes of stormwater, a rising sea level and a greater risk of landslides and quick clay slides. There is an urgent need for more knowledge to deal with these problems. A wide range of adaptation measures will be needed, from using green spaces and re-opening culverted rivers to mapping landslide and quick clay slide hazard areas, and long-term planning to avoid the negative consequences of a rising sea level.

The cultural heritage

In the long term, climate change may result in damage to monuments and sites and adverse impacts on cultural environments. For example, warmer and wetter conditions will speed up the spread of forest and scrub so that open landscapes become overgrown more quickly, and will also accelerate degradation processes that damage historical buildings. It is a challenging task to meet stricter energy efficiency requirements in historical buildings. In addition, acute damage caused by extreme weather events may become more frequent. Knowledge is needed about which effects are to be expected, how serious they will be, and how damage best can be prevented.

7. International cooperation

The wide array of challenges associated with climate change entail a growing need to enhance internationalisation in research activities. Many research tasks require coordinated efforts and more personnel and equipment than any single country can provide on its own. Broad-based international cooperation and coordinated knowledge production lead to a more visible profile and lend legitimacy to research activities and results. Moreover, finding solutions to climate change will require efforts across national borders. Only through cooperation can each individual country satisfy its need for knowledge and innovation. Norway must take on its share of responsibility for climate change and act prudently with future generations in mind.

The KLIMAFORSK programme will facilitate international research cooperation in keeping with the Research Council of Norway's strategy on international cooperation. The programme seeks to draw greater international attention to Norwegian research and to take active part in global knowledge production. The programme will achieve these aims by enhancing the quality and capacity of Norwegian research and research-driven innovation. Of particular importance in this context will be ensuring the relevance of Norway's research contribution to the activities of the Intergovernmental Panel on Climate Change (IPCC), by means of references to Norwegian researchers' publications and Norwegian co-authorship of the IPCC assessment reports. This will require publication in international peer-review journals, high citation frequency and a visible presence in international research arenas (e.g. active participation in international conferences, EU-funded projects, recruitment and network-building activities). The same applies to other relevant international initiatives as well.

The programme will promote increased Norwegian participation in international research cooperation at the Nordic, European and global level, as well as bilateral cooperation with selected countries. Key arenas for research cooperation include NordForsk-funded programmes, the EU Framework Programme for Research and Innovation (Horizon 2020), European Joint Programming Initiatives (JPI) and cooperation platforms (the ERA-NET scheme, the European Climate Research Alliance (ECRA)), and large-scale global programmes such as Future Earth under the International Council for Science (ICSU).

The KLIMAFORSK programme will be the primary channel for cultivating Norwegian participation in JPI Climate, which is emerging as an important instrument for coordinated European climate research. The international arenas for cooperation have expanded significantly in recent years, and the Norwegian research contribution has increased correspondingly. It is no longer a question of increasing international cooperation in general, but of giving priority to the right arenas and activities and focusing active efforts on these.

The KLIMAFORSK programme will facilitate international climate research by means of joint funding announcements with relevant national and international programmes. The evaluation of Norwegian climate research and a bibliometric study show that Norway enjoys a good international standing in the field.⁵ The KLIMAFORSK programme seeks to pave the way for more research collaboration with the major established and rapidly emerging research nations. The programme will also work to establish collaboration with countries in the South, where there is a particularly large need for greater expertise and capacity for dealing with climate-related challenges, and where Norwegian researchers can share their knowledge on societal transformation in response to climate change.

⁵ Norwegian climate research. An evaluation. (2012); Bibliometric Study in Support of Norway's Strategy for International Research Collaboration (2014).

8. Communication and dissemination activities, and benefits to society

The KLIMAFORSK programme will employ dynamic, targeted communication activities to ensure utilisation of research-based knowledge.

Synthesising and collating knowledge will be an important component of communication activities under the KLIMAFORSK programme. The climate-related knowledge generated at the Research Council must be presented in an integral manner, independent of programme, and targeted towards application in the development of policy and measures for society in general and trade and industry in particular. The KLIMAFORSK programme will initiate and provide support for synthesising activities via funding announcements and through internal cooperation between related Research Council programmes on the preparation and dissemination of knowledge syntheses in the climate field.

Communication activities under the KLIMAFORSK programme will build on four forms of dialogue:

- Dialogue between climate researchers;
- Dialogue between climate researchers and researchers in other fields;
- Dialogue between climate researchers and users;
- Dialogue between climate researchers and the general public.

The programme will set out guidelines and requirements for dissemination of research findings in its funding announcements. The programme will also establish a framework for arenas for dialogue.

Dialogue between climate researchers

Scholarly publication and participation at conferences and in other relevant fora are vital measures for fostering productive scientific dialogue between climate researchers. Given that climate research extends across disciplinary boundaries, it is also important to promote interdisciplinary dialogue about the field.

Dialogue between climate researchers and researchers in other fields

Communication between climate researchers and other research communities is important, but the channels for such dialogue are not well developed. The KLIMAFORSK programme will therefore take steps to improve these channels, for instance by taking part in efforts involving national and international synthesis activities, management plans, reports and evaluations.

Dialogue between climate researchers and users

The dissemination of research results under the KLIMAFORSK programme should be viewed in terms of the knowledge and expertise needed by the public administration and trade and industry. The active involvement of relevant user groups from an early stage will be key.

Dialogue between climate researchers and the general public

Communication activities under the KLIMAFORSK programme are to engage and enlighten the general public and to strengthen the overall understanding of and commitment to addressing and counteracting anthropogenic climate change. The programme will disseminate research findings via the mass media and encourage researchers to take part in the public debate, to communicate via popular science channels and to share their knowledge with organisations, companies and government agencies. Knowledge about climate change must also be disseminated to teachers and schoolchildren.

9. Budget and funding announcement plan

The KLIMAFORSK programme was launched as a large-scale programme in 2014 and is scheduled to run until 2023. In 2014, the programme has received allocations from the Ministry of Climate and Environment, the Ministry of Education and Research, the Ministry of Agriculture and Food, the Ministry of Trade, Industry and Fisheries, as well as cross-sectoral funding from the Ministry of Education and Research.⁶ Given a zero-growth budget, the programme will have an annual budget of roughly NOK 143 million in the 2014–2023 period, totalling some NOK 14.3 billion for the entire programme period.

Funding set aside for administration will be incorporated into the programme's long-term budget. The administration budget will cover synthesis, communication and dissemination activities.

Funding announcement plan

To ensure predictability vis-à-vis the research community and internally within the Research Council, the KLIMAFORSK programme has drawn up a long-term overall plan for funding announcements. Calls for proposals will rotate between each of the three thematic priority areas over three years. Interdisciplinary projects with links to the other two thematic areas will be specifically requested in each funding announcement when this is relevant.

In addition, a call for proposals for climate research projects within an open thematic framework is planned issued every other year. Roughly 10–20 per cent of the funding available for allocation that year will be set aside for independent projects.

The funding announcement plan must be considered in light of other national and international activities and calls, the allocation letters from the ministries and calls issued by other Research Council programmes. Thus the amount of funding available for projects in a given year's thematic priority area will be adjusted in relation to other activities. The thematic framework of the call will also be adapted to the funding available for allocation.

The plan is drawn up for five years at a time:

- 2013 – Societal transformation in response to climate change
- 2014 – The impacts of climate change on nature and society and research projects within an open thematic framework
- 2015 – The climate system and climate change
- 2016 – Societal transformation in response to climate change and independent climate research projects
- 2017 – The impacts of climate change on nature and society
- 2018 – The climate system and climate change and research projects within an open thematic framework

10. Coordination with other related instruments at the Research Council

Interaction between the KLIMAFORSK programme and other relevant activities at the Research Council

Climate change affects most sectors, industries and administrative areas. As a result, roughly 40 activities at the Research Council have included some form of climate research in their objectives

⁶ Cross-sectoral funding from the Ministry of Education and Research has replaced funding from the yield from the former Fund for Research and Innovation.

and/or project portfolio. Research on the climate system and much of the research on the impacts of climate change on natural systems lies within the scope of the KLIMAFORSK programme, while research questions relating to impacts on and transformation within various industries and society are addressed in several sector-oriented programmes as well. Examples of sectors with overlapping research questions include energy, transport, the environment, bioresources, health, technology and indigenous peoples.

Cooperation and effective coordination between relevant programmes and activities will be essential to promoting and reaping the benefits of an integrated effort across the entire range of the Research Council's portfolio. It is essential to prevent important research from falling between programmes. Overlap between programmes ensures flexibility and makes it possible to clarify and develop activities in several dimensions. Measures for managing boundaries between programmes and designating areas of cooperation will be specified in the KLIMAFORSK programme's action plans and realised in collaborative activities.

The KLIMAFORSK programme shares an interface with the following programmes (this list is not exhaustive):

- Polar Research Programme (POLARPROG)
- The Oceans and Coastal Areas (HAVKYST) and its coming replacement
- Sustainable Innovation in Food and Bio-based Industries (BIONAER)
- Large-scale Programme for Energy Research (ENERGIX)
- Norwegian Environmental Research towards 2015 (MILJO2015) and its coming replacement
- Aquaculture – An Industry in Growth (HAVBRUK) and its coming replacement
- Programme for Space Research (ROMFORSKNING)
- National Financing Initiative for Research Infrastructure (INFRASTRUKTUR)
- Programme on Intelligent Freight Transport (SMARTRANS)
- Large-scale Programme for Petroleum Research (PETROMAKS2)
- Health research programmes

Also of relevance are the bilateral programmes for research cooperation with China, South Africa, India and Russia, respectively, as well as the programme for supporting global partnership.

Several Centres of Excellence (SFF), Centres for Environment-friendly Energy Research (FME) and Centres for Research-based Innovation (SFI) will have relevance for the KLIMAFORSK programme as well. Further, important knowledge in the climate field is being developed within the open competitive arenas for research and innovation such as the FRIPRO funding scheme for independent projects and the Programme for User-driven Research-based Innovation (BIA).

The KLIMAFORSK programme will work to promote cooperation and coordination with the above-mentioned activities via joint strategies, funding announcements, dissemination activities, synthesis activities and meeting places.

11. Organisation

Programme board

The KLIMAFORSK programme board is appointed by and reports to the Research Board of the Division for Energy, Resources and the Environment. The programme board is responsible for achieving the programme's objectives using the instruments available under the programme. Activities are to be carried out in accordance with the intentions and objectives of the Research Council's overall strategy, the guidelines from the Council's Executive Board and the Research Board of the Division for Energy, Resources and the Environment, and the guidelines from the funding ministries. The programme's priorities, research tasks and financial framework will be assessed and adjusted in

relation to unplanned changes in the national budget and annual allocation letters from the funding ministries. The programme board's activities shall at all times be in compliance with the overall principles and guidelines for the establishment, operation and conclusion of research programmes as set out by the Research Council. The programme board acts on behalf of the Research Council and reports to the research board via the executive director.

Programme administration

The KLIMAFORSK programme administration is responsible for carrying out the day-to-day tasks of the programme and consists of a programme coordinator assisted by personnel with scientific and administrative expertise. The programme administration carries out the administrative functions of the programme and facilitates the implementation of the programme board's decisions.

Application review process

Funding announcements will be in compliance with the Research Council's applicable rules and use the fixed application submission deadlines. The KLIMAFORSK programme will employ researcher projects, innovation projects and knowledge-building projects with appurtenant assessment criteria to achieve the programme's objectives. Other application types will be employed as needed. Any additions to the requirements or assessment criteria for grant applications will be specified in the funding announcements.

Grant applications will primarily be assessed by international referee panels and/or individual experts, but may in certain cases be assessed by the administration. The composition of the referee panels or selection of individual referees will cover the thematic and scientific range of the grant applications received. The programme administration will submit a recommendation for projects to be awarded funding to the KLIMAFORSK programme board. The programme board is responsible for final approval of grant allocations.



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