

Work programme

In effect from 2018

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



Large-scale Programmes

The RCN initiative
to meet national
research priorities

Work programme

In effect from 2018

Large-scale Programme on Climate Research - KLIMAFORSK

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Visiting address: Drammensveien 288
The Research Council of Norway
P.O.Box 564
NO-1327 Lysaker

Telephone: +47 22 03 70 00

post@rcn.no

www.rcn.no

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This work programme for the KLIMAFORSK programme is a restructured revision of the 2014 work programme, which was the culmination of a comprehensive process involving research groups, the public administration, trade and industry, and other stakeholders carried out prior to the programme's launch in order to map research and knowledge needs in Norway. 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 and a detailed evaluation of Norwegian climate research. The Research Council has performed two portfolio analyses of climate research (2015 and 2017). This work programme may be revised at regular intervals to ensure that the programme has the most appropriate scientific and operational focus at all times and promotes the greatest possible scientific and societal relevance.

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1 Summary

Climate change is one of the greatest societal challenges of our time. The Large-scale Programme on Climate Research (KLIMAFORSK) will promote outstanding climate research and generate essential knowledge about the climate for the benefit of society. The programme is intended to meet a substantial proportion of Norway's research needs in the climate field. These include an understanding of natural variability and human influence on the climate system, the impacts of climate change on nature and society, climate change adaptation, and instruments and measures for reducing greenhouse gas emissions. The programme encompasses the full breadth of research and other knowledge production about the climate. Multiple programmes at the Research Council provide funding for research on climate issues, and the objectives set out in this work programme will best be achieved through effective cooperation and task distribution between these programmes. The KLIMAFORSK programme is the core programme for climate research and will work to achieve coordinated overall administration of climate research activities at the Research Council.

The primary objective of the KLIMAFORSK programme is to promote outstanding climate research and generate essential knowledge about the climate for the benefit of society.

The programme's scientific and structural secondary objectives will advance the achievement of its primary objective.

Scientific secondary objectives

The programme will fund research activities in all subject fields and disciplines to increase knowledge about:

1. natural and anthropogenic climate change;
2. the impacts of climate change on nature and society;
3. the transition to a low-emission society and adaptation to climate change.

Structural secondary objectives

The KLIMAFORSK programme will cooperate with other research funding instruments and target its own funding announcements and grant allocations to develop an effective project portfolio, and will work to:

1. Promote cooperation and task distribution in climate research;
2. Encourage boldness in scientific thinking and scientific innovation in research projects;
3. Enhance the international profile and contribution of Norwegian research groups;
4. Foster the development of a new generation of climate researchers;
5. Expand expertise and applicable knowledge in society;
6. Facilitate targeted communication and dissemination activities;
7. Increase the use of available data and research infrastructure.

Societal outcomes

The KLIMAFORSK programme will develop an objectives-oriented portfolio of projects through the use of its own grant allocations and in cooperation with other research funding instruments, and will work to expand the knowledge base for a sustainable transition to a low-emission society and adaptation to climate change. Activities under the programme are expected to play a key role in enhancing the quality of and further developing climate research and to generate research-based knowledge about the climate that is relevant for the authorities and the public and private sectors. The overall societal outcome of activities under the programme, together with climate research conducted under other Research Council programmes, is expected to contribute to ensuring that:

- Norwegian research groups contribute to global knowledge development in the field of climate and climate change in cooperation with international research groups.
- Norway has an extensive knowledge base on climate change, its impacts and relevant instruments.
- Norway has an extensive knowledge base for policy design and industrial development, of which decision-makers, interest groups and the general public are aware.
- Climate research provides the scientific basis for realising Norwegian and global climate targets, the Paris Agreement goals and relevant UN Sustainable Development Goals.

2 Background and challenges

Climate change is one of the greatest societal challenges of our time. Nature and society alike are experiencing impacts. Addressing the complex issues facing the world community will require a broad-based approach, 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. To this end, more knowledge is needed about the processes driving climate change, their impacts on society and nature, and the forms of societal transformation and adaptation required to resolve these challenges.

Addressing the research questions raised by climate change will require a global perspective, international research cooperation and integrated research activities across disciplines, sectors and national boundaries. Poor countries are the most vulnerable to climate change, but no part of the world will remain unaffected. At the same time, it is important to carry out research on conditions that are specific to Norway and to focus on 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 economic activities affected by weather and climate. Norway also has extensive experience with a wide range of policy instruments and technologies for reducing greenhouse gas emissions and facilitating transformation.

Although much is known about the extent of climate change, the future climate still comprises one of various elements of uncertainty in policy development and social planning. Research activities under the KLIMAFORSK programme will generate greater insight into uncertainties in climate projections and help to reduce these in order to facilitate optimal decision-making. The programme will help to compile and analyse the results and experience from national and global climate policy, thereby providing a basis for knowledge-based policy.

A significant amount of research has been conducted in the climate field in Norway in recent decades, giving Norwegian research groups a 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 user-oriented and scientifically innovative. The programme targets a wide range of 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 encompasses basic research, applied research and innovation activities of relevance to climate. Key users of the programme's research findings include researchers

in other fields, the public administration, trade and industry, and the general public. The programme will lay the foundation for targeted, research-based development of climate services in Norway. This will require having open access to data and building on basic climate research within all three of the programme's thematic priority areas.

Each sectoral ministry is responsible for climate research within its respective sector, and it is important that affected sectors and industries help to fund climate research. 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.

Climate research activities under the Research Council are long-term in nature and in keeping with the Government's *Long-term plan for research and higher education 2015–2024*, a number of other government white papers, national and international research strategies and reports, as well as the main strategy for the Research Council of Norway, *Research for Innovation and Sustainability*. Key focus is placed on Norway's national climate targets, the Paris Agreement goals and the 17 UN Sustainable Development Goals adopted in 2015. The KLIMAFORSK programme will generate knowledge, models and scenarios that can help society and decision-makers to implement these.

3 Objectives for the programme

Climate change is one of the greatest societal challenges facing the global community, and stringent targets have been set nationally and internationally to mitigate coming changes and reduce their impact on nature and society. Launched in 2014, the KLIMAFORSK programme is a broad-based, open-ended research programme aimed at providing new, future-oriented knowledge of national and international significance.

3.1 Primary objective

The KLIMAFORSK programme will promote outstanding climate research and generate essential knowledge about the climate for the benefit of society.

3.2 Secondary objectives

The programme's primary objective will be operationalised through scientific and structural secondary objectives.

Scientific secondary objectives

The KLIMAFORSK programme will fund research activities in all subject fields and disciplines to increase knowledge about:

1. natural and anthropogenic climate change;
2. the impacts of climate change on nature and society;
3. the transition to a low-emission society and adaptation to climate change.

Structural secondary objectives

The KLIMAFORSK programme will cooperate with other research funding instruments and target its own funding announcements and grant allocations to develop an effective project portfolio, and will work to:

1. Promote cooperation and task distribution in climate research;

2. Encourage boldness in scientific thinking and scientific innovation in research projects;
3. Enhance the international profile and contribution of Norwegian research groups;
4. Foster the development of a new generation of climate researchers;
5. Expand expertise and applicable knowledge in society;
6. Facilitate targeted communication and dissemination activities;
7. Increase the use of available data and research infrastructure.

4 Thematic and scientific priority areas

The KLIMAFORSK programme is intended to meet a substantial proportion of Norway's knowledge needs in the climate field. 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 reducing greenhouse gas emissions. The scientific priorities of the programme are divided into three broad thematic priority areas. Research will be carried out within each area as well as across them.

1. The climate system and climate change
2. Impacts on nature and society
3. Societal transformation

The knowledge needs in these three thematic priority areas must be viewed in context with one another. Research on the climate system provides a basis for studies of the impacts of climate change and society's response and transformation. In the same way, impacts of climate change on nature and societal transformation will affect the climate system. The list of research tasks below is not exhaustive.

4.1 The climate system and climate change

Objective: To increase knowledge about natural and anthropogenic climate change.

Knowledge about the climate system forms the basis for all other climate research. Our ability to make climate predictions depends on an understanding of and the ability to model the interactions between natural and anthropogenic climate change and variability. The use of advanced infrastructure and an extensive observation network that makes the most of Norway's natural advantages enables the Norwegian climate research community to develop expertise and improve task distribution. Cooperation on and utilisation of pan-European and global observation networks, application of advanced modelling tools and use of earth observation satellites are also important in this context.

The KLIMAFORSK programme is designed to combine observations, theory and modelling to improve the understanding of interactions between the different components of the climate system, including feedback effects and possible climate tipping points. The programme will also study the interactions between natural and anthropogenic climate change and develop methods and models to improve understanding of seasonal and longer-term climate variability. Activities will include the development of decadal forecasts and climate projections, and a qualitative understanding and quantitative description of their uncertainty. Continuous improvement of models and participation in international modelling campaigns that among other things supply data to the Intergovernmental Panel on Climate Change (IPCC) synthesis reports are essential for developing Norwegian expertise in climate modelling and for supplying the best possible regional climate data for users in the private and public sectors.

Research needs

1. Observations and process understanding

Research under the programme will combine observations, theory and modelling of fundamental processes that govern circulation and variability in Norway's ocean areas, atmospheric chemistry and the role of particles and short-lived climate forcers, greenhouse gases and the transformation and circulation of carbon in the entire climate system, and processes that affect the melting and extent of sea ice, glacier ice and snow cover. It is also important to observe and model changes in and use of the Earth's surface area and ecosystems since these greatly affect the hydrological cycle and the global energy and carbon balance.

2. Climate variability and change

There is a need for basic research to better understand the drivers, connections and feedback mechanisms in the climate system. These include e.g. interactions between air pollution, ocean acidification and climate change, identification of possible tipping points in the climate system, quantification of the impact of methane emissions from gas hydrates and thawing permafrost, the significance of land-use change and growth in forests, the oceans' role as a carbon sink, the mass balance of glaciers and ice caps and their influence on sea level rise, the role of greenhouse gases and particles in the hydrological cycle and variability in precipitation, and changes in the occurrence of extreme weather events. It is also important to understand global teleconnection patterns and the role of polar regions in influencing global climate and climate variability at more southerly latitudes.

3. Modelling climate evolution at the global and national level

There is a need to further develop and apply advanced earth system models, with a particular emphasis on northern latitudes, as well as to develop dynamic and statistical methods for regionalising climate data. Also needed are improved descriptions of physical and biological processes, coupled biogeochemical and physical cycles and anthropogenic climate drivers, as well as of the climate sensitivity of the individual elements of the climate system, the opportunities and risks of human interventions to moderate climate change, and how to quantify and minimise uncertainty.

4.2 Impacts 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 represents a risk to nature and society alike. It will have impacts on society, the physical natural environment, biodiversity and ecosystems, ecosystem goods and services, food production, societal security, health, infrastructure, and trade and industry. 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. The KLIMAFORSK programme is designed 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 needs

1. Impacts of climate change on the physical and chemical environment

Knowledge is needed about impacts on the physical and chemical environment, such as hydrology, geology, biogeochemistry and ocean acidification. There is a need for improved modelling, knowledge about natural hazards, including changes in their frequency and scope, and how to handle uncertainty.

2. Impacts of climate change on ecosystems

Knowledge is needed about the underlying processes and functions that govern or influence the response of ecosystems at different levels, including threshold values, tipping points, and the consequences and probability of major changes in ecosystems. An overall understanding and development of scenarios are also called for. There is a need to exploit relevant existing data, as well as to develop new observation methods for studying the ecosystems' responses to climate change itself and to various implemented measures.

3. Interactions between drivers and feedback effects on the climate system

Greater insight is needed into how climate change and other drivers of change such as land-use change, harvesting of natural resources, pollution, litter, ocean acidification and alien species combine to affect ecosystems. There is also a need for a better understanding of climate regulation by ecosystems through albedo and biogeochemical and hydrological cycles, as well as for more knowledge about how important ecosystem services are affected.

4. The consequences of climate change for infrastructure, trade and industry and living conditions

More knowledge is needed about the consequences of climate change for industries, sectors of society, human health and living conditions. More studies are needed on the impacts of changes in mean and extreme values, interactions with other processes of change, and the impacts of feedbacks between the natural environment, industry and society. There is a need to shed light on how the impacts may differ depending on geography and access to resources. A better understanding is needed of how climate change is affecting society, e.g. the attitudes and conceptions of various groups, health and safety, the business sector, and infrastructure including buildings.

4.3 Societal transformation

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 designed to build up more knowledge that can be used to achieve key targets of climate policy in these areas. 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 involves addressing value questions, knowledge and understanding of climate change issues, diverse interests and perspectives, including gender perspectives, and sharing responsibility for taking action.

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 and climate change adaptation, including the financial risk associated with climate change, risks related to decision-making in the public administration and the business sector, and the risks of taking no action. Too little is known about the conditions for innovation, implementation of new technology, and how to eliminate barriers and improve capacity for change in society. Assessment of the net climate effect and environmental impacts of implemented and planned climate and environmental measures is also needed.

2. Research questions relating to mitigation and sequestration

Knowledge development is needed for Norway to become a low-emission society. 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 to create and maintain industrial development and green growth. Knowledge should be based on experience of using policy instruments to date and the characteristics of policy instruments that are considered to be effective. Research may include studies of both stepwise and radical change. There is a need for analyses of opportunities and barriers associated with different types of climate policy. These may take the form of individual or comparative studies and must take into account public support and engagement, political support, the legal, economic, social and technological dimensions of different policies, and other considerations that may provide incentives to reduce greenhouse gas emissions. Global, national and local perspectives alike will generate useful knowledge.

3. Research questions relating to adaptation

Knowledge is needed about how human societies can adapt to and protect themselves against climate change on an increasingly large scale, and about potential new opportunities for business activities and value creation. Poor countries are particularly vulnerable to climate change, but Norway and adjacent areas will also be affected. There is a need for socio-economic and environmental analyses of adaptation instruments and measures, including use of nature-based solutions and the effectiveness of these.

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. Knowledge in the fields of natural science, social science and the humanities is needed to reduce conflicts and increase synergies between adaptation and mitigation.

5 Priorities for structuring the research effort

The KLIMAFORSK programme will primarily fund Researcher Projects. The programme may also employ other application types, including Innovation Projects for the industrial and public sectors and Knowledge-Building Projects, as well as issue funding announcements in connection with the Research Council's centre schemes or for other types of projects. The 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

issue funding announcements for Personal Visiting Researcher Grants, Personal Overseas Research Grants and Support for Events to promote recruitment and network-building.

Measures to structure the research effort under the programme will be operationalised in the programme's action plan, which will be revised on annual basis. The priorities for structuring the research effort have their basis in the structural secondary objectives.

5.1 Promote cooperation and task distribution in climate research

Climate change raises complex research questions that often require an approach across sectors, disciplines and thematic areas. 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. Many of the research questions in the field will also require new collaborative constellations. The involvement of the users of climate research is also called for in many contexts to ensure that the research is highly relevant and to take advantage of user experience. The KLIMAFORSK programme will actively promote cooperation, constructive task distribution and targeted research activity in the national and international research landscape.

In response to society's interest in and need for 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 and filling knowledge gaps, and avoiding duplication and overlap between programmes.

5.2 Encourage boldness in scientific thinking and scientific innovation in research projects

The KLIMAFORSK programme attaches importance 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. This may take the form of research based on original scientific perspectives or research originating in innovative, interdisciplinary collaboration. In certain cases it may increase the risk of the projects not achieving their objectives.

The programme will issue funding announcements for independent climate research projects at regular intervals. These funding announcements will have an open thematic framework within the scope of the KLIMAFORSK work programme and related thematic areas, and are to result in research projects of high scientific calibre that demonstrate boldness in scientific thinking and scientific innovation.

5.3 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. Many research tasks require more personnel and equipment than any single country can provide on its own. The KLIMAFORSK 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 IPCC. This will require publication in international peer-review journals, high citation frequency and a visible presence in international research arenas.

The programme will promote increased Norwegian participation in international research cooperation at the Nordic, European and global levels, as well as bilateral cooperation with selected countries.

The programme will facilitate international climate research by means of joint funding announcements with relevant national and international programmes. Norway is home to a number of research groups of high international calibre. The 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 Global 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 and adaptation to climate change.

5.4 Foster the development of a new generation of climate researchers

The KLIMAFORSK programme will work to recruit talented researchers. The programme will also facilitate researcher training that enables younger researchers to be project or work-package managers and will strive to achieve a satisfactory gender balance among project managers.

5.5 Expand expertise and applicable knowledge in society

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 are 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. Among other things, 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 work to fill knowledge needs to provide high-quality climate services in Norway.

5.6 Facilitate targeted communication and dissemination activities

The KLIMAFORSK programme will take steps to ensure that research-based knowledge is put to use. Communication activities under the programme may include collating knowledge and taking part in efforts involving national and international synthesis activities, management plans, reports and evaluations.

Scholarly publication and participation at conferences and in other relevant fora are vital measures for fostering productive, interdisciplinary scientific dialogue between climate researchers.

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

The programme will 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. Communication activities targeting the general public are to strengthen its overall understanding of and engagement in climate research.

5.7 Increase the use of available data and research infrastructure

All areas of climate research are dependent on satisfactory data. Norway has a long tradition of collecting, processing and storing vast amounts of data. Norwegian research groups therefore have an advantage in terms of compiling a national research base and competing in the international arena. The KLIMAFORSK programme will facilitate the utilisation and processing of time series and large data sets for use in research and management and to improve the use of national research infrastructure in areas where Norway has special advantages, facilities or needs.

The programme will comply with the Research Council's [Policy on Open Access to Research Data](#).

6 Cooperation with related instruments

6.1 Integration of climate research into different sectors

Climate change affects most sectors, industries and administrative areas. It will have ramifications for all stakeholders in society, and long-term plans and investments must incorporate prevention/mitigation and adaptation measures. Research must generate knowledge that is as relevant as possible, and all sectors of society must take climate issues into account when setting research priorities. The transition to a low-emission society requires knowledge about how emissions can be reduced at the local, regional, national and international levels. Knowledge about policy instruments and other types of incentives, for example to speed up deployment of low-emission 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 cooperation to best effect. Adequate information is needed about the climate system and climate services, including observed climate change and downscaled climate projections for Norway, as is insight into impacts on nature and society and the transition to a low-emission society. Knowledge about the economic, legal, institutional, organisational, social and cultural consequences of climate change will also be of importance.

Research needs linked to the programme's three scientific secondary objectives are described in Chapter 4. Knowledge needs within various sectors and areas of society are covered under other Research Council programmes and activities as well. The most important sectors are:

Towns and urban areas: Knowledge is needed for the transition to renewable energy sources, and about transport and land-use policy. There are knowledge needs relating to impacts of the changing climate, such as more frequent flooding, larger volumes of stormwater, storm surges, a rising sea level and a greater risk of landslides and quick clay slides, as well as to suitable climate change adaptation measures.

The construction sector: Knowledge is needed about energy efficiency and the transition to energy-efficient buildings. Knowledge is also needed to improve estimates of the consequences of climate change for the built environment, including cultural heritage, and to identify instruments and measures that can reduce the risk of damage.

Fisheries and aquaculture: Knowledge is needed to reduce greenhouse gas emissions from fishing and aquaculture vessels, predict future impacts of climate change on fisheries and aquaculture, and adapt to climate change. Insight is also needed into ecosystem responses and the impacts of ocean acidification and other pressures on fish resources.

Renewable energy: Knowledge and innovation are needed to reduce costs and increase the use of new renewable energy technologies and more efficient solutions for energy use and energy supply, as well as to determine the location and dimensioning of energy infrastructure to make it adaptable to climate change.

Agriculture: Knowledge is needed about reducing emissions throughout the production and consumption chain and about cost-effective adaptation strategies to climate change.

Cultural heritage: Knowledge is needed to identify expected impacts on cultural monuments and cultural environments, to assess how serious these will be, and to determine how damage best can be prevented.

Land-based industry and industrial development: Knowledge is needed about e.g. benefits of phasing in technology and new intermediate inputs. There is a general potential for growth in green jobs and for strengthening the competitiveness of the business sector by using climate-friendly solutions in the fields of environmental technology, renewable energy and energy efficiency.

The petroleum sector: Knowledge and technological innovation in a wide range of disciplines are needed to achieve emissions cuts. Knowledge about climate change and future demand will be important in the project planning phase, particularly for activities in the Arctic and northern areas.

Forests and forestry: More knowledge is needed about the impacts of the forestry sector and how forests and the forestry sector can help to enhance forests as a carbon sink, as well as about the use of forest bioenergy and adaptation to climate change.

Transport: Knowledge and innovation are needed to advance the transition in this sector, as well as to equip transport infrastructure to withstand climate change. Transport is currently the sector that accounts for the largest proportion of Norway's greenhouse gas emissions.

Water supply and sewerage systems: Knowledge is needed about e.g. the effects of extreme precipitation events, and about new technological solutions and alternative forms of stormwater management. Climate change in the form of more 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.

The knowledge needs within all of these sectors are covered in part by various Research Council programmes and activities that provide funding for some form of climate research.

6.2 Cooperation with other instruments at the Research Council

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. The KLIMAFORSK programme will work to achieve cooperation and coordination with the following programmes (this list is not exhaustive):

- Polar Research Programme (POLARPROG);
- Programme on Space Research (ROMFORSK);
- Lavutslipp 2030 initiative;
- Svalbard Science Forum (SSF);
- Research Programme on Sustainable Innovation in Food and Bio-based Industries (BIONÆR);
- Norwegian RD&D CCS Programme (CLIMIT);
- Large-scale Programme for Energy Research (ENERGIX);
- Research Programme on Marine Resources and the Environment (MARINFORSK);
- Programme for Environmental Research for a Green Transition (MILJØFORSK);
- Programme on the Cultural Conditions Underlying Social Change (SAMKUL);
- Transport 2025 programme.

The National Financing Initiative for Research Infrastructure (INFRASTRUKTUR) provides funding both to expand Norwegian research infrastructure for climate research and to increase Norwegian participation in relevant European infrastructure. A number of other programmes and schemes also generate valuable, relevant knowledge, including 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), and the Centres of Excellence (SFF), Centres for Environment-friendly Energy Research (FME) and Centres for Research-based Innovation (SFI) schemes.

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

7 Anticipated results, impacts and societal outcomes

The KLIMAFORSK programme has high aspirations for helping to satisfy society's need for knowledge about climate and climate change. It is difficult, however, to measure the societal outcome of the research. This is both because the programme's impacts and societal outcomes will often be indirect, and because the KLIMAFORSK programme is one of several initiatives targeting the thematic priority areas it encompasses, and it will not be easy in many cases to distinguish this programme's impact from the impact of research funded by others. Still, there will be concrete results that can be linked to the research conducted under certain projects.

The secondary objectives form the basis for activities under the programme. The research effort within the various activities launched will be reflected in results, impacts and societal outcomes achieved at least in part by those activities. A good indicator for the programme in this context will be whether the funding announcements result in a project portfolio that helps to achieve the scientific and structural objectives.

Project reports and the programme's own reports and portfolio reviews will provide a basis for ongoing assessment of the achievement of programme objectives. In addition, surveys of resource input in the field of climate research will give a picture of its development over time. A more comprehensive evaluation of the programme is planned for 2018.

7.1 Results

Priorities and activities under the KLIMAFORSK programme will help to generate a variety of research results within a three to five-year perspective. An effective project portfolio will be a prerequisite for this. The programme will apply the Research Council's general indicators to assess whether the programme's efforts are on track to achieving the programme objectives. The more programme-specific indicators correspond to the priorities for structuring the research effort:

1. Promote cooperation and task distribution in climate research

Climate research is carried out in every discipline, and the programme will promote cooperation and distribution of tasks across disciplines and research groups.

Coordinated initiatives between programmes and other activities will be an indicator for measuring the degree of cooperation and task distribution in climate research. Other indicators may include joint funding announcements, joint publications, number of doctoral degrees completed on topics encompassed by the KLIMAFORSK programme but funded under other programmes, and new researcher networks and constellations of cooperation with participants from different subject fields, disciplines and research sectors.

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

Projects awarded funding under the programme are expected to promote scientific innovation within the programme's thematic priority areas.

Indicators for measuring scientific innovation will be the number of publications, quality of the publications as measured by citation frequency and the journals' impact factor, number of publications with authors from multiple subject fields and/or sectors, and number of comparative projects.

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

The KLIMAFORSK programme seeks to cultivate a new generation of climate researchers within its thematic priority areas.

Indicators for measuring this are the number of doctoral and post-doctoral research fellowships awarded and the number of young project managers in projects funded under the programme.

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

The KLIMAFORSK programme seeks to promote increased internationalisation of Norwegian research and increased participation in international projects.

Indicators for measuring the degree of international research cooperation and international knowledge sharing as a result of the programme are the number of international partners in research

projects funded under the programme, number of project managers under the programme who apply for and subsequently receive funding under international funding schemes, number of Norwegian researchers who contribute to IPCC activities, and number of doctoral fellows under the projects who complete research stays abroad.

5. Expand expertise and applicable knowledge in society

The KLIMAFORSK programme seeks to increase user participation in the research and expand cooperation between researchers and users. User participation in programme activities is intended to enhance the benefit and relevance of the research and promote competence development in research groups as well as among the users of the research in the public administration and the business sector. User participation in projects also encourages networking and establishment of contacts between users and researchers, which in turn facilitates knowledge sharing beyond the framework of the projects funded under the programme.

Indicators will be the number of projects with user participation, and whether knowledge generated by the projects is put to use in society.

6. Facilitate targeted communication and dissemination activities

The KLIMAFORSK programme seeks to facilitate dissemination of findings and results from research projects funded under the programme.

Indicators for measuring dissemination of climate-related knowledge will focus on dissemination via a number of different channels, such as meetings with key stakeholders, lectures, newspaper articles, teaching materials, videos, blogs, use of results in university courses, etc.

7. Increase the use of available data and research infrastructure

Projects awarded funding under the programme are expected to comply with the Research Council's Policy on Open Access to Research Data and work towards coordinated use of research infrastructure, when this is relevant.

Indicators will be the proportion of research projects that are partially or entirely based on the reuse of existing data rather than on the collection of new data, proportion of research projects that make their data available for use by other researchers after project completion, and use of relevant research infrastructure.

7.2 Impacts

The KLIMAFORSK programme is expected to generate impacts of importance to societal development within a four to seven-year perspective. Potential impacts may include:

- Research projects funded under the programme contribute to global knowledge development in the field of climate research, e.g. to the IPCC, and researchers in Norway maintain a high level of expertise and quality and contribute in global arenas.
- All sectors have access to necessary knowledge to fulfil their responsibility to conduct climate research, reduce greenhouse gas emissions and adapt their respective sector to climate change.
- The programme helps to increase participation in projects with funding from international sources, among other things in the form of a higher returns share from Horizon 2020 and the subsequent framework programmes.

Other impacts may include new collaborative relationships between disciplines and researchers, new climate services, etc. Indicators for quantifying the impacts of the programme's funding of projects and research groups include:

- research-based knowledge about the climate that is applicable and accessible to the authorities and the public and private sectors;
- number of researchers involved in the programme who participate in advisory groups and bodies in the public and private sectors;
- number of researchers involved in the programme who participate in international knowledge processes such as the IPCC, and number of publications produced that are used in such processes;
- number of user-oriented reports and policy briefs produced and user-oriented dissemination measures organised;
- number of projects that incorporate user participation;
- number of projects that incorporate interdisciplinary collaboration across institutions and sectors.

7.3 Societal outcomes

The KLIMAFORSK programme is expected to generate outcomes of importance to societal development within a seven to 15-year perspective. Activities under the programme are expected to play a key role in enhancing the quality of and further developing climate research. It is important to note that a research programme such as the KLIMAFORSK programme is but one of several contributors towards desired societal outcomes. In 2014 institutions in Norway used a total of NOK 4 billion on climate research and development (NIFU report 2016:4, in Norwegian only). It is also important to be aware that it is very difficult to measure the societal outcomes of (basic) research in the long term, and virtually impossible in the short term. Thus caution must be taken when attempting to measure the societal outcomes of individual programmes. Nevertheless, the overall societal outcome of activities under the programme, together with climate research conducted under other Research Council programmes, is expected to contribute to ensuring that:

- Norwegian research groups contribute to global knowledge development in the field of climate and climate change in cooperation with international research groups.
- Norway has an extensive knowledge base on climate change, its impacts and relevant instruments.
- Norway has an extensive knowledge base for policy design and industrial development, of which decision-makers, interest groups and the general public are aware.
- Climate research provides the scientific basis for realising Norwegian and global climate targets, the Paris Agreement goals and relevant UN Sustainable Development Goals.

Diagram of the programme logic model for the KLIMAFORSK programme:

Primary objective	Secondary objectives	Activities	Results	Impacts	Societal outcomes
<p>The KLIMAFORSK programme will promote outstanding climate research and generate essential knowledge for the benefit of society.</p>	<p>Scientific:</p> <p>Increase knowledge about natural and anthropogenic climate change</p> <p>Improve knowledge about the impacts of climate change on nature and society</p> <p>Enhance knowledge about the transition to a low-emission society and adaptation to climate change</p>	<p>Issue funding announcements for investigator-driven projects and invest in outstanding climate research</p> <p>Engage the public and private sectors in climate research</p> <p>Issue joint calls and coordinated calls with priority programmes and priority countries</p>	<p>Effective project portfolio</p> <p>High-quality scholarly publications</p> <p>R&D institutions cooperate more closely with the private and public sectors</p> <p>The authorities and public and private sectors have access to research-based, applicable knowledge</p>	<p>Norwegian research groups maintain their expertise and quality and contribute to global knowledge production</p> <p>The authorities, the private and public sectors and society have greater knowledge about climate issues</p> <p>All relevant sectors have necessary knowledge to fulfil their responsibility for climate research and climate change mitigation and adaptation</p> <p>Norwegian participation in research projects with funding from international sources is increasing</p> <p>A new generation of climate researchers is being recruited</p>	<p>Norwegian research groups contribute to global knowledge development on climate and climate change in cooperation with international research groups</p> <p>Norway has an extensive knowledge base on climate change, impacts and instruments</p> <p>Norway has an extensive knowledge base for policy design and industrial development, of which decision-makers, interest groups and the general public are aware</p> <p>Climate research provides the scientific basis for realising Norway's commitments under the Paris Agreement, national and global climate targets, and relevant UN Sustainable Development Goals</p>
	<p>Structural:</p> <p>Promote cooperation and task distribution in climate research</p> <p>Encourage boldness in scientific thinking and scientific innovation in research projects</p> <p>Enhance the international profile and contribution of Norwegian research groups</p> <p>Foster the development of a new generation of climate researchers</p> <p>Expand expertise and applicable knowledge in society</p> <p>Facilitate targeted communication and dissemination activities</p> <p>Increase the use of available data and research infrastructure</p>	<p>Exploit Norway's competitive advantages in climate research</p> <p>Fund doctoral and post-doctoral fellowships</p> <p>Facilitate dissemination of findings and results</p> <p>Work to coordinate use of research infrastructure and comply with Research Council Policy on Open Access to Research Data</p>	<p>Norwegian research groups have a high international profile, contribute to global knowledge development and influence international research priorities</p> <p>Greater number of doctoral degrees completed and number of young project managers</p> <p>Dissemination of project results via various channels</p> <p>Greater scientific capacity at R&D institutions</p>	<p>Norwegian research groups maintain their expertise and quality and contribute to global knowledge production</p> <p>The authorities, the private and public sectors and society have greater knowledge about climate issues</p> <p>All relevant sectors have necessary knowledge to fulfil their responsibility for climate research and climate change mitigation and adaptation</p> <p>Norwegian participation in research projects with funding from international sources is increasing</p> <p>A new generation of climate researchers is being recruited</p>	<p>Norwegian research groups contribute to global knowledge development on climate and climate change in cooperation with international research groups</p> <p>Norway has an extensive knowledge base on climate change, impacts and instruments</p> <p>Norway has an extensive knowledge base for policy design and industrial development, of which decision-makers, interest groups and the general public are aware</p> <p>Climate research provides the scientific basis for realising Norway's commitments under the Paris Agreement, national and global climate targets, and relevant UN Sustainable Development Goals</p>

8 Resources and budget

The KLIMAFORSK programme was launched as a Large-scale Programme in 2014. At start-up it received allocations from the Ministry of Climate and Environment, the Ministry of Agriculture and Food (until 2016), the Ministry of Trade, Industry and Fisheries, and cross-sectoral funding from the Ministry of Education and Research. The programme received a total allocation of NOK 153 million in 2017.

The programme's long-term budget incorporates funding set aside for administration of the programme.

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. 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 at regular intervals.

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, and joint calls for proposals may be issued with other programmes. The thematic framework of the call will also be adapted to the funding available for allocation.

9 Governance and organisation

The KLIMAFORSK programme board is appointed by and reports to the Research Board of the Division for Energy, Resources and the Environment. The activities of the programme board must comply with the framework documents approved by the division research board, including the work programme, action plan, long-term budget and plan for funding announcements. The programme board's activities must be in compliance with the Research Council's overall principles and guidelines for the operation of research programmes.

The Research Council administration is responsible for all aspects of the programme's day-to-day operation and for ensuring that this complies with the framework documents, plans and guidelines for the programme. The Research Council administration will serve as the secretariat for the programme board and is responsible for ensuring that the programme board can carry out its tasks.

The valid terms of reference set out the roles of the programme administration and programme board in the operation of the programme. The terms of reference for the programme board and a list of programme board members may be found [here](#).



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The Research Council of Norway
Drammensveien 288
P.O. Box 564
N-1327 Lysaker

Telephone: +47 22 03 70 00
Telefax: +47 22 03 70 01
post@rcn.no
www.rcn.no

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