

Work programme

Programme for Environmental Research for a Green Transition –
MILJØFORSK

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1 Summary

The Programme for Environmental Research for a Green Transition (MILJØFORSK) is the Research Council of Norway's principal environmental research initiative, and encompasses the land-based environment, fresh water and air. The programme will generate more knowledge about key environmental challenges and provide the public administration, trade and industry, and society at large with a better foundation on which to take decisions to promote a green transition.

Environmental research extends across every aspect of society and targets major, complex issues that require an interdisciplinary approach. The MILJØFORSK programme is designed to expand the scope of research on the environment and society, and thus will view the environment as a challenge, a resource base and a competitive opportunity, in which ecological and social processes interact. Similarly, the concept of sustainability incorporates ecological, economic, social, technological and cultural dimensions.

The MILJØFORSK programme will facilitate closer dialogue between knowledge producers and various user and interest groups. The programme seeks to strengthen the development of knowledge of relevance to the public administration and trade and industry and will promote wider cooperation and integration between the environmental sector and various users in the public and private sectors.

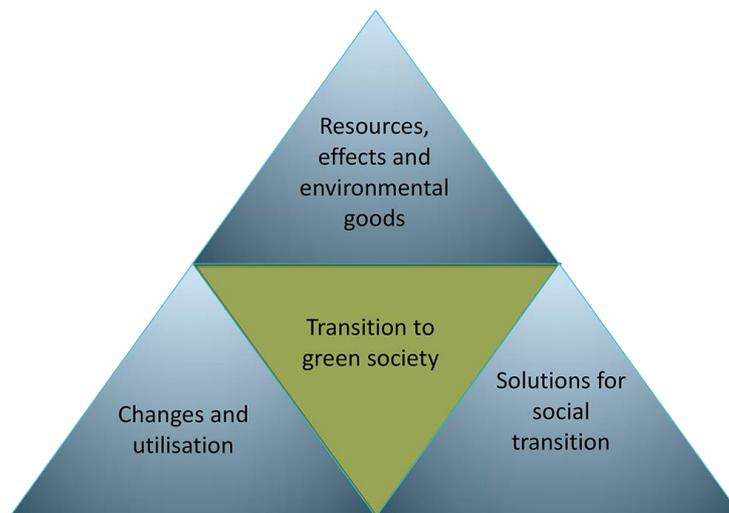
The MILJØFORSK programme builds on and designates priorities on the basis of an extensive research-based knowledge base. The programme addresses the most pressing national and global environmental challenges, categorising them into three thematic priority areas that are broken down into 11 research areas. The thematic priority areas are interrelated, sharing a set of general underlying perspectives. It is a stated objective that research under the programme will link together elements from all three of these thematic priority areas in order to satisfy complex knowledge needs.

Knowledge about resources, effects and environmental goods will be developed in light of insight into changes and utilisation and an understanding of solutions for societal transformation. Together the research activities under the programme will strengthen the knowledge base for sustainable development and the transition to a green society.

1. **Resources, effects and environmental goods:** This thematic priority area encompasses knowledge about resources, how they are being affected, their capacity for renewal, and how they can be utilised as public goods.
Research areas:
 - 1.1 Biodiversity and ecosystem services
 - 1.2 Hazardous substances and pollutants
 - 1.3 Cultural heritage and cultural environments
 - 1.4 Interacting and cumulative environmental effects

2. **Changes and utilisation:** This thematic priority area targets knowledge about change processes, utilisation of environmental goods, social and natural drivers/responses, and potential measures.
Research areas:
 - 2.1 Landscape and land use development in rural and urban areas
 - 2.2 Ecosystems in change
 - 2.3 Societal change and its drivers
 - 2.4 Global change and environmental impacts

3. **Solutions for societal transition:** This thematic priority area deals with knowledge on which to base solutions for the transition to a more sustainable society.
Research areas:
 - 3.1 Sustainable solutions for use in society and the business sector
 - 3.2 Management and societal perspectives
 - 3.3 The environment, health and quality of life



The MILJØFORSK programme will primarily provide support for applied research projects, but will also accommodate basic research and innovation projects, when relevant.

The programme will cooperate extensively with other Research Council programmes and instruments and sets out relevant areas for cooperation in this work programme. These efforts will increase the impact and scope of activities as well as promote multi- and interdisciplinary cooperation and network-building. The programme will operate in an international context and promote international cooperation.

The MILJØFORSK programme is designed to enhance the relevance to society of environmental research. Much of the research conducted will be change- and solution-oriented and targeted towards the major tasks inherent in "societal transformation" and the "transition to a green

economy". The knowledge generated must reach a wide audience, and the programme will give high priority to knowledge sharing and dissemination activities.

The MILJØFORSK programme has four strategic roles:

1. To carry out the core tasks for which it has the main *financial* responsibility;
2. To deal with interfaces and areas of overlap in which multiple programmes must *together* share the *financial* responsibility;
3. To provide knowledge about the *prerequisites* and assume a *role as a driving force* for research on environmental questions that lie outside its scope of financial responsibility;
4. To make use of its *role as a driving force* and implement *mobilisation measures* in areas in which funding is being provided at the *international* level, e.g. under Horizon 2020 and associated funding instruments.

2 Background

The Programme for Environmental Research for a Green Transition (MILJØFORSK) expands on the experience gained under the programme Environmental Research towards 2015 (MILJO2015). The MILJO2015 programme provided an arena for consolidating Norwegian environmental research activities and generated a great amount of relevant, high-quality knowledge. The MILJØFORSK programme will continue in the same vein, and aspires to involve an even wider range of disciplines and actors. It will focus attention on the *opportunities* that emerge in connection with the transition to a greener society.

The programme will continue activities in research areas from the MILJO2015 programme, when this is relevant for existing or future knowledge needs. At the same time, the MILJØFORSK programme will address new knowledge needs and topics relating to the development of society and based on relevant parts of the national environmental R&D strategy, *Miljø21* (2014). The strategy summarises existing knowledge needs and provides a number of recommendations for future research in the areas of biodiversity, landscapes and cultural heritage, pollution, and the environment and industrial activity. The following points were given particular focus in the design of the MILJØFORSK programme:

- addressing environmental challenges facing society requires collaboration on more integrated knowledge development;
- research must be targeted towards solving environmental problems and cultivating “green” opportunities;
- closer links must be forged between environmental research and industrial development;
- environmental research and climate research must be viewed together;
- urbanisation is giving rise to new knowledge needs, particularly related to cities and semi-urban areas;
- tackling international environmental problems requires international efforts.

The programme will follow up the Norwegian Government’s *Long-term plan for research and higher education 2015–2024*, which emphasises that comprehensive research efforts are essential for dealing with major global environmental threats. The main strategy for the Research Council of Norway, *Research for Innovation and Sustainability (2015–2020)*, also stresses the important role research has to play in enhancing the sustainability of society.

The Government has a stated objective to achieve significantly greater Norwegian participation in the current EU Framework Programme for Research and Innovation, *Horizon 2020*. The MILJØFORSK programme will work to ensure that Norwegian research groups succeed in the competition for project funding. Horizon 2020 views protection of biodiversity and sustainable management of natural resources and ecosystems as an essential prerequisite for making the transition to a green society in Europe. Many of the most pressing global challenges are linked to population growth, changing and increasing consumption, international trade and investment, and expanding resource scarcity. These are all addressed in the new UN Sustainable Development Goals adopted in 2015. Achieving these goals will require further knowledge development in the environmental field.

The MILJØFORSK programme is an environmental research programme that encompasses the land-based environment, fresh water and air as well as management of natural resources and cultural environments. The programme shares an interface with many other programmes and funding instruments, and cooperation with these is essential for achieving the most integrated environmental research possible. The MILJØFORSK programme will operate with an integrated socio-ecological perspective in which the interactions between social and ecological processes will be viewed in a unified context. The transition to a greener society entails a need for more integrated knowledge about the influence of the environment on human perceptions of well-being, opportunities for

development and risk, as well as insight into how environment-related knowledge can be used to promote sustainable social and industrial development. These factors in turn have an effect on behavioural change. Moreover, environment-friendly solutions also require an understanding of the causes of the social drivers that create – or can solve – environmental problems. Achieving a more comprehensive understanding of the environment will require the integration of natural science, social science, humanities and technological research.

Specific challenges for Norway

Norway has low population density, a strong economy and a rich resource base. At the same time, findings from projects under the MILJØ2015 programme show that Norway is facing the same environmental problems as the rest of the world. One example is the continual emergence of new hazardous substances. Too little is known about the individual substances and their effects or how different substances interact. There are rapid changes in land use, with major consequences for biodiversity, nature, food production and adaptation to climate change. We know too little about the scope of these changes, their impacts on ecosystems or the cumulative effects of various pressures.

The effect on Norway of international developments is increasing. Like other countries, Norway must promote more environmentally sound production and consumption within tolerance thresholds, develop more sustainable energy systems, adapt to climate change and protect resources and ecosystems that are under pressure. We must also deal with challenges such as changes in mobility, digitalisation, use of raw materials, new forms of governance and cooperation, and new markets. Norway is in a unique position to take the right decisions and to promote international solutions. Norway is privileged and must shoulder its share of responsibility.

At the same time, Norway has special areas of responsibility, including areas of untouched wilderness of particular significance for biodiversity, especially in the Arctic and northern areas where the unique ecosystems are of global importance. Moreover, particular attention must be given to specific areas of resource management, such as wild reindeer management, and areas of special cultural history. Norway must also tackle concrete environmental problems such as long-range transport of hazardous substances to vulnerable areas.

Policy and society

Environmental research extends across every aspect of society. The main challenge is to generate knowledge that will help to weigh the different societal considerations in policy design and management and support future-oriented decisions regarding our environmental goods and the basis for our existence. The environment represents irreplaceable values and is critical for adequate living conditions and good health.

The improvement in living standards of recent decades has come at a high environmental price. International-level decisions and cooperative arenas affect Norway in many areas, for example through regulation of hazardous substances, the EU Water Framework Directive and the global Aichi Biodiversity Targets of the Convention on Biological Diversity. Urbanisation, industrial development and demographic change affect settlement patterns and land use as well.

There are fundamental changes taking place in the framework of actors involved. An increasing number of actors in the public, private and non-governmental sectors are taking part in decision-making processes. The public sector is undergoing rationalisation measures at the same time as more and more tasks are being decentralised. The government administration is becoming more politicised, with changes in power structures and decision-making processes. The relationship between actors and institutions is changing, creating new challenges for more knowledge-based management. These challenges are intensified by conflicting objectives within and between policy areas.

Coordination for the transition to a green society

Better coordination between environmental research activities and various forms of value creation, innovation, recycling and industrial development may provide previously unimaginable opportunities for new solutions. Keywords in this context are societal restructuring, the low-emission society, the bioeconomy, the circular economy, environmental technology, recycling, reduced levels of hazardous substances, food, health, quality of life and ecosystem services. Extensive knowledge development is called for, as are new arenas for knowledge exchange. New opportunities will follow in the wake of new knowledge for the transition to green social and industrial development, but there may also be limitations and problems. What are the prerequisites, drivers of change and challenges related to such a transition? How can innovative thinking be maintained? Where should Norway focus its efforts? The MILJØFORSK programme aspires to take part in setting the agenda for and act as a driving force behind the development of knowledge-based, sustainable solutions.

3 Objectives for the programme

Primary objective

The MILJØFORSK programme will strengthen the knowledge base for sustainable development and the transition to a green society.

Scientific secondary objectives

The MILJØFORSK programme will deliver knowledge about:

1. **Resources, effects and environmental goods:** knowledge about resources, how they are being affected, their capacity for renewal, and how they can be utilised as public goods;
2. **Changes and utilisation:** knowledge about change processes, utilisation of environmental goods, social and natural drivers/responses, and potential measures;
3. **Solutions for societal transition:** knowledge on which to base solutions for the transition to a more sustainable society.

Strategic secondary objectives

The MILJØFORSK programme will attach importance to:

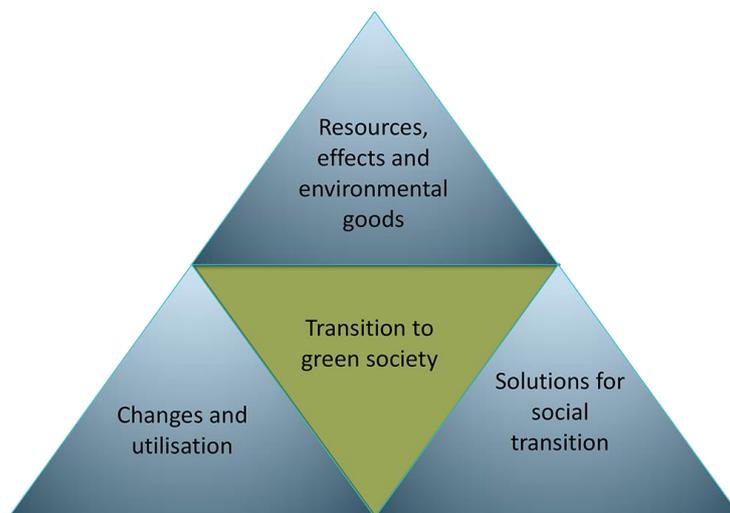
- funding activities to generate knowledge of high quality and relevance;
- coordinating activities with other programmes and activities, when this is relevant;
- fostering the development of a strong, interdisciplinary environmental research community and recruiting new environmental researchers;
- encouraging national and international cooperation;
- establishing meeting places and cultivating arenas for dialogue and knowledge development;
- enhancing user participation;
- implementing dynamic, targeted communication activities.

4 Scientific priorities

The MILJØFORSK programme addresses the most pressing national and global environmental challenges, categorising these into three thematic priority areas. These are broken down into 11 research areas, which are described in this chapter. The programme will develop knowledge about:

1. **Resources, effects and environmental goods:** This thematic priority area encompasses knowledge about resources, how they are being affected, their capacity for renewal, and how they can be utilised to as public goods (see the four research areas listed under Chapter 4.1).
2. **Changes and utilisation:** This thematic priority area targets knowledge about change processes, utilisation of environmental goods, social and natural drivers/responses, and potential measures (see the four research areas under Chapter 4.2).
3. **Solutions for societal transition:** This thematic priority area deals with knowledge on which to base solutions for the transition to a more sustainable society (see the three research areas under Chapter 4.3).

It is a stated objective that research under the programme will link together and integrate elements from all three of these thematic priority areas and the 11 research areas through multi- and interdisciplinary research and syntheses to promote a green transition. The thematic priority areas and research areas are interrelated, sharing a set of general underlying perspectives. This results in some natural overlap between the subchapters. Knowledge about resources, effects and environmental goods will be developed in light of insight into changes and utilisation and understanding of solutions for societal transformation. Together the research activities under the programme will strengthen the knowledge base for sustainable development and the transition to a green society. The scientific priorities must also be considered in context with the strategic priorities outlined in Chapter 5.



4.1 Resources, effects and environmental goods

The MILJØFORSK programme gives priority to research on resources and how they are being affected, the human/environment relationship, how to renew resources and how they may be utilised to create public goods. Hazardous substances and pollutants pose serious threats to biodiversity, ecosystem services, cultural heritage, cultural environments, food supply and health. The programme also attaches importance to increasing knowledge about the interacting and cumulative effects over time.

4.1.1 Biodiversity and ecosystem services

Norway's varied natural landscape is home to a wide array of species, populations, ecosystems and landscape types. The country's biodiversity has also been shaped in part by how resources have been utilised over time. Norway has an obligation to safeguard its biodiversity for future generations, as set out in national legislation such as the Planning and Building Act and the Nature Diversity Act and in relevant international conventions to which Norway is a signatory state.

Environmental research previously concentrated on individual resources, species, habitats and preservation. Now, however, there is increasingly wider application of a socio-ecological systems perspective on the dynamics between natural processes and processes resulting from human activity (social, economic, institutional and cultural). Complex causal relationships are involved, and development also leads to complex knowledge challenges. Therefore the research must encompass a more integrated and interdisciplinary approach to generate sustainable knowledge for the public administration, industrial development and society at large.

The Norwegian Red List for Species (2015) has assessed more than 21 000 of Norway's roughly 44 000 known species. Over 10 per cent of the assessed species are classified as threatened. Of these, 241 are considered critically endangered. By comparison, 40 nature types were classified as threatened four years earlier. There is a need for knowledge facilitating sound management and utilisation of biodiversity and for measures to protect threatened nature types. Meld. St. 14 (2010–2011) *Towards greener development* emphasises that any utilisation of nature must be sustainable. Limiting and preventing the extinction of species and decline of nature types is a major societal challenge.

The term "ecosystem services" is increasingly being used to communicate the fact that natural resources and ecosystems provide fundamental capital for the people's welfare and quality of life as well as value creation. It is also a useful term for identifying the economic and sociocultural importance of biodiversity through the valuation of environmental goods. Knowledge development is boosted by interaction with local communities, non-governmental organisations, resource-based industries and public administration institutions. The challenge lies in developing more dynamic, hypothesis-driven and adaptive ways to monitor biodiversity and ecosystem services.

Changes in land use and climate change are the main causes of declining and lost biodiversity in Norway, and there is a need for deeper insight into these relationships. Land-use change occurs through e.g. urbanisation, expansion of infrastructure, land-intensive industrial development, and changes in agricultural and forestry operations whether due to intensified operations or closures. Reduction of extensive agriculture activity and other operational changes are key drivers of change for species and nature types. Measures such as hydropower and wind power development and major infrastructure expansion such as roads also have ramifications for biodiversity due to land-use change. Other factors include the spread of alien species, pollution and harvesting, all of which affect biodiversity in combination with climate change. Urbanisation, with its increased pressure on land areas close to urban and semi-urban areas, along with the depopulation and overgrowing of rural

areas, have ramifications for biodiversity, natural environments of historical value, and important arable soil resources.

The growth of industrial activities such as mineral extraction, energy production, seafood production and tourism has impacts on biodiversity, cultural environments, ecosystem services, recreation areas and traditional industries such as reindeer husbandry. This affects the opportunities for long-term, sustainable use and conservation of biological and societal resources and industrial development within an environmentally sound framework for e.g. Sámi land use and cultural practices.

Under the MILJØFORSK programme, priority will be given to research on pressure areas where too little is known about impacts, cumulative environmental effects, instruments and measures. This applies in particular to towns and semi-urban areas, coastal areas, parts of the northern areas with intensified industrial development, and areas dealing especially with new climate change mitigation measures and changed resource utilisation. This does not, however, rule out research on the impacts of depopulation of rural areas, land-use change and overgrowing and the consequences they may have for biodiversity, cultural environments and landscapes.

Long time series are needed to distinguish natural climate variation from the effects of human activity. Complex and interdisciplinary analyses require better access to databases from different disciplines and the development of new technological platforms and analytical methods.

Research needs

- Loss of biodiversity: causes, drivers and interactions between environmental pressures;
- The relationship between ecological status and robustness/resilience of ecosystems and their capacity to deliver ecosystem services;
- Ecosystem services: understanding and valuation of biodiversity and environmental goods;
- Ecosystem-based management tools and integrated solutions for sustainable use;
- Relationships between biodiversity and ecosystem services;
- Method development for mapping and monitoring of biodiversity and ecosystem services.

4.1.2 Hazardous substances and pollutants

Society needs to know more about the sources, spread, extent and effects of hazardous substances and pollutants, including radioactive pollution, in terrestrial and aquatic ecosystems. There is also a need for research on measures and instruments for preventing and helping to solve these problems. Hazardous substances are a global problem. Norwegian conditions such as low temperatures and large seasonal variations affect uptake, transport and effects. There is a need for new knowledge about how specifically Norwegian conditions, combined with climate change, affect species and ecosystems that are particularly vulnerable to hazardous substances.

Knowledge about the extent, accumulation and effects of hazardous substances is fundamental to the design and enforcement of international regulations and conventions such as EU chemicals legislation (the REACH Regulation) and global conventions. These are very time-consuming, resource-intensive processes largely based on research and monitoring activities. Because of its geographical location, Norway has a special responsibility for safeguarding the environment of the northern areas, including the Arctic. Knowledge about the long-range transport of hazardous substances and their extent and effects in Arctic areas can be critical for gaining support for international agreements that protect this fragile environment.

Over the past 30 years, point-source emissions from industry, agriculture and other activities have been steadily reduced. The challenge in the future will be to reduce discharges from the many diffuse sources of hazardous substances, including from products. Other major dispersal sources are

atmospheric transport and transport with ocean currents from other countries and continents, runoff from urban environments, contaminated soil and seabeds, emissions from the management of waste and wastewater, and resource recovery. There is much that still remains unknown in connection with pollution from agricultural activities, particularly with regard to nutrients and pesticides. More knowledge is also needed to identify any potential damage from nanoparticles and microplastics.

Management regimes to limit hazardous substances and pollutants must be based on knowledge of the various sources' relative contributions to the cumulative effects on people and nature. Over 70 000 different chemicals are found in products and waste or used in industrial processes. In addition to the known hazardous substances, new substances are being invented constantly and we know too little about the effects of such substances and their degradation products on health and the environment. There are also significant discharges of regulated substances, such as PCBs, PAHs, dioxins and brominated flame retardants. In addition, environmental pollution nearly always involves complex mixtures. There is a need to know more about the interactive effects between hazardous substances as well as which criteria to apply when assessing chemical mixtures. There is a need to further refine methods for the chemical and biological measurement, monitoring and risk assessment of how hazardous substances alter natural processes and affect ecosystems.

Too little is known about effects on organisms when habitats such as sediment and soil are exposed to high levels of hazardous substances. There is a significant need for knowledge when it comes to more realistic exposure scenarios, such as long-term exposure to low concentrations of hazardous substances, cocktail effects and interactions with climate change. There are also knowledge gaps regarding genotoxicity and effects on the immune system, behaviour and development, as well as endocrine disruption and its impact on ecosystems. There is limited understanding of the role of seasonal variations in uptake, accumulation and potential effects of hazardous substances, made all the more complex by interactions with climate change. Such knowledge is important for identifying the extent, spread and effects of hazardous substances and for their international regulation. There are also major challenges related to understanding the relationships between climate change, hazardous substances and other types of pollution.

Air pollution remains a health and environmental concern, and there are still large gaps in our knowledge about the effects of air pollution on health and the environment. Particularly in winter, local air pollution poses a health risk for vulnerable population groups. There is a need for research to provide a basis for developing new, effect-based international agreements on reductions in air pollution. Research on this field should be carried out in cooperation with health research activities.

Research needs

- Knowledge about the spread of hazardous substances and other types of pollutants from different sources, including local and long-range pollution and the spread of hazardous substances via products and waste;
- Effects of individual substances, degradation products and complex mixtures (cocktail effects) at the organism, population, community and ecosystem levels;
- Analytical methods, measurement and modelling of the behaviour and toxicity of new hazardous substances and pollutants (e.g. microplastics, nanoparticles), including uptake, mobilisation and accumulation;
- Transport mechanisms for hazardous substances and other pollutants in water, air and soil, including more knowledge about inputs and deposits of pollutants;
- Measures and instruments for preventing and reducing pollution, including instruments for effectively phasing out the use of hazardous substances and restoration of previously contaminated areas;

- Significance of seasonal variation and climate change as regards the transport, uptake and effects of hazardous substances and pollution in terrestrial and aquatic nutrient structures;
- Knowledge that provides a basis for quantifying the effects of different measures to limit urban air pollution;
- Knowledge about the environmental impact associated with the use of pesticides and waste-based and mineral fertiliser products, and other pollution-related challenges linked to food production and agriculture.

4.1.3 Cultural heritage and cultural environments

Cultural heritage and cultural environments link the past, present and future and constitute an important source of knowledge about how people lived in earlier times. Cultural history values provide a basis for a sense of place, identity and belonging, positive experiences and quality of life. These values give people a feeling of being rooted in space and time and help to strengthen the social and cultural sense of community. The cultural environment is shaped in dynamic interaction between ecology and culture. Physical traces in the landscape from social and cultural activities provide insight into how the environment has been used and managed through the ages. The historical dimension reveals different lifestyles and living conditions while promoting an understanding of cultural diversity related to e.g. coastal cultures, agriculture, Sámi culture, urban development and green spaces. Cultural heritage and cultural environments also provide an important basis for value creation through e.g. tourism, good living environments, and community and regional development.

A number of natural and anthropogenic factors have an impact on cultural history values, such as climate change, resource recovery, infrastructure development, centralisation and urbanisation as well as social, cultural and political factors. This generates the need for more-integrated, knowledge-based management. Cultural heritage research has focused little attention on the effects of globalisation, market changes and major human resettlements. Certain areas need particular attention, not least urban environments, which are attracting an ever larger proportion of the population and putting pressure on cultural heritage and cultural environments. Complex, bureaucratic planning processes regarding residential construction, land use and transport also have impacts on cultural environments. Cultural monuments from both older and more recent times in large tracts of land and marine areas along the coast are inadequately mapped. Moreover, Norway has a special responsibility for preserving Sámi cultural heritage.

Interest in cultural heritage has shifted from preservation of individual cultural monuments towards a stronger focus on the connections between cultural monuments and their surrounding context. Internationally, too, the trend is towards viewing cultural heritage as a resource for value creation in the context of societal development as well as from a more integrated, environmental and sustainability perspective.

Research needs

- Knowledge for policy development and management regimes, frameworks and sustainable use and protection of cultural environments in an integrated societal perspective;
- Effects of changes on cultural heritage and cultural environments, related to e.g. sustainable urban and semi-urban development, climate change and changes in land use;
- The significance of cultural heritage for understanding, identity, social unity, integration and identifying common values in a multicultural society;
- Value creation through the sustainable use of cultural history values, e.g. along the coast and in Sámi and urban areas;
- Development of methods for mapping and monitoring cultural environments.

4.1.4 Interacting and cumulative environmental effects

There are major scientific challenges to understanding how interaction between multiple drivers of change affects organisms, ecosystems and cultural environments. Drivers of change may include changes in land use, pollution and hazardous substances, harvesting, alien species and climate change. Currently no tools exist for incorporating these factors in management regimes in an integrated way. Drivers and environmental effects are typically analysed and managed separately from one another and by different actors.

The cumulative effects can exceed the tolerance thresholds of ecosystems. It is important to examine the environmental effects from urbanisation, new infrastructure development, commercial activities and various forms of land use in the same overall context. Currently, effects of hazardous substances are mostly studied individually and at the population level, and it remains unclear whether the measured effects can be upscaled to the ecosystem level. There are too few integrated studies of complex and cumulative environmental effects, and too few modelling tools to ascertain the relative significance of anthropogenic versus natural drivers of change.

One example is the coastal zone, where a variety of industrial and development activities related to aquaculture, agriculture, the petroleum industry, mining, holiday cabins, tourism and fisheries lead to ecological and chemical changes, loss of biodiversity, pollution, declines in wild salmon stocks, effects on outdoor recreation opportunities and degradation of marine cultural environments and of other environmental goods.

Research needs

- Methods for mapping and quantifying cumulative effects;
- Upscaling of data on environmental pressures and effects for use by the authorities;
- Integrated assessments of pressures and effects and potential measures for reducing ecological strain on biodiversity, ecosystems and cultural heritage values;
- Interactive effects of environmental pressures such as changes in land use, hazardous substances and climate change.

4.2 Changes and utilisation

The MILJØFORSK programme attaches importance to knowledge development about natural and societal change processes and the drivers of environmental change. Greater insight into pressures on land, resources and ecosystems is important for understanding changes in the state of the environment, for our ability to prevent harmful effects, and for realising potential for sustainable value creation. More knowledge is also needed about human use of the environment and resources, including land use changes and urbanisation, and about global dimensions of future risk factors.

4.2.1 Landscape and land use development in rural and urban areas

Norway's landscape ranges from coastal and cultural landscapes to mountain, rural and urban landscapes, and encompasses major assets. The landscape represents the physical setting for the environment and resources. It provides a concrete expression of the interplay between resource bases, policy and utilisation. According to the European Landscape Convention, Norway is under obligation to protect, manage and plan the utilisation of the landscape. Competition over land is growing in pressure areas, at the same time as depopulation and changes in land use are leading to the spread of forest and woodland in rural areas. This makes it increasingly difficult to find a balance between sustainable utilisation and protection, not least when old and new forms of resource utilisation intersect.

Population density in urban areas is increasing, and pressure on coastal-zone resources is rising as well. It is important to generate knowledge about sustainable urban and semi-urban development.

The transition to a low-emission society will have impacts. The result is more development and pressure on the landscape's biodiversity, cultural environments and arable soil resources. Future expansion will require new, more integrated expertise and new solutions for planning, management and industry.

A more sustainable path of development requires land use management that integrates environmental and industrial issues, particularly in pressure areas. Land resource-based industries such as agriculture and reindeer husbandry have stewardship over large environmental assets, but at the same time are facing major pressures and challenges posed by e.g. urbanisation, new industries and farm closures. There is a need for greater knowledge about the effects of changing forms of utilisation on land use and landscape development and as a foundation for knowledge-based, integrated management regimes. A variety of problems must also be addressed in relation to travel and tourism, motorised and non-motorised off-road traffic, holiday cabins, aquaculture facilities, mineral extraction, renewable energy production, reindeer husbandry, coastal zones and agriculture.

The landscape is becoming fragmented by an increasingly dense network of regulated river systems, high-voltage wires, roads and railways. It is also affected by more intensive forms of agriculture operations, overgrowing of open landscapes, new energy production facilities, mineral extraction, construction of holiday cabins, tourism and reindeer husbandry. The expansion of access routes requires major changes in land use. Efficient, environment-friendly transport of people and goods will require innovative solutions. It is essential to examine the interplay between the transport sector and other sectors, as well as how to plan combined solutions between sea, road and railway routes, and how increased mobility affects the utilisation and development of environmental resources and landscape.

Research needs

- Environmental impacts of changes in land use: drivers, interaction between different public interests, an integrated perspective, large-scale changes and analyses;
- Environmental impacts of land-use policies, management regimes and industrial development: conflicts and synergies between various user interests;
- Areas under particular pressure, such as urban and semi-urban areas and the coastal zone, and environmental impacts on biodiversity, cultural environments and soil conservation;
- Urbanisation: sustainable urban and semi-urban development, especially in relation to land-use policies, soil conservation, environmental qualities and ecosystems;
- Management and protection of threatened areas of natural habitat and of cultural historical areas;
- Effects of changed land use on species, populations, and natural and cultural landscapes;
- Values of and potential in the agricultural landscape and in the cultural landscapes of reindeer husbandry.

4.2.2 Ecosystems in change

Ecosystems, resource bases, cultural environments and natural resource-based industries are in constant flux, leading to declines in some populations while others expand. Increased travel, trade and climate change are leading to the spread of invasive alien species, genetically modified organisms, parasites and diseases. In addition there is increased risk of the spread of zoonoses, i.e. diseases such as Lyme disease that can be transmitted from animals to humans. Changes can also cause populations to tip more out of balance, which in turn has impacts on ecosystems and ecosystem services. Too little is known about the various drivers of change, for instance what has led to declining populations of pollinating insects.

Large-scale change processes will have an impact on biodiversity, including species that can be harvested. There is a need to develop system indicators to predict processes of this type. The changes may alter salmon migration patterns. The combination of e.g. aquaculture, river regulation, harvesting and pollution can lead to population declines.

There is close interaction between the rural landscape, which is primarily a producer of ecosystem services, and the urban landscape, which is largely a consumer of those services. The urban and rural landscapes are intertwined in a mutually dependent relationship with one another. Conflicts arise, however, related to e.g. differing valuations of nature and resources, of predators and hunting, and the preservation of biodiversity.

The socio-ecological approach requires new organisation and tactics. Modern information technology, remote sensing methods and accessibility, as well as sharing and standardisation of data can all help to accelerate advances in environmental research. Expertise in analysing and synthesising large data sets must also be expanded.

Research needs

- Functional relationships within ecosystems and large-scale change processes, as a knowledge base for ensuring sound management and sustainable industries;
- Relationships between urban and rural areas, in terms of ecosystem services, social values, and more;
- Sustainable harvesting of populations in fresh water and uncultivated land;
- Grazing ecology and effects of grazing on wild and domesticated populations;
- Modelling, risk assessment and monitoring methods for detecting the spread and establishment of invasive alien species, parasites and diseases, including zoonoses.

4.2.3 Societal change and its drivers

Changes are taking place in population structures, values, attitudes, consumption patterns and preferences, political orientation, and environmental knowledge and awareness. Societal processes and drivers have significance for environmental policy and management. Economic restructuring is accompanied by social change and differing mindsets. Traditional and new industries compete with one another. Different value orientations and perceptions of the future and “the good life” may also be pitted against one another. Other drivers of critical importance for a more sustainable future are international law and international conventions, as well as environmental technology and new forms of cooperation between the private and public sectors.

Macro-economic and socio-economic societal changes are of great significance for resource utilisation, land-use policies and property management. Such changes also affect how people experience and relate to their surroundings. The global megatrend of urbanisation and centralisation is shaping development in Norway as well. Cities and semi-urban regional areas are expanding, fortified by economic, social and cultural capital. With climate change comes a need for knowledge about the transition to a low-emission society and how to deal with the coming environmental and climate-related challenges. Trade and investment may be part of these problems but can also help towards solutions, for instance by integrating environmental considerations into agreements and law-making.

Changes in agriculture combined with less and less industrial activity make it more difficult for regional districts to maintain jobs, production and service functions. New local resource-based jobs are being developed in many places, based on local food production, travel and tourism, utilisation of uncultivated areas, etc. Meanwhile the digital revolution is creating new opportunities for information exchange, work, products and markets that are not tied to location. Digitalisation can

also contribute to enhancing the general public's knowledge about the environment, to influence attitudes and to support a sustainable transition.

Research needs

- Large-scale societal change, including changed values and attitudes, with particular relevance for environmental and land resources;
- Societal basis for effective environmental policy;
- Drivers that produce societal change: ownership rights, trends in ownership patterns, fundamental values and attitudes, and demand for environmental resources and environment-friendly products and services;
- Attitudes towards and valuation of environmental goods.

4.2.4 Global change and environmental impacts

Norway has a great responsibility for resource management, made more challenging by change processes and globalisation. The state of the environment must be assessed in terms of risk and vulnerability. Increased risk and uncertainty as a result of climate change, for example, will also require changes to management regimes. As yet, there is too little knowledge generated for such risk management, i.e. the development of steering systems capable of dealing with risk and uncertainty. Future resource policy will necessarily place heavy emphasis on food security, water resource management, efficient utilisation of resources, energy preparedness and adaptation to climate change. Norway's obligations and contributions to international resource policy will also be central in this context.

Cultural heritage may be intentionally destroyed as a strategy to target ethnic groups in conflict and at war. Climate change may bring more frequent extreme weather events, droughts, floods, landslides, forest fires and heathland wildfires, along with their attendant impacts on biodiversity, pollution and cultural environments. Air and ocean currents along with international trade contribute to the long-range transport of hazardous substances. Alien species are spread both intentionally, through the introduction of production species, or unintentionally, such as stowaways on imported garden plants. Many of these alien species will become established and have negative impacts on native species. International and transnational instruments are still not adequately developed to deal with this. International trade and investment is one of the main drivers of globalisation. Freer international trade and a market economy have fostered tremendous advancements in economic development and welfare, but have also led to intensified pressure on resources, higher emissions and thus greater environmental and climate-related challenges.

Plant and animal breeding using traditional and modern biotechnological methods is on the rise, and breeding has potential applications in many areas, including agriculture, aquaculture, medicine and industry. At the same time, too little is known about the effects on health and the environment, such as those in connection with genetically modified organisms (GMO). There is also a need for more knowledge about how genetic diversity can best contribute to the global food supply and food security.

Norway should build expertise that can contribute to the global development of knowledge and in international knowledge-building processes for environmental research relating to risks to society and to resources. Expertise in national security issues should incorporate environmental perspectives to a greater extent. Global interconnectedness means that socio-economic and environmental changes in one place may lead to comprehensive changes in other places. Far too little is known about what the interweaving of socio-economic and environmental processes at the global level truly entails and about the impacts this may have on the set of threats and Norway's preparedness and societal security.

Research needs

- International policy on resources, climate and the environment and Norwegian preparedness in connection with environmental resources such as water supply, energy, critical raw materials, food and cultural heritage;
- Growing international trade and transport of raw materials, products and waste: environmental status in Norway and Norway's ecological and social footprint in other countries;
- Global demand for sustainable energy and the resulting impacts on environmental status and ecosystem services in Norway;
- International trends in consumption of natural resources, and the state of the environment in Norway;
- Alien species and effects on biodiversity and the capacity of ecosystems to supply services;
- Plant and animal breeding, including GMO: environmental risk assessment, contribution to sustainable development, benefit to society and ethical considerations;
- The significance of genetic diversity in facing outbreaks of new plant and animal diseases, as a result of e.g. climate change.

4.3 Solutions for societal transition

The MILJØFORSK programme attaches importance to contributing to a reliable knowledge base for sustainably managing biodiversity and cultural environments in light of current and future challenges. This includes mitigating or preventing pressure from human activity, hazardous substances and other pollution, as well as an approach that targets emerging opportunities by expanding the interface with business activity. Research under the programme is also intended to study issues related to the environment's importance for health, quality of life and more effective environmental management. The programme will also contribute to expanding knowledge exchange, dialogue between the different sectors of society, and new solutions.

4.3.1 Sustainable solutions for use in society and the business sector

A stated aim of the MILJØFORSK programme is to contribute towards a green transition in which natural resources and cultural environments are utilised sustainably. Knowledge, innovation ability and value creation in both the public and the private sectors all play key roles in the transition to a green society that is ecologically, economically, socially and culturally sustainable. Closer cooperation between the business sector, the public administration and the research community can facilitate this development. The actors encompass public authorities, companies, organisations and civil society.

Industrial activity contributes to changes in land use, land area fragmentation, contamination of soil, air and water, and loss of biodiversity and cultural monuments. Industrial activity such as agriculture can become sustainable through more targeted plant and animal breeding and green tourism. The private sector has an important social responsibility, and new knowledge about the environment can challenge and help the business sector towards a green transition in situations where a positive reputation for environmental thinking means new opportunity. Environmental technology and new innovations can help to reduce pollution and lead to more-sustainable utilisation of natural resources and cultural environments. Achieving a non-toxic, low-emission society that safeguards biodiversity and cultural diversity requires a comprehensive approach where trade and industry function both as a contributor and as an engine of change.

Sustainable business development requires a systems-oriented life-cycle approach, which is a fundamental principle of a circular economy and the bioeconomy. The total environmental impact of products and services must be taken into consideration. The focus must be on optimal utilisation of raw materials, efficient use of resources, closed material loops, responsible use of chemicals, waste minimisation, product lifetime and quality considerations. It is also important to study environmental

impact during the use phase, potential for reduced consumption, recycling and integrated value chains.

Knowledge is critical for developing the private and public sectors alike. In the public administration, knowledge pertaining to sustainable and environment-friendly technology can be useful in developing regulations related to e.g. targeting of instruments and measures. This knowledge can also be implemented to encourage purchasing of environment-friendly, sustainable solutions. At the same time, trade and industry are often the drivers of development when it comes to future-oriented environmental technology and innovative, environment-friendly solutions. For this reason it is important that research activities contribute to value creation in trade and industry and to environmental technology development. Only then will we achieve new solutions and measures that safeguard the environment as well as the economy.

Waste management and treatment technology help to reduce emissions of substances harmful to health and the environment. There is a need for ongoing development of technology for utilising these resources better and thereby minimising waste flows from the production and use phases, while also increasing the proportion of waste recovered without increasing the spread of hazardous substances. The development of environmental monitoring technology helps to enhance understanding of natural processes and anthropogenic effects.

It is consumers, however, who make the daily choices concerning products and services. Consumers' environmental awareness is rising, and research activities must help people to make informed choices. Targeted efforts are needed to understand what influences consumers' attitudes, behaviour and choices and what may help to lower overall consumption. A large degree of interdisciplinary knowledge development is called for if the private sector is to become more willing to combine innovation with greater focus on solutions that are technologically and economically optimal. New solutions and innovations must be devised, but it is also challenging to determine how to facilitate their actual implementation in markets, policy and management. Research on consumption encompasses the environmental impacts of consumption in a life-cycle perspective as well as the roles and responsibilities of various actors such as politicians, producers and consumers within this life cycle. The public sector plays an important role in mitigating risk when it comes to the application of new solutions.

Research needs

- Environmental knowledge about natural resources, hazardous substances and cultural environments as developmental and competitive factors upon which sustainable solutions are based;
- Conditions for faster implementation of environmental measures promoting the transition to a green society in the whole of society and/or in society, trade and industry and the public administration;
- Innovation initiatives for environment-oriented trade and industrial development, critical factors and integration of environmental risk assessments;
- Effects of instruments and measures for more sustainable solutions for environment-oriented industrial development in the public and private sectors;
- Consumption in a sustainability perspective: incentives and solutions that can promote reduced consumption and a lighter footprint. Regulation, responsibilities, voluntariness and product design;
- Positive and/or negative environmental effects of new technologies;
- Environment-friendly and resource-efficient solutions for products and waste, recycling and new markets, including waste prevention and resource efficiency;
- Environment-friendly treatment solutions for water, soil and air;

- Enhanced sustainability and reduced environmental impact for Norwegian food production;
- The public sector as knowledge-based consumer and authority;
- Urban environments: potential for new and more environment-friendly solutions for society;
- Potential for protection and value creation through sustainable use.

4.3.2 Management and societal perspectives

Legal and economic instruments, knowledge development, information and awareness-raising activities are important elements of environmental policy and as drivers of societal development. The organisation of the public administration is also essential to environmental policy. The system of governance in the management of natural resources and cultural environments is undergoing change. Current management activities are organised on several institutional levels and are administered under various acts of legislation and regulations, which sometimes have conflicting frameworks and objectives. For example, the Norwegian water resource management plan stipulates new arenas with water region committees, the municipalities have been assigned greater responsibility for environmental issues, and the county municipality has been given new tasks in connection with hunting, fishing and wild reindeer management. The large number of management agencies and levels entails a need for extensive coordination to ensure efficiency, legitimacy and proper governance.

Increasingly, sectoral decision-making in the central government administration is being shifted to local government-level political bodies. More network-based and locally rooted management models exert influence on actors from the public administration, trade and industry, and local communities. The extent to which this strengthens democratic governance and contributes to sustainable management and value creation is unclear. For example, trade and industry and development actors are increasingly influential agenda-setters through private zoning plans and access to capital. But these do not necessarily have a local base.

Generally, the development of new forms of governance goes more quickly than the development of policy, knowledge and instruments. This can lead to new lines of conflict, both vertically and horizontally in the governance systems and between actors in society. In addition, there are major challenges in how to make management more knowledge-based and what kinds of knowledge should be applied for decision-making.

Effective management requires that policy and instruments are perceived as legitimate, reasonable, relevant and suited to solving tasks which the public views as important. Here the great knowledge challenges lie in areas such as agriculture in general and soil conservation in particular, reindeer husbandry, the northern areas, the coastal zone, urban green structures, conservation of nature, protection of cultural heritage, predators and wild reindeer. Environmental values often come in conflict with other interests and sectors of society. There are also conflicts internally in climate and environmental policy, for instance between preserving biodiversity and developing renewable energy, and between the conservation of nature and protection of cultural heritage.

There is a need for knowledge based on a more cohesive, cross-disciplinary approach to environmental challenges in order to counteract the negative effects of sectorisation. For example, ministries and management bodies may present conflicting measures and instruments. Actors and rights-holders often interpret things differently, and clashes may be due to the impact of different interests on the assessment of biodiversity and ecosystem services. Different environmental considerations require different instruments, e.g. considerations for climate and renewable energy may conflict with considerations for environmental sustainability. What are the existing political, economic and technological instruments and how can they be implemented? What are the effects of

local administration, and which instruments and forms of dialogue are best suited to reducing conflicts between public needs and private interests?

The challenges are complex and are related among other things to power, rights, and different forms of governance. It is therefore necessary to carry out more interdisciplinary research that can enhance the knowledge base for developing policy, management regimes and instruments for safeguarding environmental goods. The environmental authorities have also been given a number of new instruments via the Nature Diversity Act.

Research needs

- Power relations, conflicts, legal issues, sector organisation and competing systems of governance;
- Ownership rights and land use management: changes in land tenure, deregulation and privatisation, opportunities for value creation resulting from new forms of management;
- Models for better coordination between different types of utilisation and different ecosystem services;
- Overall environmental impact of instruments that cross-cut multiple policy areas and conventions, including the Planning and Building Act and the Nature Diversity Act;
- Analysis of key concepts and knowledge traditions, including the uncertainty of knowledge and different quality requirements;
- Models for conflict resolution, participation, democracy and cooperation;
- Management models for sustainable urban development;
- International conventions and agreements, implementation in Norwegian management, and opportunities for sustainable, environment-oriented industrial development.

4.3.3 The environment, health and quality of life

Biodiversity and cultural environments are key resources for a number of areas of society and ecosystem services such as food, health, quality of life, and a sense of belonging and identity. Increasing attention is being focused on everyday outdoor recreation, recreation areas, healthful food, hunting/collecting food in nature, new activities, and travel and tourism. People's preferences and opportunities for outdoor recreation activities vary widely, dependent in part on age, personal finances, gender, ethnicity and lifestyle. Outdoor recreation areas in local environments can hold great potential for measures to improve public health.

Society is in need of knowledge related to consumption, hazardous substances in consumer goods, food safety and health effects. Organically grown food, locally grown food and traditional food are gaining in value not only due to their environmental, health-related and market-economy benefits, but also from their function as cultural carriers with respect to forms of production, use of ingredients and local preparation customs. Knowledge development must be addressed in cooperation between the MILJØFORSK programme and other programmes that are responsible for research relating to food production and public health.

Research needs

- Outdoor recreation and quality of life in urban areas and other pressure areas;
- Different forms of outdoor recreation related to natural resources and cultural environments, changes, conflicts, opportunities and significance for health, the environment and quality of life;
- Relationships between perceived quality of life and consumption, food production, and hazardous substances in the air, food and other consumption goods;
- The significance of cultural environments and biodiversity, including the blue-green structure for quality of life and everyday well-being.

5 Strategic priorities

The MILJØFORSK programme has a results-oriented, applied research focus and will address environmental challenges facing society. The programme board's strategic responsibility and role in operationalising the programme objectives is set out in this work programme, but will also be articulated in the programme's action plans, funding announcements and various strategic priorities. This will entail, among other things, measures to strengthen priority areas under the programme as well as different forms of cooperation and coordination at the national and international levels in order to strengthen the scope of environmental research and ensure satisfactory performance achievement under the programme.

The MILJØFORSK programme has four strategic roles:

- To carry out the core tasks for which it has the main *financial* responsibility;
- To deal with interfaces and areas of overlap in which multiple programmes must *together* share the *financial* responsibility;
- To provide knowledge about the *prerequisites* and assume a *role as a driving force* for research on environmental questions that lie outside its scope of financial responsibility;
- To make use of its *role as a driving force* and implement *mobilisation measures* in areas in which funding is being provided at the *international* level, e.g. under Horizon 2020 and associated funding instruments.

New approaches and work forms

The MILJØFORSK programme will continue to develop projects with a more integrated perspective, in which knowledge about resources, change processes and solutions is considered together to a greater degree. This will call for more large-scale, cross-cutting and interdisciplinary efforts with incorporation of natural science, social science, humanities and technology disciplines. The programme will launch larger-scale, more complex projects with a broader scientific scope and budget framework, but will also accommodate smaller-scale projects that address more narrowly targeted and basic knowledge challenges with less emphasis on interdisciplinarity. These will primarily take the form of investigator-driven projects (researcher projects), but other types of grants may be relevant as well, particularly to encourage greater participation on the part of trade and industry. Funding instruments may furthermore be made available for projects based on bold, innovative thinking and which involve higher risk.

Profile and cooperation (see Chapter 6)

The MILJØFORSK programme will develop thematic areas and activities targeted towards specific knowledge needs and societal challenges. The programme will be open to employing co-funding between multiple actors or other models of coordination to a greater extent.

User participation and increased involvement of business sector actors

The MILJØFORSK programme will have an applied focus and will give priority to instruments that can expand dialogue with and the participation of various user groups in the public administration, society at large, and trade and industry. Measures will be specified in action plans, funding announcements, project requirements and communication plans.

Relationship with trade and industry and industry-oriented programmes

The MILJØFORSK programme will give priority to enhancing the relevance to industry of the environmental research conducted. The programme seeks to achieve wider cooperation and integration between the environmental sector and various users in the public and private sectors. The distribution of responsibilities and the potential for coordination between the MILJØFORSK programme and the large-scale industry-oriented programmes and other relevant activities at the

Research Council should be clarified. Consideration may be given to co-funding by the MILJØFORSK programme of the most closely related research tasks. In other knowledge areas in which safeguarding environmental considerations is vital, but for which the programme does not have the direct responsibility, the programme should develop a role as an agenda-setter and driving force for addressing environmental questions, without having to take on financial responsibility.

The programme must primarily prioritise research and cooperation with the business sector in those areas where the programme's scope of responsibility clearly intersects with industrial and commercial challenges.

National and international cooperation (see Chapters 6 and 7)

The MILJØFORSK programme will help to develop more robust environmental research in alignment with priority challenges. The programme will strengthen research groups, and work to take advantage of opportunities in areas where Norway has advantages and can contribute significantly to advancing the international knowledge front in the environmental field. The programme will emphasise international cooperation in its funding announcements and through participation in international programmes and fora.

Recruitment

The MILJØFORSK programme will work to recruit talented researchers, primarily through the incorporation of various types of recruitment and mobility grants in the projects it funds. Other measures, such as national graduate-level researcher schools in the environmental field, may also be considered, along with potential recruitment positions of environmental and industrial relevance.

Meeting place (see Chapters 6 and 8)

The MILJØFORSK programme will further develop its role as a meeting place. One relevant measure will be to create arenas that promote dialogue on topics that are divisive or where there is major disagreement among scientists. The programme will also facilitate dialogue between groups whose paths traditionally do not cross.

Gender equality and gender perspectives

The MILJØFORSK programme will follow up the Research Council's policy on gender balance and gender perspectives in research and innovation in all its activities. The programme will attach importance to achieving a satisfactory gender balance among project managers and encourage younger researchers to take on project coordination responsibilities. It will also work to strengthen gender perspectives in the research carried out under the programme.

Adaptation during the programme period

The MILJØFORSK programme will be open to adapting the thematic priority areas and strategic priorities during the period covered by this work programme. This will ensure that the programme has the necessary flexibility to address significant emerging knowledge needs or far-reaching scientific advances.

6 Cross-cutting cooperation with related funding instruments

The MILJØFORSK programme addresses major environmental challenges and is targeted towards integrated knowledge development to find solutions to complex societal challenges. The programme will serve as a hub for environmental research at the Research Council. The MILJØFORSK programme employs a flexible structure that is open to different forms of binding cooperation with relevant programmes and initiatives at the Research Council that address common knowledge challenges and cross-sectoral issues.

The programme shares an interface and areas of overlap with a number of other programmes and activities at the Research Council (see overview in Attachment 1). Delimitations and interfaces will be clarified on an ongoing basis through action plans and in joint funding announcements with related programmes and activities. Examples of cross-sectoral issues and areas for cooperation include impacts of climate change, land use, social conditions that affect environmental understanding, conflicting interests in the coastal zone, impacts of hazardous substances on agriculture and food safety, sustainable transportation planning and sustainable energy supply, the circular economy, value chains and sustainable development of the bioeconomy.

The programme should provide funding for studies where e.g. land area development puts pressure on environmental resources, such as in the coastal zone and in urban and semi-urban areas. Where new technologies and trade and industry are being developed, such as within the framework of the bioeconomy and low-emission society, the programme must assess the knowledge challenges and determine whether to contribute funding or instead to provide knowledge and a guiding framework for development as a driving force for safeguarding environmental concerns.

Role as funder

- The programme may contribute funding to another programme's call for project proposals.
- Programmes may collaborate scientifically and/or financially on a targeted call.
- Programmes may collaborate on larger-scale calls with a broad thematic focus.
- Co-funding may also extend to more innovative and/or ground-breaking projects.

Role as a driving force and agenda-setter

- The programme will utilise knowledge to be a driving force and agenda-setter for research in areas where it does not have the main financial responsibility.

Role as a meeting place

- Develop broader communication activities and meeting places to promote more unified, synthesised and targeted communication with user groups.
- Attach greater importance to developing arenas for dialogue and discussion on important social issues, including where there are conflicting interests and conflicts.

Role as advisor

- Develop scientific and strategic cooperation between programmes to strengthen the Research Council's advisory role, for example in budget and planning processes, and to promote a more integrated approach to environmental and sustainability challenges.

Role as an international driving force

- Increase cooperation between programmes on international activities and promote mobilisation for participation in international efforts.

7 International cooperation

The environmental research front is international. Extensive international research cooperation is essential for achieving the objectives of the MILJØFORSK programme. The wide array of challenges related to the environment entail a growing need to enhance internationalisation in research activities, as specified in the UN Sustainable Development Goals adopted in autumn 2015, in which environmental challenges are included among the key goals. Many research tasks require coordinated knowledge development and greater investment of resources than any single country can provide on its own. Moreover, finding solutions to environmental problems will require efforts across national borders. Research is also an important instrument for national implementation of international agreements, conventions and EU directives.

Collective global effort

The MILJØFORSK programme will facilitate international research cooperation in keeping with the Research Council's strategy on international cooperation. The programme seeks to draw greater international attention to Norwegian research and take active part in global knowledge production. Therefore the programme will enhance the quality and capacity of Norwegian research and research-driven innovation. This will be of major importance for Norway's research contribution to the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) and other international initiatives and treaties.

The MILJØFORSK programme will make a targeted effort to encourage international cooperation in research projects. This will be done by stipulating clear requirements, and requiring more comparative research and international publication, as well as participation in international arenas.

The MILJØFORSK programme will promote increased Norwegian participation in international research cooperation at the European and global level, as well as bilateral cooperation with selected countries. The programme will also work to establish collaboration with countries in the South, where there is a particularly great need for wider expertise and capacity for dealing with environmental problems. Norwegian researchers can contribute to knowledge development to promote the transition to a green society.

Incentive measures

The programme will regularly assess the need to develop measures to make Norwegian researchers and research groups more active participants in international research arenas. Key arenas include the current EU Framework Programme for Research and Innovation (Horizon 2020), European Joint Programme Initiatives (JPI) (particularly JPI Water, JPI Cultural Heritage and JPI Urban Europe), and cooperation platforms (particularly ERA-Net BiodivERsA). The MILJØFORSK programme will promote coordination to optimise synergies with the research strategies of relevant JPIs and ERA-NETs. The programme will also work to increase the participation of Norwegian actors in Horizon 2020, supporting this through both qualifying and incentive measures.

Large-scale global programmes such as Future Earth under the International Council for Science (ICSU) and the Belmont Forum are important cooperative arenas and agenda-setters. In the future it will be particularly important to give priority to the right arenas and activities and focus active efforts on these.

The MILJØFORSK programme will set aside a certain portion of the budget each year for international cooperation. Among other things, the funds should be used to facilitate the Norwegian contribution to international joint calls and possibly to co-finance international measures with other programmes. (See Chapter 8.)

8 Communication and dissemination activities

Communication activities under the MILJØFORSK programme will draw attention to the Research Council's environmental research initiatives, as part of the Council's overall communication activity and in keeping with its central communication strategy. The programme will also pave the way for more and better dissemination from the projects, which is primarily the responsibility of the researchers and institutions. Dissemination activities will be crucial to achieving the programme objectives and this will be reflected in the funding announcements. The programme will assess dissemination measures on an ongoing basis, particularly with regard to the general public, politicians and the public administration.

Objectives for communication activities

- Improve dialogue between the research community and society at large.
- Strengthen user participation in scientific development.
- Highlight the strategic role of the Research Council in environmental research.
- Promote targeted communication and good dissemination of environmental issues in cooperation with related funding instruments and research groups.
- Ensure an adequate number of high-quality grant proposals in response to the programme's funding announcements and to those of relevant international activities.

Target groups

The MILJØFORSK programme will seek active communication with a wide range of research groups. Politicians and the public administration also comprise key target groups for environmental research, along with business and environmental organisations. The general public and the media are important actors and target groups for the programme as well.

Main principles

- Cooperate with related programmes/funding instruments to communicate with and disseminate results to various user groups at the overall or thematic level.
- Cooperate on international instruments to give a more visible profile to Norwegian participation.
- Cooperate with research groups to publicise good examples of research results.
- Cooperate with user groups.
- Facilitate targeted communication efforts under the projects and follow up the activities.

Instruments

- Provide meeting places for different target groups, from broad-based conferences on topics relevant to the public debate to dialogue meetings and purely scientific conferences/meetings.
- Use the press/media, including the national media, scientific media and the Norwegian-language popular science website *forskning.no*.
- Use the Research Council's own channels, including the Project Databank.

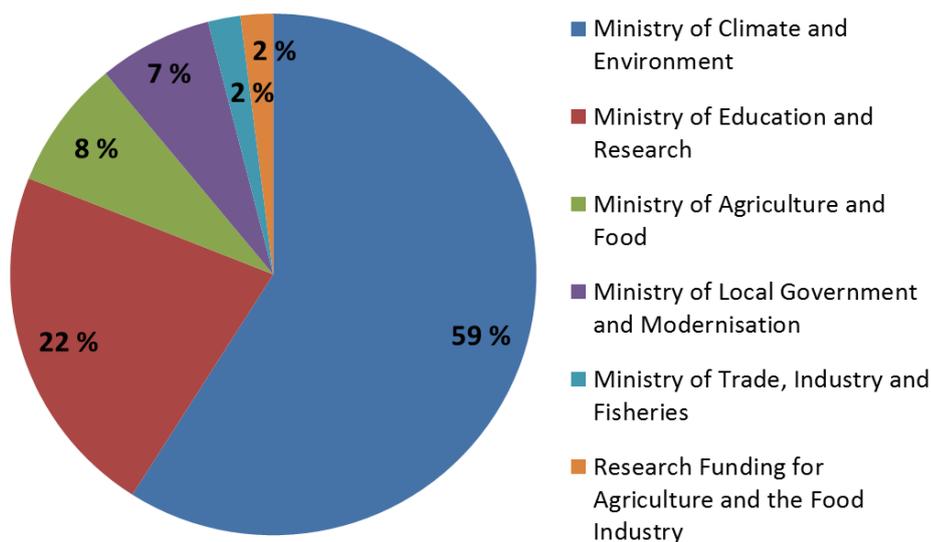
Based on this, the programme will provide input to the Division for Energy, Resources and the Environment's annual communication plan for environmental research.

The division administration will determine the communications-related tasks for which the programme administration will be responsible. Responsibilities will be distributed in dialogue with the programme administration.

9 Budget

The MILJØFORSK programme was launched in 2016 and is an open-ended programme. The programme has received allocations from five ministries and two industry actors for its first year. In 2016 the MILJØFORSK programme has a total budget of NOK 89 million; see the chart below for the distribution of allocations by funding source. The Ministry of Climate and Environment allocated over 60 per cent of the overall funding and is thus the most important funder of the programme.

Allocations to the MILJØFORSK programme in 2016



Environmental research extends into many social arenas, and the challenges are continuing to expand. The MILJØFORSK programme has identified research needs in existing areas of responsibility in addition to the need for research and cooperation in new areas. The funding required to address all of these needs exceeds the budget of the MILJØFORSK programme, and thus a substantial budget increase is called for. Identified needs should be incorporated into the Research Council's annual input to the national budget to ensure that the priorities set out in the Long-term plan for research and higher education 2015–2024 can be followed up.

Given a zero-growth budget, the programme will have a budget totalling some NOK 760 million for the entire programme period. The programme's long-term budget will incorporate funding set aside for the following:

- cooperation with other activities at the Research Council, roughly 10–25 per cent;
- international cooperation and incentive measures, roughly five per cent.

To provide predictable frameworks for the research community and internally within the Research Council, the MILJØFORSK programme will draw up a long-term overall plan for funding announcements. Calls for proposals for the programme's main research topics will be issued at regular intervals. Which forms of cooperation are nationally and internationally relevant will be assessed on a case-by-case basis.

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 areas will be adjusted in relation to other activities. The thematic framework of the call will also be adapted to the funding available.

10 Follow-up and evaluation

The MILJØFORSK programme will follow the development of the programme towards achieving its stipulated scientific and strategic objectives. With regard to the scientific secondary objectives, analyses of the project portfolio will show the extent to which the measures implemented under the programme are helping to meet the knowledge challenges described in Chapter 4 of the work programme.

The strategic objectives will be followed up and assessed regularly, both qualitatively and through the use of statistics and analyses. Information on the strategic role of the MILJØFORSK programme, the manner in which the programme is being implemented, the actions taken and work methods selected, and the collaborative platforms developed will be set out in the programme's annual report. Furthermore, the programme board will assess the programme's performance achievement on an ongoing basis and introduce new concrete measures in the programme's action plans and funding announcements.

The portfolio analyses will provide a statistical basis on, among other things: national and international cooperation; user participation; commercial relevance and involvement of industry actors; gender perspectives; and, recruitment and gender balance.

The MILJØFORSK programme is an open-ended programme, and the members of the programme board are appointed for a four-year period. Towards the end of this period the programme board will consider the need for an evaluation of the programme in light of the changes that have emerged and the challenges facing the programme. After 10 years of operation, the need for a major revision of the knowledge base should be assessed.

11 Organisation

Programme board and programme administration

The MILJØFORSK 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 specific instruments available. Activities are to be carried out in accordance with the intentions and objectives of the Research Council's strategies and guidelines, 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 and other funding sources. Programme activities will be planned in cooperation with related programmes to ensure that research needs extending across the area of responsibility of the individual programmes are covered. The Research Council's routines for planning cooperation between programmes will be followed. The programme board acts on behalf of the Research Council and reports to the research board via the executive director. The MILJØFORSK programme administration is responsible for carrying out the day-to-day tasks of the programme, performing the administrative functions of the programme and facilitating 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. Thematic framework, requirements and assessment criteria for grant applications will be specified in the funding announcements. The quality of the grant proposals will primarily be assessed by international referee panels and/or individual experts. Advisory groups may be appointed to assess the relevance of the grant proposals, help to prepare the funding announcements or assist in other tasks on which the programme board would like advice. The programme administration will submit a recommendation for projects to be awarded funding to the MILJØFORSK programme board, which is responsible for final approval of grant allocations.

