

BIONÆR Work Programme

Applicable from 2018

Research Programme
Sustainable Innovation in Food and Bio-based Industries – BIONÆR



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1 Summary

The BIONÆR programme has responsibility for research on the agricultural and forestry sector, reindeer husbandry and other land-based and bio-based industries, including bioresources, food processing and the food industry.

The BIONÆR programme's primary objective is to promote the bioeconomy through research and innovation on agricultural and land-based bioresources that will increase the level, profitability and sustainability of production in the bio-based industries. The term "bioeconomy" encompasses all sustainable production and processing of biological resources for food, feed, health and fibre products, industrial products and energy.

The scientific scope of the BIONÆR programme encompasses a wide range of value chains. The research funded must help to solve specific industry challenges, and give adequate consideration to various areas of interface with society at large.

The programme is an important instrument for ensuring sustainability in the land-based, bio-based industries, while at the same time contributing to industrial development, innovation, raising efficiency and improving resource utilisation within the circular economy. Activities under the programme must be adapted to ongoing change processes in society and the emergence of new technologies, while at the same time adhering to the following cross-cutting perspectives:

- **Closed-loop-systems:** Optimal utilisation of biomass/residual raw materials throughout the entire value chain. Reduced waste, extended shelf life and higher quality. Marine/agriculture synergies, cross-utilisation between bioresource streams, new processes, products and technologies. Ongoing risk assessments.
- **Sustainability:** Attention across the board to ethical, environmental, social and economic aspects of sustainability. Minimum greenhouse gas emissions in all production stages. Biodiversity conservation.
- **Value creation:** Knowledge-based value creation, good profitability, market orientation, innovation and efficiency. Consumer and resource management dimension, public sector framework and demand for these factors.
- **Interdisciplinary approach:** Relevant interdisciplinary and unified knowledge development, shedding light on key challenges facing industry and society. Long-term knowledge-building relevant in the context of society.

For food production in particular, it is essential to ensure:

- **Food security:** Knowledge to ensure that food production increases at a pace with the needs of a growing Norwegian population. Norway must also help to secure the global food supply.
- **Safe and healthy food:** Safe food that promotes good health must be the aim in all stages of the value chain.

Norway has abundant bioresources that are unutilised or underutilised. New technology opens up major opportunities for the development of new products based on biological raw materials and residual raw materials. The BIONÆR programme will facilitate this development and at the same time help to develop regulatory frameworks, organisation and policies for promoting new solutions and new products. The programme will collaborate with other Research Council programmes and instruments where the thematic area extends beyond the scope of the programme.

Effective cooperation on R&D funding both nationally and internationally will be critical to succeed in applying the bioeconomy to meet major societal challenges. The BIONÆR programme will actively participate in international research cooperation to improve the quality of knowledge-building and boost innovation in industry.

Annual priorities for the BIONÆR programme will be identified through dialogue with the research community and industry, and in relation to current research policy and other political guidelines.

2 Background and challenges

Resolving the global challenges related to population growth, climate change and resource needs will require a transition to the use of renewable resources. Norway has committed to following up the 17 United Nations Sustainable Development Goals¹. To be able to reach the goals set for Norway there is a need to develop green competitiveness and expanding the circular economy, including the bioeconomy.

The Government's Bioeconomy Strategy, *Familiar resources – undreamt of possibilities*,² takes as its point of departure the OECD's view that the bioeconomy offers major potential for value creation. According to the Government strategy, the national effort to develop the bioeconomy will increase value creation and employment, reduce greenhouse gas emissions, and promote more efficient, sustainable utilisation of renewable biological resources. Dealing with these challenges will require research and innovation, and the Research Council of Norway, together with Innovation Norway and Siva (Industrial Development Corporation of Norway), will play a key role in following up the strategy.

The overall objective of the BIONÆR programme is to promote the bioeconomy by providing support for research and innovation activities that will increase the level, profitability and sustainability of production in the bio-based industries that use agricultural and land-based biological resources. The programme is thus an important instrument in the Research Council's follow-up of the Government's bioeconomy strategy, but the scope of the BIONÆR programme does not extend to the entire bioeconomy. The BIONÆR programme encompasses the segment involving research and innovation activities to develop the value chains for agriculture, forestry and nature-based industries, and in addition addresses areas combining marine and land resources ("blue-green") and other cross-sectoral areas in cooperation with other programmes. In general, there are no clear boundaries drawn between the BIONÆR programme and the other Research Council programmes with responsibility for the bioeconomy. Related programmes and interfaces for collaboration are described in Chapter 6.

The BIONÆR programme is primarily funded by the Ministry of Agriculture and Food. A number of national policy documents, including the Government's bioeconomy strategy, point out the need for a unified initiative to improve utilisation of Norway's biological resources. (Please see the list further down in this chapter.) Activities under the programme will have to be based on the sphere of responsibility of the various funding ministries and applicable policies in those sectors.

¹ <http://www.un.org/sustainabledevelopment/>

² The Government's Bioeconomy Strategy, *Familiar resources – undreamt of possibilities* (2016). https://www.regjeringen.no/en/dokumenter/regjeringens-biookonomistrategi-kjente-ressurser--uante-muligheter/id2521997/?q=bioeconomy& t_dtq=true

In 2015, a total of NOK 2.4 billion was used on agricultural and food-related R&D,³ accounting for 4 per cent of Norway's total R&D expenditure. The increase in expenditure in this research field since 2007 has been the same as for the country's total R&D expenditure. Investment on the part of trade and industry has increased, and now makes up 40 per cent of the total investment in agricultural and food-related R&D. There has been a reduction in investment of roughly 2 per cent in the university and university college sector, and of roughly 0.5 per cent in the research institute sector. This downward trend in the university and university college and research institute sectors must be reversed if knowledge needs in the area are to be met.

The BIONÆR programme will promote a value-chain and circular approach in the bio-based industries. Existing biomass is underexploited, for instance there are vast amounts of waste and residual raw materials that are not utilised. Yields and productive land area can be expanded, new and improved species/varieties can be introduced, and food waste and other biomass waste can be reduced. Development is dependent on the integration of technologies and solutions into regulatory frameworks, production, organisation, policies, infrastructures and markets, which means that social science research and management research are also important components of the programme. Research can also help to enhance the potential for value creation based on Norwegian cultural landscape services, such as tourism and care services. Furthermore, the BIONÆR programme will work to maintain Norway's leading position with regard to food safety, animal and plant health and animal welfare.

Norwegian research groups are expected to hold a high standard, both nationally and internationally. The BIONÆR programme will actively promote knowledge-building, innovation and value creation in traditional value chains for food and agriculture. At the same time, the programme will be open to addressing emerging opportunities within the bioeconomy, including those arising from synergies and collaboration across branches of industry and sectors. In addition, biotechnology, information and communications technology (ICT), and nanotechnology are opening up completely new areas for use of biological resources. (Please also see Chapter 6.)

While Norway's abundant bioresources warrant ambitious plans for increasing sustainable value creation at the national level, it is equally important to contribute to the international knowledge pool. Thus the BIONÆR programme will promote international research cooperation within its area of responsibility, among other things by working to increase the proportion of scientific papers with international co-authors to the level of Norwegian research as a whole (67 per cent).⁴

There are a wide range of possibilities for improving resource utilisation, increasing efficiency and introducing automation/robotisation and digitalisation in existing production and processing of land-based biological resources. Norway also has tremendous unexploited potential for increasing value creation on the basis of entirely new products created in the interface between traditional primary production, processing and emerging technological solutions. New technologies will lead to radical changes within society as a whole, and the agricultural sector is no exception.

Strategies and policies

The BIONÆR programme is designed to address a number of scientific and strategic challenges and to follow up national scientific and research-policy objectives, including international commitments.

³ [Rørstad K., Sundnes S., Kartlegging av landbruks- og matrelatert FoU i 2015: Ressurser og vitenskapelig publisering.](#) [Overview of agricultural and food-related R&D in 2015: Resources and scholarly publications], The Nordic Institute for Studies in Innovation, Research and Education (NIFU), 2017

⁴ *ibid.*

The footnote provides a list of some of the most important background documents for the programme.⁵ This list is not exhaustive, nor are the documents listed in order of priority.

⁵ <http://www.un.org/sustainabledevelopment/>

The Government's Bioeconomy Strategy, *Familiar resources – undreamt of possibilities* (2016)

<https://www.regjeringen.no/en/dokumenter/regjeringens-bioekonomistrategi-kjente-ressurser--uante-muligheter/id2521997/?q=bioeconomy& t dtq=true>

[Meld. St. 31 \(2014–2015\) Garden som ressurs – marknaden som mål](#) [The farm as a resource – the market as a goal]

[Meld. St. 6 \(2016–2017\) Verdier i vekst. Konkurransedyktig skog- og trenæring](#) [Growing value. Competitive forestry and wood-based industries]

[Meld. St. 11 \(2016–2017\) Endring og utvikling. En fremtidsrettet jordbruksproduksjon](#) [Development and change. A future-oriented agricultural sector]

[Meld. St. 32 \(2016–2017\) Reindrift Lang tradisjon – unike muligheter](#) [Reindeer husbandry. Old tradition – unique opportunities]

[Rørstad K., Sundnes S., Kartlegging av landbruks- og matrelatert FoU i 2015: Ressurser og vitenskapelig publisering, NIFU, 2017.](#) [Overview of agricultural and food-related R&D in 2015: Resources and scholarly publications]

[SKOG22](#) [National RD&I strategy for the forestry and wood-based industries]

National Strategy against Antibiotic Resistance 2015–2020

<https://www.regjeringen.no/en/dokumenter/national-strategy-against-antibiotic-resistance/id2424598/?q=antibiotic%20resistance>

National Action Plan for a Healthier Diet

<https://www.regjeringen.no/en/dokumenter/norwegian-national-action-plan-for-a-healthier-diet--an-outline/id2541870/>

Report from the Norwegian Government's Expert Committee for Green Competitiveness

<https://www.regjeringen.no/en/dokumenter/green-competitiveness/id2518147/>

Strategies for the Research Council of Norway, including the main strategy Research for Innovation and Sustainability; Strategy for International Cooperation; Strategy for Sustainability; Strategy for an Innovative Business Sector; policy for recruitment

<https://www.forskningsradet.no/servlet/Satellite?c=Page&cid=1185261825639&pagename=ForskningsradetEngelsk%2FHovedsidemal>

[4th Foresight, Standing Committee on Agricultural Research \(SCAR\), 2015](#)

Strategic Research Agenda:

[Joint Programming Initiative on Agriculture, Food Security and Climate Change \(FACCE-JPI\)](#)

[Joint Programming Initiative Healthy Diet for a Healthy Life \(JPI HDHL\)](#)

[OECD: The Bioeconomy to 2030 – Designing a Policy Agenda](#)

3 Objectives for the programme

The scope of the BIONÆR programme encompasses agriculture, forestry and other nature-based value chains.

Primary objective

The BIONÆR programme will promote the bioeconomy by providing support for research that will increase the level, profitability and sustainability of production in the bio-based industries that use agricultural and land-based biological resources.

The programme will:

1. Strengthen and develop:
 - a. knowledge and expertise for new and existing bio-based industries and bioresource management;
 - b. research-based innovation in food and other bio-based companies and bioresource management.
2. Encourage Norwegian knowledge environments to take part in international research cooperation.
3. Increase value chain and closed-loop-system/circular production in the food industry and other bio-based industries.
4. Use innovative coordination and communication activities to enhance the benefits of knowledge and expertise gained by the industry and public administration.

4 Thematic and scientific priority areas

The BIONÆR programme is responsible for the bioeconomy segments within the entire spectrum ranging from terrestrial areas and resource bases to raw materials production, processing, marketing and consumption. Food security and food safety are paramount. Forestry and wood products industries are equally important topics. The BIONÆR programme's primary sphere of responsibility is agriculture and terrestrial nature-based value chains. Climate-related and environmental perspectives are integrated into this across the board. The programme's targets are also aligned with the cross-sectoral opportunities in the bioeconomy, which will require extensive cooperation across Research Council activities and elsewhere in the research and innovation system (see Chapter 6).

Research activities are to target industry's knowledge needs, in relation to both further developing existing industries and facilitating the establishment of new industrial activities in Norway. It is equally important to generate knowledge for use in resource management and policy development. Increased value creation and sustainability in the bio-based industries requires not only skilled, innovative industrial actors, but also adaptation of public incentives, the regulatory framework and other framework conditions. Moreover, the public administration has its own specific knowledge needs in relation to the exercise of authority in the areas of food security and traceability, plant and animal health, and animal welfare, which also lie within the scope of the BIONÆR programme.

The BIONÆR programme will work to promote gender balance and incorporate gender perspectives in research. These activities will take place in cooperation with other actors, through the application of internal measures and instruments and when assessing the need for new national and international initiatives.

Meld. St. 25 (2016–2017) – The Humanities in Norway, white paper from the Ministry of Education and Research identifies new areas where humanities perspectives can and should be used to provide insight, e.g. climate, the environment, sustainability, and the major technology shifts. The BIONÆR programme acknowledges that humanities research may provide valuable contributions towards finding new solutions to problems in areas within the scope of the programme.

The following cross-cutting perspectives will apply to activities within all the thematic priority areas of the BIONÆR programme:

CLOSED-LOOP-SYSTEM/CIRCULAR approach	SUSTAINABILITY	VALUE CREATION in Norwegian bio-based industries	INTERDISCIPLINARY APPROACH
Optimal utilisation of biomass/residual raw materials throughout the value chain. Reduced waste, extended shelf life and higher quality. Marine/agriculture synergies, cross-utilisation between bioresource streams, and new processes, products and technologies. Ongoing risk assessments.	Attention across the board to ethical, environmental, social and economic aspects of sustainability. Minimum greenhouse gas emissions in all production stages. Biodiversity conservation.	Knowledge-based value creation, good profitability, market orientation, innovation and efficiency. Consumer and resource management dimension, public sector framework and demand for these factors.	Relevant interdisciplinary, unified knowledge development, shed light on key challenges facing industry and society. Long-term knowledge-building relevant in the context of society.

For food production in particular, it is essential to ensure:

- Food security: Norway must help to secure the global food supply. Knowledge is required to ensure that food production increases at a pace with the needs of a growing Norwegian population.
- Safe and healthy food: Safe food that promotes good health must be the aim in all stages of the value chain.

The closed-loop-system/circular approach described above must underlie the approach to be employed in all industries and activities within the scientific scope of the BIONÆR programme. For practical reasons it is nevertheless necessary to divide the programme's area of responsibility into four thematic priority areas, described in sections 4.1 to 4.4 below. The boundaries between these four thematic priority areas are flexible.

The scope of the BIONÆR programme encompasses a wide range of value chains. Priorities for targeting activities will be determined with the help of knowledge analyses and when preparing annual funding announcements, which among other things will involve active dialogue with various user groups (see Chapter 5).

4.1 Basis for production and framework conditions

The focus of this thematic priority area is to promote research activities of relevance to sustainable land-use and resource management as a basis for producing products, services and public goods. In addition to food production, political objectives include the production of environmental goods, safeguarding biodiversity, minimising the environmental impact and climate footprint of industrial activities, and protecting and further developing forestry resources in Norway. There are several potentially conflicting objectives in the public framework for the bio-based industries. Activities under the BIONÆR programme will seek to provide greater insight into these. The programme will also provide support for research that extends beyond current political targets in the field, including the need for new framework conditions and instruments to promote growth.

The BIONÆR programme has responsibilities for funding R&D activities focusing on the agriculture sector and the marine sector independently, as well as addressing the connections between the two sectors. There are numerous challenges relating to commercial use of land area, marine areas and raw materials with respect to other interest groups and industries. Research on the development of framework conditions, regulations and industrial policy for organising the bio-based industries will thus comprise a key area of research under the BIONÆR programme. Greater insight is also needed into social and socio-economic factors, production structures, cultures and knowledge systems, and how these can support innovation and sustainable resource-based and land/sea-based industrial development. International competition lays a foundation for activities in Norwegian bio-based industries. The programme will promote the development of high-quality research groups working within the social sciences as well as collaboratively with research groups in, for example, biology and technology disciplines.

4.1.1 Trade and industrial policy

The BIONÆR programme is responsible for promoting research-based knowledge about the natural resource-based industries and how they can be developed within the established national political framework. The bio-based industrial sphere influences and is affected by international developments. There is a need for knowledge about e.g. stable framework conditions for the food industry and the dynamics around import protection. The World Trade Organization (WTO), trade agreements with the EU and EFTA's free trade agreements affect the level of national support to

industry, tariff rates and non-tariff barriers to trade, as well as trade opportunities for agriculture and forestry. Climate challenges must be addressed at the national level, but within a framework of international conventions and obligations. Policy instruments in the areas of climate and the environment, forestry, reindeer husbandry and agriculture each set out policy targets that have ramifications for industrial development, use of land and sea area, and settlement. Climate change is one of the most complex challenges facing society today. New technology, new and improved production methods, and knowledge about the market are essential to adapting and maintaining or increasing the production of food and fibre while still satisfying emissions requirements. There is a need for more knowledge about the inherent tension between deregulation, which seeks to improve economic efficiency in industry, and regulation, which seeks to ensure that industry fulfils requirements based on other socio-political objectives. Requirements to reduce emissions and for environmental and climate documentation are key. New industrial activities based on utilisation of residual raw materials will be dependent on changes in legislation and the development of regulations, incentives and other framework conditions.

4.1.2 Resource and land-use management

Increased industrial activity and biomass production exert growing pressure on land and sea area. There is a need to learn more about how to utilise forestry resources, productive agricultural land, uncultivated pasture, the coastal zone and cultural landscapes in a sustainable manner that balances commercial interests with conservation of resources and biodiversity. Knowledge about the impacts of government regulation and the effects of trade, industrial, coastal and land-use policies and appurtenant policy instruments is important as a basis for decision-making in the political arena. Different societal interests have somewhat divergent needs and desires in relation to the use of land/sea areas and natural resources. These interests may be in direct conflict with one another. There is a need for more knowledge about the production of public goods as a basis for the production of private goods via industrial activity. New industrial development may pose challenges to companies, public authorities and politicians alike. In this context, research-based knowledge derived from interdisciplinary activities as well as cooperation on new solutions are needed. The objective is to generate knowledge for use in developing policies that support sustainable growth and innovation in the primary and related industries.

4.2 Primary production

The BIONÆR programme will work to promote increased, sustainable production to ensure a safe and adequate food supply and to increase value creation in the agricultural sector. Increased production will require maintaining and further developing fundamental know-how to achieve more productive, resource efficient and environmentally sound production of food and other bio-based products. Effort must be made to achieve new, more efficient production cycles. Livestock production offers opportunities for agricultural activities throughout the country, including opportunities linked to the utilisation of land area that cannot be directly used for the cultivation of food plants. Ambitious targets have been set for the forestry sector, focusing on increased harvesting and attaching great importance to the vital role of the forests in climate and environmental development. Research is essential to achieving these targets. Climate change will give rise to new challenges and new opportunities, and the industrial and research communities and public authorities must join forces to address these.

Research activities must be carried out along several lines: the basis for production must be strengthened, primary production must be made more resilient to climate change, and negative impacts on the environment and biodiversity must be avoided. The latter also encompasses the

agriculture sector's most important contribution to reducing greenhouse gas emissions. Good plant and animal health is crucial to ensuring food safety and food security and provides a basis for efficient, sustainable production.

4.2.1 Soil and plants

Boosting production of plants for animal feed and human consumption will play a key role in increasing overall land-based food production in keeping with political objectives. This area encompasses everything from soil quality, soil biology and fertilisation to crop production, plant breeding and pesticide management. Integrated pesticide management will be a guiding principle underlying future research activities. Crop production encompasses plants for food and feed as well as plants not intended as food (e.g. fibre), but the "Food first" principle (see section 4.3) will apply. Production is to be sustainable, environment-friendly and be targeted towards ensuring efficiency, intensification and optimal utilisation of resources. Challenges to solve in the future include waste reduction and utilisation of side streams, preferably across value chains and sectors. Production adapted to new climatic conditions and reducing greenhouse gas emissions are key. Efforts to improve or maintain good soil quality will be essential to solving all these challenges. Technology development, including advances in biotechnology, modelling, bioinformatics and robotisation – all in conjunction with biological principles – will be important for achieving sustainable intensification and increased production.

4.2.2 Livestock

Livestock production, including reindeer husbandry, is a pillar of Norwegian agriculture, and potential changes in the livestock sector will shape the future direction of this production in terms of sustainability, the environment and preparedness.

Escalating market competition and more pressing demands for cost-effective production have been key drivers of the structural changes taking place in the agriculture sector in recent years. Livestock production is undergoing a shift towards more professionalised knowledge and technology-based operations and fewer, larger units. The transition to new, efficient production systems has an effect on animal performance, health and well-being.

Knowledge is needed across a wide range of issues, from basic knowledge to applied topics in livestock science and veterinary medicine. Ethical animal husbandry and optimal animal welfare, the One Health Initiative and antimicrobial resistance (see section 4.3.1) are also key topics for generating new knowledge.

There is a need for specific knowledge on the part played by livestock production in an environmental and climate-related context, and about circular approaches that account for increasing competition for raw materials as feed ingredients and protein sources, utilisation of residual raw materials, and different types of risk assessments relating to livestock production, including factors associated with knowledge-based preparedness.

R&D on the genetic potential in livestock animals through selective breeding techniques promotes increased food production, lower greenhouse gas emissions and better resource utilisation, in addition to enhancing the international competitiveness of the industry.

4.2.3 Forestry and wood

The past decade has seen a growing awareness of the importance of forests in society. This is due in good part to the role played by forests in a climate context in terms of carbon uptake and

storage and as a provider of renewable energy and raw materials for a wide range of bio-based products. Norway's forestry industry seeks to be an important driver behind the bioeconomy and the green transition. At the same, market conditions have led to significant downsizing in the Norwegian wood processing industry, posing major challenges to domestic sales of wood. There are also many challenges involved in striking a balance between intensifying climate and environmental measures in forests, and ensuring economic return in primary forestry as well as value creation from the entire spectrum of Norwegian wood processing.

Society's growing demand for sustainable production and optimal utilisation of raw materials will lead to greater focus on production of specific products and qualities. Forestry is shifting towards more product-adapted deliveries through sorting based on the requirements of the end product. Adaptation of wood types, genetic breeding and technology development in the production chain will create major opportunities in the longer term. Customisation of raw materials for various types of products will give rise to major research-related challenges and will require efficient, effective and environmentally sound production techniques.

A great deal of knowledge is still needed in vital segments of the value chains for wood-based construction products from forest to market. The use of wood poses challenges to the construction industry in particular, including the further development of digital tools, of recognised construction solutions that satisfy technical specifications, and of documentation of the performance of wood-based construction solutions in a closed-loop-system/circular perspective. This includes prerequisites for durability and useful life, as well as recycling and re-use of materials and life-cycle analyses. Within the wood-based value chains there are now many opportunities to further develop the use of wood in the markets for new construction, restoration and furniture/interior decor. Knowledge is needed to promote innovation, new combinations of materials, industrialisation, profitability and market orientation in wood-based value chains.

4.3 Processing, marketing and the consumer

The BIONÆR programme will promote research-based innovation in existing processing and industrial activities for food from land, feed production, use of wood and more. The programme will also promote entirely new opportunities for value creation based on bioresources. Residual raw materials will be considered on a par with primary raw materials, waste is to be avoided and cross-utilisation between resource streams must be encouraged where it leads to more sustainable and efficient ways of utilising Norwegian bioresources.

In 2015 the EU Standing Committee on Agricultural Research (SCAR) drew up the Foresight report *Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy – A Challenge for Europe*⁶. The report describes five key principles for a sustainable bioeconomy, the first of which is Food first (see section 4.3.1). The other four key principles are Sustainable yields/harvesting, Cascading approach, Circularity of biomass and Diversity (in actors and scales).

Knowledge about consumer trends is a prerequisite for further developing the food industry and industries founded on various new, bio-based products. Research under the BIONÆR programme is intended to help to provide consumers with products that are tailored to modern lifestyles and meet consumer demands relating to quality, the environment, climate, health, ethical production, etc.

⁶ [4th Foresight Exercise, Standing Committee on Agricultural Research \(SCAR\), 2015](#)

Cost-effective and transparent value chains will foster know-how in the areas of traceability, documentation, labelling systems, export market requirements and more.

4.3.1 Food

Food security for a growing population is a global challenge. One of Norway's targets is to maintain domestic market shares in food production. The food industry is based on raw materials from the agriculture and marine sectors, and close collaboration between the BIONÆR programme and related Research Council programmes with responsibility for seafood is essential (see Chapter 6). Competence-building, technology development, innovation and restructuring are of fundamental importance to ensuring competitiveness in domestic and international markets. The BIONÆR programme will promote the development of knowledge to create a sustainable, innovative and competitive food industry in Norway.

Much biomass is wasted, not least during food production. Significant knowledge-building is needed to utilise residual raw materials from the production and consumption of food, for production of non-food products. Similarly, research targeting reduced food waste is needed. This research calls for collaboration with other Research Council programmes that have responsibilities within the bioeconomy (see Chapter 6).

The BIONÆR programme will build knowledge to develop high-quality, safe, healthy and competitive agriculture-based food products that can boost value creation and self-sufficiency in Norway. This requires coordination between research activities within primary production and the food industry. Awareness of Norwegian food traditions and food culture is growing. An array of smaller players market local products, adding variety and breadth to the selection available and contributing to regional value creation.

The National Action Plan for a Healthier Diet (2017–2021)⁷ stresses the importance of knowledge about correlations between food, nutrition and health, and states that the authorities will be encouraging more research on such correlations. The BIONÆR programme, together with other Research Council programmes, will work to enhance knowledge about the health effects of various foods and food components, and the health effects of different food refinement and processing methods. The BIONÆR programme will also promote technology development and innovation that lead to healthier food products.

A more open global market entails new research challenges in the realm of food safety. A lack of knowledge may result in health risks, higher costs, a tarnished reputation, increased waste and lower value creation. More knowledge is needed to ensure that food safety regulations are rooted in scientific risk assessments. Optimal handling in the primary stage is critical to food safety, but risk factors may emerge and change during processing, storage and handling in the retail stage as food makes its way to the consumer. Non-traditional application areas, focus on closed-loop systems and cross-utilisation will also give rise to new food safety-related challenges. More knowledge is also needed about the effects that nutrients and foreign agents harmful to health have on each other.

In the National Strategy against Antibiotic Resistance 2015–2020⁸, the Government sets objectives for carrying out the efforts, which must be viewed in a One Health perspective (i.e. correlations between the health of humans, plants, fish and other animals, as well as the

⁷ [National Action Plan for a Healthier Diet \(2017–2021\)](#)

⁸ [National Strategy against Antibiotic Resistance 2015–2020](#)

environment/ecosystem). The BIONÆR programme will work to achieve the national strategy's objectives within its areas of responsibility.

To be competitive, agriculture and the food industry must ensure the availability of food through efficient, quality-preserving and sustainable distribution, logistics and transport and a well-organised retail trade. There are numerous issues that require further study in this area.

4.3.2 Feed

The demand for suitable, effective feed ingredients is climbing, while the availability of marine resources for use in feed is dropping. Meeting this demand and the need for feed in the livestock industry is an area of untapped potential.

Norway produces a large amount of plants and residual raw materials from food production, etc. that are used as ingredients in animal and fish feed. Research has made it possible to gradually increase the proportion of vegetable ingredients in fish feed, but there is still much to learn about this cross-utilisation. Research is needed on processing, on the relationship between feed and the quality of the end product, and on health perspectives, consumer understanding, and more.

With the help of knowledge-building across a wide spectrum and radical innovations involving the use of biotechnology, for example, it is expected that tree fibre can become an important feed resource, with major potential in the global market.

Another resource that is little-utilised in Norway is insects, which in other parts of the world are used in fish and animal feed, as well as food for human consumption. Norway now permits insect-based additives in fish feed. Overall there is growing demand for "climate-friendly protein" and there is potential for insect-based industrial development in Norway.

4.3.3 Innovative bio-based products

Advances are being made in the development of new bio-based products by refining or processing all types of biomass. Today these types of products often compete on the market with petroleum-based products. ICT, nanotechnology and biotechnology open up new vistas for the development of new products based on fibre, wood, cellulose and residual marine and terrestrial raw materials.

The BIONÆR programme will focus on innovative products based on biological raw materials, residual raw materials and biological processes from land-based sectors. Products must be primarily designed for use in the value chains for wood, food and feed. Funding is also available for research targeting applications beyond these value chains through cooperation with other Research Council programmes. R&D targeted towards specific products, implementation of know-how and practical application of ICT, nanotechnology and biotechnology with the aim of expanding utilisation of biomass lies within the scope of the BIONÆR programme. The programme has special responsibility for research to identify new ways of utilising residual raw materials from land-based biological primary production. The collection and use of residual raw materials as ingredients in fish feed, pharmaceuticals, health food products, etc., require extensive knowledge-building and application of new technologies. Basic research in these areas as well as research related to products based on wood/cellulose is funded under other programmes at the Research Council (please refer to Chapter 6).

4.4 Service-based value creation

The agriculture industries manage resources (buildings, landscape, uncultivated land, genetic resources, culture, etc.) of major significance for employment and industrial development

throughout the country. Norway's abundance of resources provide a basis for the development of new, more diverse industrial activities that will help to bolster competitiveness.

4.4.1 Outdoor activities and the tourism industry

The Norwegian coastal and cultural landscape and deep-rooted cultural traditions are enormous assets for tourism, settlement and local value creation. Uncultivated land and coastal resources form the basis for sustainable production, products and recreational activities that are unique on the national as well as the international market. There is potential for creating stronger links between tourism and local food, cultural landscape and uncultivated land, and between agriculture, aquaculture, fisheries, reindeer husbandry, other industries and the tourism industry. There is a need for more professionalisation, market orientation and cooperation. Further development of the tourism industry must be economically, environmentally and socially sustainable.

This area encompasses fishing and hunting tourism, rural tourism, culinary traditions and general tourism, nature guiding, outdoor recreational activity, and sports animals and pets. Norwegian culinary traditions need to be disseminated, developed and made available in the context of the tourism industry in relation to national and international demand. The nature and culture-based tourism industry needs know-how to increase professionalisation, innovation capacity and profitability. Key challenges in the area of culture-based industrial development and value creation are the preservation of cultural landscape, public goods, identity and quality of life. With regard to outdoor recreational activity, there are growing challenges and opportunities related to e.g. cultivating and commercialising the use of natural public goods, and the public right of access to and accessibility of outdoor recreational areas. Combining the sale of hunting and fishing experiences together with the sale of wild game and fish offers new opportunities which can help to create a more complete experience and enhance value creation. Digitalisation and knowledge about business models and pricing will be valuable for realising increased sustainable production.

In a field as multifaceted as this, effective coordination of instruments is needed, both instruments of a regional nature and more direct industrial policy-related measures.

4.4.2 Health and care

Health, welfare and care services represent a growing segment of the agriculture industry, and promote sustainable value creation through opportunities for a wider variety of production forms.

Green care services and multifunctional farms and forestry play a key role in utilising agricultural resources in new ways to promote welfare policy objectives for e.g. the educational and health sectors. This extensive field of research encompasses farms as arenas for learning, rehabilitation and activity, including therapeutic measures, and forests and other natural landscapes as arenas for rehabilitation, recovery and positive experiences. This calls for cooperation with health-related programmes at the Research Council (see Chapter 6).

5 Priorities for structuring the research effort

5.1 Work forms

The BIONÆR programme will promote the bioeconomy by encouraging and funding research that will help to increase the level, profitability and sustainability of production in the bio-based industries that use agricultural and land-based biological resources. The research funded must help to solve specific industry challenges, as well as give consideration to various areas of interface with society at large. In order to address the most pressing societal challenges the programme will incorporate perspectives such as *closed-loop-system/circular thinking*, *sustainability* and *value creation* into all of its activities. In its ongoing priority setting, the programme will take into account that the interaction between research, technology and society is continually changing and that sustainability and climate-related considerations must remain a key focus. This will call for extensive use of dialogue and communication activities, among other things.

The programme must lay a foundation for new constellations and forms of interaction within the research community and between the research community and industries/companies, the public authorities and consumers. This will call for the capacity and willingness to be flexible when it comes to new ways of working, new meeting places and new networks. A targeted effort will be made to develop work forms for funding and organising research activities that address needs and challenges. The programme will also work to ensure adequate recruitment to agricultural and food science subjects.

The BIONÆR programme will initiate state-of-the art reviews and evaluations of the programme. To promote long-term competence development, the programme will issue annual funding announcements for Researcher Projects that encompass the entire programme scope, and will define thematic priority areas based on scientific input from research groups, political guidelines from the funding ministries and the composition of the project portfolio at any given time.

Social dialogue and meeting places

The BIONÆR programme will organise forums for dialogue between industry stakeholders, industry organisations, research groups and the public authorities. The programme will work to increase participation on the part of the business sector and to give the programme a more visible profile in various environments.

Effective science communication and dissemination and utilisation of research results pose a significant challenge, but are essential to achieving programme objectives. Communication and dissemination activities via channels such as webpages, newsletters and meeting places will therefore be an integral part of the programme's activities. At the same time, the programme will help to ensure that the researchers themselves draw up effective dissemination and communication plans, among other things by making these a requirement in its funding announcements.

5.2 Funding instruments

The programme will base its selection of funding instruments on the need to ensure predictability for users and a suitable balance between Researcher Projects and Innovation Projects. Given that the bioeconomy extends far beyond the BIONÆR programme's area of responsibility, close cooperation with related programmes, such as in the form of joint funding announcements, will also be critical. (Please also see Chapter 6.)

Long-term competence development

Addressing the challenges that the BIONÆR programme is designed to help solve will often call for knowledge-building across subject areas and disciplines. The main channel for long-term research under the programme will be large-scale, interdisciplinary Researcher Projects, which can encompass both industry-oriented research and more strategic basic research. Knowledge-building to meet the needs of industry and the public administration can also be integrated into these large-scale projects. The projects must be organised in a manner that promotes user participation and the flow of information within the project itself. Encouraging cooperation between large and small stakeholders is an important instrument for boosting value creation.

In cases where the research questions are narrower, or where for various reasons it is not expedient to conduct large-scale projects, the programme will fund projects of smaller scope. Narrower research questions will also be addressed through international cooperation and joint funding announcements. Support for such research may also be sought from other funding sources, such as the FRIPRO funding scheme for independent projects and the regional research funds.

User-driven research

User-driven research is important both for increasing value creation and for helping to find solutions to the Grand Challenges. The programme will fund Innovation Projects to encourage companies in all segments of the value chains to step up their research efforts. To be eligible for funding, Innovation Projects must address topics within the programme's area of responsibility; normally there will be no other thematic limitations. The Research Council issues funding announcements for innovation projects at the same time to ensure that grant proposals are directed to the programme which offers the best fit. In cases where there is a need for a funding announcement within a topic extending beyond the scope of the BIONÆR programme, a joint funding announcement with related programmes will be considered.

The BIONÆR programme will also further develop cooperation with Innovation Norway by issuing joint funding announcements for pre-projects, among other things.

Other funding instruments

Other funding instruments include support for events, funding to enable Norwegian actors to position themselves in the competition for international funding, mobility grants, network-building measures, funding for pre-projects, Idélab workshops/innovation camps, certain types of courses, etc. All of these instruments involve limited financial awards. The programme will continually assess the need to employ these types of instruments, as well as the opportunities for cooperating with other Research Council programmes and the other agencies in the research and innovation system.

6 Cooperation with related instruments

6.1 Cooperation within the Research Council

The BIONÆR programme's broad collaborative interface is well aligned with the Government's bioeconomy strategy (2016), which states that cooperation is to be coordinated across relevant instruments within the Research Council. The Research Council is focusing on research related to the bioeconomy across a broad spectrum. The BIONÆR programme will be a key component in this, but other thematic programmes, programmes on generic technologies and international initiatives and programmes will have important roles to play as well. Active use will be made of coordinated initiatives, joint funding announcements and other forms of collaboration. The Research Council will attach importance to close, systematic cooperation and offering users the greatest possible flexibility. Joint dialogue with users and joint strategic planning and funding announcements are relevant measures in this context.

Blue-green opportunities in research and innovation comprise one of the most important topics for cross-cutting collaboration. Strategic, ongoing cooperation with the marine research programmes – [the Large-scale Programme on Aquaculture Research \(HAVBRUK\)](#) and [the Research Programme on Marine Resources and the Environment \(MARINFORSK\)](#) – will be of key importance in this context. Systematic cooperation will also be established between the BIONÆR programme and the programmes targeted towards the application of new technology: the Research Programme on Biotechnology for Innovation (BIOTEK2021), the Research Programme on Nanotechnology and Advanced Materials (NANO2021) and the IKTPLUSS initiative for ICT and digital innovation (IKTPLUSS). There are grey areas to be found in thematic areas shared between the various programmes, and the Research Council will determine the distribution of responsibility in specific areas on an ongoing basis. In many cases, strengthening cooperation between relevant programmes will be a good way of ensuring adequate research funding in these grey areas. Suitable topics for cooperation are found in particular in new, innovative fields of knowledge, e.g. residual raw materials with multiple applications (several programmes), algae and feed (the HAVBRUK2 and MARINFORSK programmes), and bioplastics (the Programme for User-driven Research-based Innovation (BIA)).

Other relevant topics for ongoing cooperation between programmes include food and health (the Research Programme on Better Health and Quality of Life (BEDREHELSE)), the environment and climate (the Programme for Environmental Research for a Green Transition (MILJØFORSK) and the Large-scale Programme on Climate Research (KLIMAFORSK)), bioenergy (the Large-Scale Programme for Energy Research (ENERGIX)), as well as urban research, urban agriculture, etc. (various programmes). For the BIONÆR programme this generally applies to topics in the interface between land-based primary production, processing and application in areas which lie outside the sphere of responsibility of the funding ministries.

The BIONÆR programme will also assess on an ongoing basis the need for cooperation with funding instruments for research infrastructure and international cooperation in education, as well as with funding instruments that increase participation on the part of the business sector and actively promote commercialisation of research results and boost research and innovation activity within companies.

6.2 Cooperation with other agencies in the research and innovation system

The Research Council and other public funding instruments can complement each other with regard to research and application/implementation in the area of the bioeconomy. Cooperation has been established with Innovation Norway and Siva in this area. In the areas of food and forestry/wood, the industry-specific funds are of major importance and help to finance research activities aimed at achieving common industry goals. In the area of forestry/wood there are three different funds: the Forest Research and Development Fund, the Forestry Development Fund and the forestry industry's value creation fund (Skogbrukets verdiskapingsfond). In the area of food, there is Research Funding for Agriculture and Food Industry, which comprises funding from the Foundation for Research Levy on Agricultural Products (FFL) and the Agricultural Agreement Research Fund (JA). The BIONÆR programme collaborates closely with the FFL and JA on annual joint funding announcements for Innovation Projects and on providing supplementary funding and/or establishing the thematic focus for Researcher Projects. Importance will also be attached to productive dialogue and relevant cooperation with the regional research funds. An effort will be made under the BIONÆR programme to enhance cooperation and coordination with all of these funds to ensure optimal task-sharing and integrated activities to the benefit of the industries.

6.3 International cooperation

Effective distribution of tasks between national and international R&D funding sources is crucial to creating a thriving bioeconomy that can effectively address the Grand Challenges. The programme will actively promote international cooperation, particularly when it will improve the quality of knowledge-building or encourage more or better innovation in trade and industry, in keeping with the Research Council of Norway's Strategy for International Cooperation and the objectives set out in the Government's *Long-term plan for research and higher education*. The BIONÆR programme will attach great importance to this. The role of the bioeconomy is emphasised in most of the strategy documents and processes that comprise the framework and agenda for international research cooperation. The BIONÆR programme administration will actively follow up ongoing and future initiatives on its own or in cooperation with other segments of the Research Council administration.

Norway is a participant in two European Joint Programming Initiatives (JPIs) of relevance to the BIONÆR programme: Agriculture, Food Security and Climate Change (FACCE-JPI) and A Healthy Diet for a Healthy Life (JPI HDHL). The EU framework programmes for research are of major importance to the BIONÆR programme. Detailed information will be provided to users on developments under relevant programme sections. National funding of large-scale, interdisciplinary collaborative projects with user and industry involvement will also help to raise the calibre of Norwegian research groups, thereby enabling them to participate in projects under the framework programmes.

Other key instruments for promoting international cooperation will be participation in joint calls for proposals across national boundaries; for example, joint calls under the ERA-NET scheme, joint Nordic calls, and bilateral calls under the auspices of the BIONÆR programme itself or as part of funding announcements issued centrally by the Research Council. The programme will take active part in ERA-NET calls and calls issued under the auspices of the Nordic organisations NordForsk and Nordic Innovation. The programme will also participate in *Nordic cooperation* under the Nordic Joint Committee for Agricultural Research (NKJ).

The programme will employ instruments to support institution-to-institution collaboration in cases where creating ties between Norwegian research groups and institutions in selected countries will strengthen knowledge-building in Norway. The need to implement specific measures to promote participation in international cooperative efforts will be assessed on an ongoing basis. Funding to enable Norwegian actors to position themselves in the competition for international funding and incentive schemes will be relevant in this context.

The BIONÆR programme will attach importance to international cooperation in its budget and its project portfolio. The focus and scope of this collaboration will be reviewed prior to the issue of each funding announcement and will be clearly expressed in the funding announcements themselves.

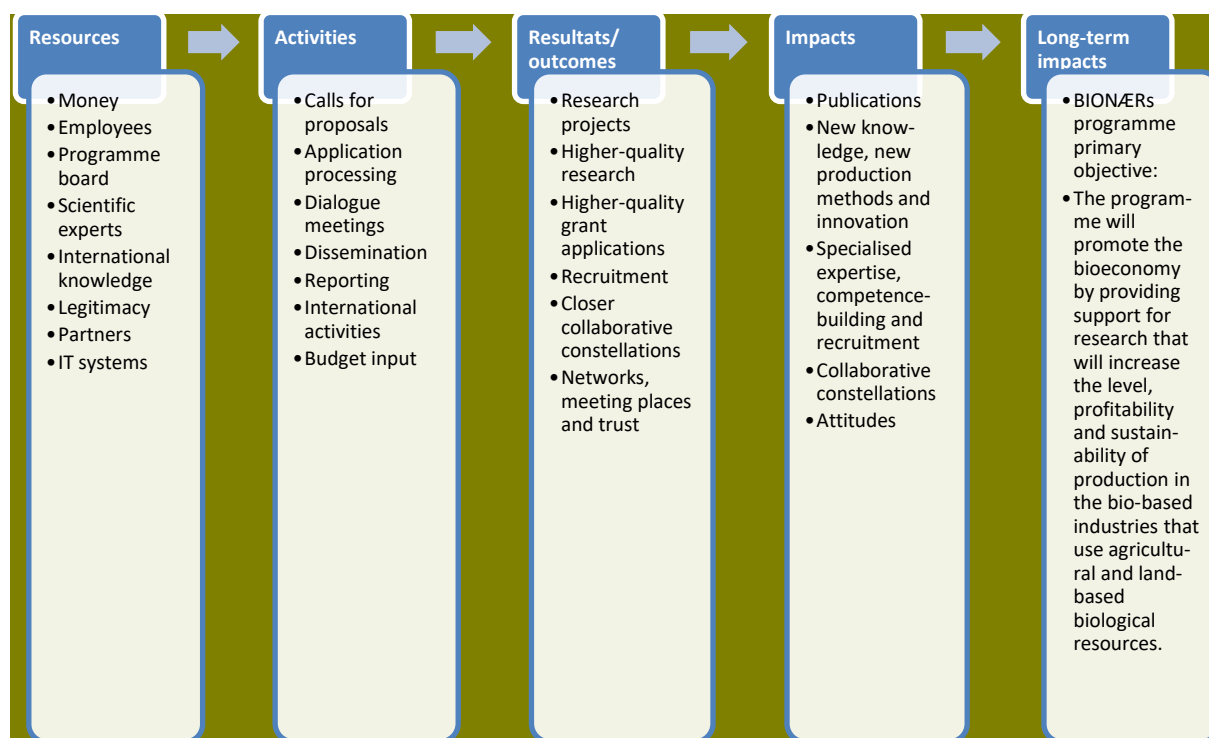
7 Anticipated results, impacts and societal outcomes

The formative evaluation of the BIONÆR programme (2013–2017) includes a customised programme theory model, a programme logic model (see figure below) and accompanying Management by Objectives system. The programme theory focuses on the purpose of an activity, which objectives apply, which measures to implement in order to achieve those objectives, and which assumptions on causal relationships form the basis for selecting measures.

This creates a basis for measuring the extent to which resources, activities and results in the BIONÆR programme are aligned with the programme’s overall objectives. The indicators in the management-by-objective system comprise data from the BIONÆR programme’s project portfolio, the survey of project managers and partners, and standard performance quantifying measures from the projects. The indicators are organised in relation to the BIONÆR programme’s primary and secondary objectives. When it comes to measuring impacts and societal outcomes, which is the most difficult methodologically, the strength of the management-by-objective system lies in that it makes a comprehensive assessment possible based on a combination of different kinds of data and indicators.

Communication and dissemination activities are essential to achieving BIONÆR programme objectives. Evaluation of results, impacts and societal outcomes from the programme must seek to document the benefit that the funded R&D&I has had for industry, the public authorities, competence development and society at large.

BIONÆR programme logic model.



8 Resources and budget

In 2015, a total of NOK 2.4 billion was used on agricultural and food-related R&D, accounting for 4 per cent of Norway's total R&D expenditure. Trade and industry's R&D expenditures exceeded NOK 1 billion, as did the research institute sector's, while universities and university colleges invested NOK 330 million in R&D.

The BIONÆR programme participates in a variety of international initiatives and joint funding announcements within the programme's thematic areas of responsibility, such as forestry and wood products industries, sustainable livestock production, agriculture and food processing, organic foods, and pesticide management. On average, a budget of approximately NOK 10 million is provided per initiative or joint funding announcement. Annual budgets typically in the range of NOK 15–30 million are provided for targeted international initiatives, but these amounts vary considerably.

8.1 Long-term budget

The BIONÆR programme's budget for 2017 is comprised of the following allocations (rounded up to nearest NOK million):

- Ministry of Agriculture and Food: NOK 215 million
- Ministry of Education and Research: NOK 9 million.

The BIONÆR programme's long-term budget over five years:

	2017	2018	2019	2020	2021
Disposal budget	274 755	232 372	191 926	182 036	201 559
▷ Revenues	245 069	251 069	247 069	235 069	225 069
▷ Expenditures	293 451	287 515	244 959	205 546	213 141
Provisions/transfers	-18 697	-55 143	-53 033	-23 510	-11 582
Provisions/transfers to disp. budget	-7%	-24%	-28%	-13%	-6%
Planned allocations	200 000	160 000	210 000	230 000	230 000

In the long term, budget expenditures are planned to cover all the programme's thematic areas of responsibility.

9 Governance and organisation

The programme board of the BIONÆR programme 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 schedule for funding announcements. The programme board's activities must also 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.

A list of the members of the programme board as well as other relevant information may be found on [the programme webpages](#).



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Publisher:

© The Research Council of Norway
Sustainable Innovation in Food and
Bio-based Industries– BIONÆR
www.rcn.no/bionaer

June 2018

ISBN 978-82-12-03665-9 (pdf)

Design cover: Melkeveien Designkontor AS

Photo cover: Shutterstock,

John Yngvar Larsson/NIBIO, Adigo AS

Translation by: Victoria Coleman/Darren
McKellep/Carol B. Eckmann