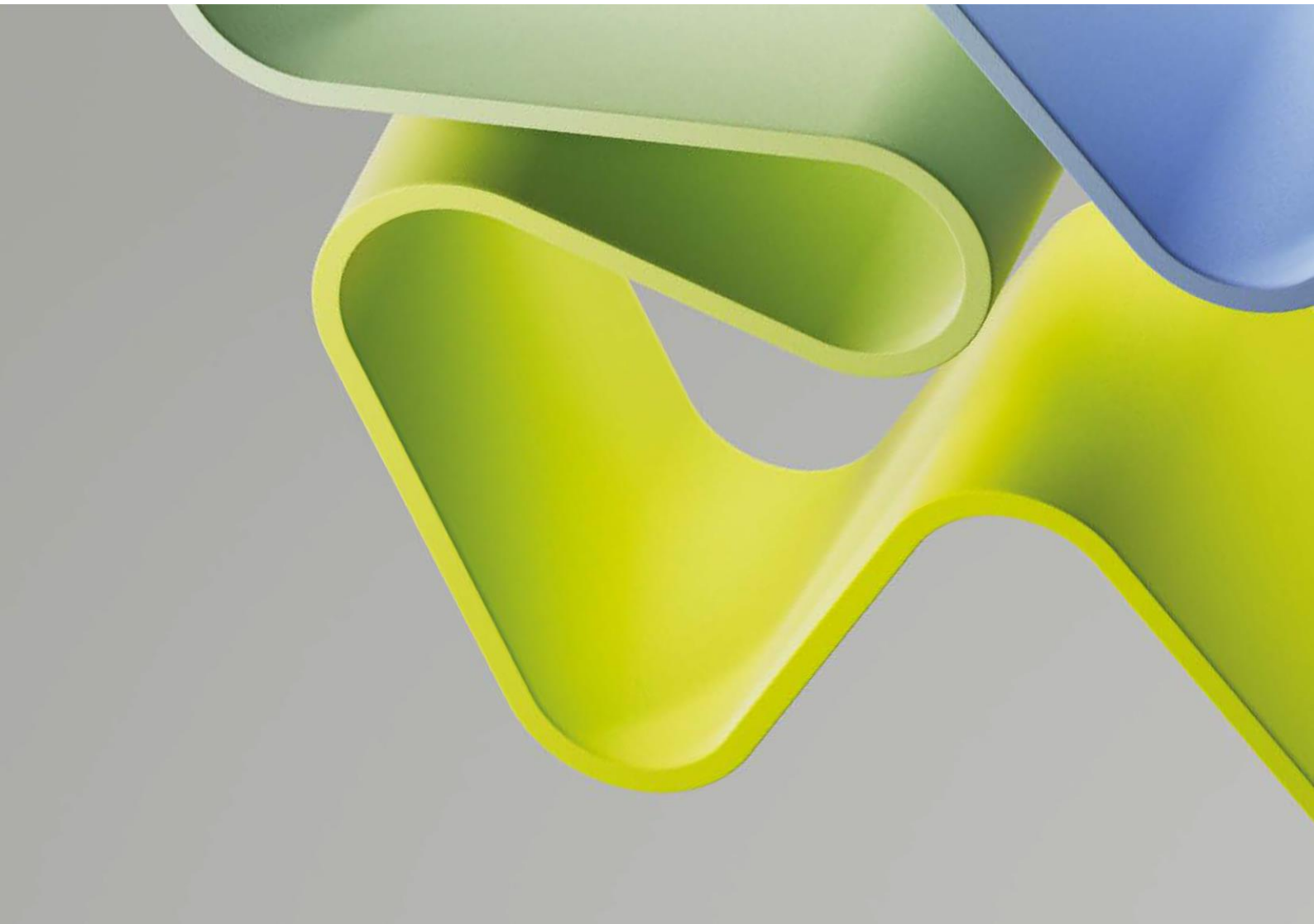
The Research Council of Norway

Evaluation of Life Sciences 2022-2024

National report

Evaluation of Biosciences in Norway 2022-2024

March 2024



Contents

Preface by the Research Council of Norway

The Research Council of Norway (RCN) has been given the mission by the Ministry of Education and Research to perform subject-specific evaluations. The RCN carried out an evaluation of Norwegian research within Biosciences in 2022-2024. The evaluation of Biosciences is a part of the evaluation of life sciences, which is being carried out as two evaluations: Evaluation of Biosciences 2022-2024 and Evaluation of medicine and health 2023-2024.

The primary aim of the evaluation of Biosciences is to identify and confirm the quality and the relevance of research performed at Norwegian Higher Education Institutions (HEIs) and across the Institute Sector.

The evaluation was carried out by international peers with reference to the Evaluation protocol for life sciences in Norway 2022-2024.

The evaluation has been done at three levels. First, ninety-seven research groups were evaluated by five expert panels divided by subjects and disciplines within the field of Biosciences (mainly non-human topics) across sectors. Thereafter, three evaluation committees were established to evaluate the 22 participating administrative units (faculty/institute/department/centre). The assessments and recommendations from the evaluation committees are compiled in 22 reports. These reports give important input to the individual administrative units. Each administrative unit has a responsibility to follow up on the recommendations provided in their evaluation unit report. The chairs of the three evaluation committees constitute the National Evaluation Committee which was requested to compile a report based on the assessments and recommendations from the 22 independent evaluation unit reports. The national report will be used by the Research Council in developing national funding schemes and in dialogue with the ministries and institutions involved in the development of bioscience research.

The national report pays specific attention to:

- Strengths and weaknesses of the research area in the international context
- The general resource situation regarding funding, personnel, and infrastructure
- Ph.D. training, recruitment, mobility, and diversity
- Research cooperation nationally and internationally
- Societal impact and the role of research in society, including Open Science

This national report offers an overall assessment of the state of the research involved. All committee members support the conclusions and recommendations presented here concerning the future development of Biosciences research in Norway.

Lysaker March 1st 2024

Executive summary

This is the report of the National Evaluation Committee, which was asked by the RCN to evaluate Bioscience research in Norway over the period 2011-2021 to identify and confirm the quality and the relevance of research performed at Norwegian Higher Education Institutions (HEIs) and across the Institute Sector. The report builds on the previous evaluations of 97 research groups and 22 administrative units in this research field, which were carried out in 2023 and documented in separate reports.

Biosciences is an important research field for Norway. Biosciences includes fisheries, aquaculture and ecological research with a focus on understanding and monitoring nature and biodiversity as well as the consequences of human activities, including the effects of climate change. It further includes other, mainly biotechnological, research for food and non-food applications.

The administrative units (these included Norwegian Institutes or components of such Institutes, as well as University Departments, Faculties, or Centres) were evaluated based on five criteria. These were Strategy, resources and organisation, Research production quality and integrity, Diversity and equality, Relevance to institutional and sectoral purposes, and Relevance to society. The evaluation of the administrative units built on the assessments of the 97 research groups. Norwegian research is generally considered good, with a few of the research groups evaluated as very good or excellent in an international comparison and a few rated below the bar. At the administrative unit level, there were examples of societal impact and cooperation between the HEIs and Institute Sector.

The generous and constant core funding for the HEIs, the availability of excellent research infrastructure and long-term datasets in several critical areas (e.g. fisheries, seabirds) are considered strengths of Norwegian research. Weaknesses are the general lack of a strategic approach at all levels of the research system (which has led to a scattered research landscape), the low basic funding of the Institute Sector and the museums, the general low performance in (international) competitive research programmes, the low international visibility of Norwegian research, and the ageing population of the research staff. Although there are many publications with Norwegian co-authors outside their own organisation, and even more with international co-authors, there seems to be space for increasing the diversity of the international collaborators and for cooperation with internationally leading groups.

There is no doubting the societal impact that Biosciences research in Norway has. Administrative units that support the regulation of major industries, such as wild fisheries and aquaculture, have a very direct societal impact, while other administrative units are providing a key Norwegian presence at international negotiations as well as providing the evidence base used by regulators and the national government. This is exemplified in many of the impact cases presented by the administrative units. That said, there is a tendency to use apparent drivers, e.g. the UN Sustainable Development Goals (SDGs), as hooks to justify the research without clearly showing how the research will help achieve delivery and thus societal change. In some respects, there was a disappointing lack of a sense of urgency associated with the climate and biodiversity crises, both of which will have a profound impact on Norway.

Eight recommendations that could lead to increased quality and further impact (see Chapter 7 for full details):

- *Make sure all administrative units in this research area have coherent and synergistic strategies and implement mechanisms to coordinate them on the national level. A national strategy on Biosciences could help.*

- *Create, through clear strategies, more direction and critical mass in the HEIs and Institute Sector as a whole, to achieve excellence in science.*
- *Increase incentives to use the core funding to win additional competitive funding.*
- *Generate incentives and programs to foster collaboration, both nationally and internationally.*
- *Continue the support for Research Infrastructures and optimise their use.*
- *Generate incentives and programs to make use of scientific results and increase economic and societal impact.*
- *Establish measures for a stronger talent pipeline, combining domestic education and hiring of international staff.*
- *Make use of science advisory boards to provide external review, advice and assistance with developing the strategies.*

Sammendrag

Dette er rapporten fra den nasjonale evalueringskomitéen i EVALBIOVIT, som på oppdrag fra Forskningsrådet er bedt om å evaluere norsk biovitenskapelig forskning for å identifisere og bekrefte kvalitet og relevans av forskning utført ved norske høyere utdanningsinstitusjoner (HEI) og på tvers av instituttsektoren i perioden 2011-2021. Rapporten bygger på evalueringer av 22 innmeldte administrative enheter og inkluderer evaluering av deres tilsammen 97 forskningsgrupper. Evalueringen ble gjennomført i 2023.

Biovitenskapelig forskning er et viktig forskningsområde i Norge som omfatter fiskeri og akvakultur, økologisk forskning med fokus på forståelse og overvåking av natur og biologisk mangfold og konsekvensene av menneskelige aktiviteters effekter på klimaendringer samt bioteknologisk forskning på mat og andre applikasjoner.

De administrative enhetene (fakultet, institutt, avdeling, senter) ble evaluert i henhold til de fem evalueringskriteriene: strategi, ressurser og organisering, forskningskvalitet -og integritet, mangfold og likestilling, relevans for institusjonelle og sektorielle formål og relevans for samfunnet. Evaluering av de administrative enhetene bygger på ekspertvurderingene for de 97 forskergruppene på tvers av de tre evalueringsdimensjonene organisering, forskningskvalitet og innvirkning på samfunnet. Norsk biovitenskapelig forskning vurderes som generelt god. I et internasjonalt perspektiv vurderes noen forskergrupper som svært gode, mens noe få forskergrupper vurderes til å være under streken. Evaluering av de administrative enhetene viser at det finnes eksempler på hvilke påvirkninger på samfunnet de administrative enhetene har og at det er samarbeid mellom administrative enheter tilhørende HEI og instituttsektoren.

Styrkene ved norsk biovitenskapelig forskning er den generøse basisfinansieringen til universitet- og høgskolesektoren, tilgjengelighet til utmerket forskningsinfrastruktur og langsiktige datasett på flere kritiske områder (f.eks. fiskeri og sjøfugl).

Svakheter er den generelle mangelen på strategi på ulike nivåer i forskningssystemet (som medfører et spredt forskningslandskap), lav basisfinansiering til instituttsektoren og museene, generell lav innvilgelse i (internasjonalt) konkurransedyktige forskningsprogrammer, lav internasjonal synlighet av norsk biovitenskapelig forskning og en aldrende forskerstab. Selv om det er mange publikasjoner med norske medforfattere utenfor egen organisasjon, og enda flere med internasjonale medforfattere, synes det å være rom for å øke mangfoldet av de internasjonale samarbeidspartnerne og øke samarbeid med internasjonalt ledende grupper.

Det er absolutt ingen tvil om at norsk biovitenskapelig forskning har og bidrar til viktige endringer i samfunnet. De administrative enhetene som støtter regulering av de store næringene som viltfiske og akvakultur har en svært direkte samfunnsmessig påvirkning, mens andre administrative enheter bidrar med sentral norsk tilstedeværelse i internasjonale forhandlinger og med viktig dokumentasjon og kunnskapsgrunnlag som brukes av regulatorer og nasjonale myndigheter. Dette er eksemplifisert i mange av impact casene som de administrative enhetene har sendt til evalueringen. Når det er sagt, er det en tendens til å bruke åpenbare drivere f.eks. innfrielse av FNs bærekraftsmål (SDG) for å rettferdiggjøre forskningen uten å tydelig vise hvordan forskning faktisk bidrar til endringer i samfunnet. I noen tilfeller var det en skuffende mangel på fokus på at det haster å få knyttet forskningen til klima- og biologiske mangfoldskriser, som begge vil ha en dyp innvirkning på Norge.

Åtte anbefalinger som kan bidra til å øke kvaliteten på norsk biovitenskapelig forskning og bidra til ytterligere påvirkning:

- *Sørge for at alle administrative enheter har en strategi samt se på behovet for å koordinere strategiene på nasjonalt nivå. En nasjonal strategi for biovitenskap forskning kan bidra til dette.*

- *Skape, gjennom helhetlige og klare strategier, retning, økt fokus og kritisk masse for å oppnå høy vitenskapelig kvalitet på biovitenskapelig forskning i HEI og i instituttsektoren.*
- *Utvikle insentiver slik at basisfinansiering benyttes til økt innvilgelse på den internasjonale konkurransearenaen.*
- *Utvikle insentiver og programmer for å fremme samarbeid, nasjonalt og internasjonalt.*
- *Videreføre støtte til og optimalisere bruk nasjonal forskningsinfrastruktur .*
- *Utvikle insentiver og programmer for økt bruk av vitenskapelige resultater og øke økonomisk og samfunnsmessig påvirkning.*
- *Etablere tiltak for en sterkere talentpipeline som kombinerer norsk utdanning og internasjonal ansettelse.*
- *Opprettelse av vitenskapelige råd for ekstern gjennomgang, råd og bistand med å utvikle strategier.*

Det er det engelske sammendraget som er det gjeldende.

1. General observations on Norwegian Biosciences

Over the period 2011-2020 the expenditure on Research and Development (R&D) in Norway increased from 1.65% of Gross Domestic Product (GDP) to 2.24% but decreased in 2021 to 1.94%.[1] With this expenditure, Norway is far behind leading countries in the world (Israel and Korea) that spend approximately 5% of GDP on R&D, as well as behind the leading European countries that are all above 3% (Belgium, Sweden, Switzerland, Austria and Germany) and even below the EU average of 2.3%. Norway has set itself a target of 3% of GDP for R&D expenditure by 2030 and originally aimed at reaching this target by 2020.

In absolute terms the Norwegian expenditure on R&D in 2021 was about 80 billion NoK. At that time there was a total of 51,659 Full Time Equivalents (FTEs) working in R&D in Norway.[2]

The (public) research in (non-medical) Biosciences in Norway covered in this evaluation (period 2011-2021) is estimated to cost 5.5 billion NoK[3], therefore almost 7% of the total R&D in Norway. Participation in the EVALBIOVIT evaluation was voluntary, but most research organisations active in the field had their relevant research groups and administrative units evaluated. In total 97 groups from 22 administrative units participated. These were embedded in 5 institutes (IMR, NINA, NOFIMA, NPI and SINTEF) and 8 universities (NMBU, NORD, NTNU, UiA, UiB, UiO, UiS and UiT). Four of the administrative units evaluated were museums (Bergen, Oslo, Trondheim and Tromsø). With the large number of, in an international context, comparatively small research groups across many different organisations, the Norwegian research landscape in the Biosciences is rather diverse and decentralised.

A total of approximately 4,700 staff members (of which 1,932 were from the Institute Sector) are included in this evaluation. According to Statistics Norway[4] of these 4,700 staff, 1,591 are researchers in the HEIs and 1,285 are researchers in the Institute Sector (meaning that just under 40% of staff within the administrative units are not considered to be a researcher but were administrative and technical staff).

In comparison with other research areas, the role of the Institute Sector in the non-medical Biosciences is relatively large. The research in this evaluation covers approximately 15% of all university research in Norway and 18-19% of all research in Norwegian science institutes.

Around 45% of the funding is base funding by the Norwegian government; slightly above 60% for universities and slightly below 30% for institutes[5].

The research in Biosciences in Norway has three, partially overlapping, themes:

- Fisheries and aquaculture. Norway's industry is world leading in this area.

[1] R&D and GDP data based on Worldbank. The drop in R&D% in Norway in 2021 is mainly caused by a sharp increase in GDP. In absolute terms the expenditure on R&D increased with 5% in 2021

[2] Continued growth in Nordic R&D | Forskningspolitikk | Forskningspolitikk (fpol.no))

[3] Based on the specification of the various administrative units. Turnover figures were not available for all university admin units. For those units where no figures were available the turnover was estimated by multiplying the number of staff by the average turnover per head at the university admin units for which figures were available (962 kNoK/head)

[4] Analysis of Statistics for use in the evaluation of Biosciences in Norway - Analysis of research personnel in 2013, 2017 and 2021, Kristoffer Rørstad, Kaja Wendt, Statistics Norway, Oslo, 2022, ISBN 978-82-587

[5] Depending a on how IMR is counted: Infrastructural investments are counted as base funding, the rest as government assignment

- Ecological research, focusing on understanding and monitoring nature and biodiversity (including research from the natural history museums) and the consequences of human activities, including the effects on climate change. Here research on the effects of aquaculture and fisheries on biodiversity and fish health is an important theme, as is research on the environmental effects related to energy extraction. Polar research is also an important topic in this thematic area.
- Other mainly biotechnology research for food and non-food applications (food and feed production, agriculture, bioeconomy). In an international perspective, the size of research in this domain seems rather limited.

2. Strength and weakness of Norwegian Biosciences research in an international context

All research groups participating in this evaluation were assessed along 3 dimensions. Each dimension was graded with a numerical score on a scale of 1 (worst) to 5 (best):

- Organisation (How adequate the organisational environment is in supporting the production of excellent research).
- Quality (Research and publication quality/Research group's contribution).
- Societal impact dimension (Research group's societal contribution/User involvement) and user interaction.

Thirteen of the groups, distributed across the HEIs and Institute Sector, have outstanding organisational quality (score 5/5). Eight research groups, again distributed across the HEIs and Institute Sector, have very modest organisational quality (score 2/5). There is a strong correlation between organisational quality and research quality.

Norwegian bioscience research publishes above the global average with an average Mean Normalised Citation Score (MNCS - an MNCS value of two means that the publications of a country have been cited twice above the average of their field and publication year) of 1.17 in 2020 and in line with most Western countries. This is confirmed by the number of publications that are in the top 10% cited for their fields (about 10%). From the perspective of other countries, Norway is a strong research country, with a few units or groups in the lead in the world, including agricultural research, fisheries research and zoology, which are particularly highly cited.

During the earlier phases of this evaluation, the average quality of the research across all research groups was rated between "internationally recognised" and "internationally excellent". Seventeen (out of the 97 research groups assessed) are considered outstanding (i.e. internationally in the forefront of research in their area, score 9/10 or 10/10 for the quality dimension). Four groups are below the level of being internationally recognised (score 5/10 for the quality dimension). University groups score slightly better in this perspective than those from the Institute Sector.

On the societal impact dimension, the variation in the scores is higher. Most of the groups show impact that is, according to the panel evaluators, on a par with what is expected from groups in the same domain internationally. Thirty-three groups score (significantly) better (score: 8/10 or higher) but 19 are below par (5/10 or lower). On average, the Institute Sector groups have better scores on the impact dimension than the university groups, and there are more Institute Sector groups that score above par in this dimension.

Overall, combining the three dimensions, the quality of the research groups is generally good, with a few research groups evaluated as very good or excellent in an international comparison (10 out of 97 score 22/25 or higher), and a few rated below the bar (11 out of 97 score 14/25 or lower).

Most evaluated administrative units do not seem to have international comparators in their focus. When asked for a benchmark[6] they generally did not mention an international group or organization with which they compared themselves.

A clear strength of the research system in Norway is the generous and constant core funding for the HEIs. Most HEI administrative units reported between 50 and 70% core/state funding, which is high in an international comparison and provides them with the freedom to undertake visionary and curiosity-driven research projects. Some of the groups do use the funding to create a good position when applying for external funding (competitive grants or other competitive funding) and attain up to 70% external funding. This shows that there are possibilities for growth for the remaining units. The Institute Sector, however, has less basic funding and has seen the absolute value of the funding go down. It will thus be important for Norway to decide strategically on the role of the Institute Sector, e.g., related to long-term government research contracts.

A further strength of the Norwegian system is the availability of excellent research infrastructure in the HEI and Institute Sectors. These range from state-of-the-art molecular screening platforms (mass spectroscopy, genomics, sequencing) over imaging (microscopy) to research vessels, research farms, a centre for plant research in controlled climates, a bio-refinery, veterinarian facilities, and a unique research food factory (FoodPilotPlant at campus Ås). The museums have access to and contribute to building important databases on plants and animals. The fact that many of these large research infrastructures are available as technology platforms for shared use is particularly positive and allows Norwegian science to accomplish more and be more cost-effective.

Norway has been conducting long-term research in several critical areas (e.g. fisheries, seabirds). These datasets are of huge and fundamental importance and represent a significant asset. Given the challenges associated with the combined impacts of climate change and a loss in biodiversity, long-term time series are critical in differentiating natural fluctuations from the impacts of human activities.

Unfortunately, several of these vitally important research infrastructures do not seem to be on a solid financial foundation in the long term, putting at risk an important competitive advantage of Norway. Also, the high level of infrastructure quality is not shared among the museums, which have aging and often inadequate infrastructure. They fulfil an important role in Norwegian society and curate massive, and significant, collections, but they cannot apply for competitive funding due to a lack of research activity.

A weakness of the Norwegian Biosciences landscape is the general lack of strategy. This is apparent at all levels across the research system. Many research groups perform sub-optimally because they lack strategy and focus, as is also concluded for several of the administrative units overall. At the national level there does not seem to be much coordination and collaboration between the (geographically and organizationally) scattered units. Almost all research units perform work that is going to be key in achieving the UN Sustainable Development Goals (SDGs) and transformation to a green/blue bioeconomy. To date, however, these potentials are not fully realised. This particularly applies to research areas where Norway, according to the National Evaluation Committee, is destined to be leading internationally but is currently not realising its full potential (e.g., arctic marine biology, biodiversity and climate change (happening faster in northern Norway (Svalbard) than elsewhere), biofuels, aquaculture, and up-cycling). These areas are of great societal and economical importance to Norway and the world, and therefore to the position of Norway in the world. The sense of urgency to address these issues and to grasp the opportunities to play a leading role in the world seems to be generally insufficient among scientists in Norway. A national Biosciences strategy with clear goals, clear definition of roles and a well-defined focus for the various units (rather than an inventory of activities) and a roadmap with agreed milestones would help bring Norwegian research in Biosciences

[6] During the interviews with peer-review committees

to the next level and would also help the units decide on new research directions, e.g. when group leaders retire.

The national strategy should also emphasise interdisciplinary cooperation, since the societal issues Norway is facing, and the opportunities to solve them, such as the biodiversity and climate crises, biomedical Artificial Intelligence (AI), farming robotics, or food science, require interdisciplinary approaches and solutions. The present level of interdisciplinarity and the number of interdisciplinary, cross-faculty research centres seem to be significantly lower than in countries like the US, UK, Germany, or the Netherlands. A more visionary strategy is therefore required to leverage synergies beyond shared use of infrastructures, e.g., in teaching and using computational methods and AI in the Biosciences. This does require a top-down strategy, as synergies across different units and locations are unlikely to emerge bottom-up. Such a strategy should also incentivize stronger collaboration between the Institute Sector and the HEIs.

A clear strategy could also help with the general observation that, while a lot of good and very good research is done in Norway, it is internationally not as visible as it deserves to be and could be. This is partly due to a lack of publication and public relations strategies, and partly due to weak international networks.

A final weakness in the Norwegian research system lies in the composition of the research staff. The research population is generally ageing. The universities seem to produce too few graduates that want to pursue a research career and it appears difficult to attract foreign talent into permanent positions (see Chapters 3.2 and 4).

3. The general resource situation

In addition to human resources, there is a requirement for funding to meet the costs of both the human resource and the supporting infrastructure. The National Evaluation Committee were conscious that there were various funding models and associated terminology across the administrative units. This was, in part, because both HEIs and the Institute Sector were included in this review. Furthermore, the nature of, for example, the institutes, varies with some receiving funding to undertake specific activities that are required for regulation or form part of international activities. This provides, in some cases, significant regular funding.

Resources include infrastructure, and the National Evaluation Committee was impressed with some of the modern infrastructure available to researchers. This is supported by data archives which hold critical information since they include long-term time-series that are essential for separating anthropogenic signals from natural environmental variation. In addition, Norway is guardian of some exceptional collections in its museums, although there is concern about the buildings in which they are kept.

3.1 Funding

Funding remains a key issue for all sectors that were assessed, although the issues are not the same across sectors. For example, core funding for the HEI Sector can be as high as 70%. This was viewed by the National Evaluation Committee as being too high as there is a risk that sustained high core funding reduces the drive to seek external funding. It can also limit people looking more widely for funding, including from the European Union (EU). This is exacerbated by the low return on national grant applications (granted applications in the independent project scheme in 2022 was 5.3%[7]). If there is minimal chance of success, and significant core funding is available, then the incentive to spend the significant amount of time required to write a grant application is low. One possible solution is to make more use of a two-stage grant application process in which the first step requires much less work by the applicants, while at the second stage the chance of success is improved which incentivises the applicants.

Core funding for the Institute Sector is quite different from the HEI Sector. Often it is less than 15%. That said, funding is generally fair for the Institutes, though when it comes to government funding of the Institutes this is not well coordinated. Many of the Institutes include commercial contracts in their portfolio. In addition, the applied nature of their work, or direct links to an industry (e.g. aquaculture) or government facilities, provides access to specific funding that is required for compliance and regulation purposes, both at a national and international level. However substantial this funding may be, it is for specific activities and cannot be used for 'creative', curiosity-driven research. The National Evaluation Committee concluded that, for the Institute Sector, there are not many private, non-industrial, funds (such as foundations) available for research.

A challenge faced by all sectors receiving core funding is that core funding has not increased in recent years, but costs have risen due to inflation. This decreases the real value of the core funds. This is particularly relevant for research using long-term time series, which is essential if the anthropogenic signal is going to be differentiated from natural environmental fluctuation. There are examples of such time-series in Norway and their considerable benefit to decision making. However,

[7] Source: Research Council of Norway

their funding remains precarious, putting the time-series, and thus a key resource for making informed decisions, at risk.

As highlighted in Chapter 2, the lack of clear strategies impacts on funding decisions (or the lack of them). In this respect, rather than focusing on the need for more funding, there need to be strategies (at national, ministry and institute level) which provide clear priorities at each level, resulting in a more efficient funding profile. This is not currently at the forefront of planning processes.

The National Evaluation Committee is of the opinion that, at this stage, it would not be appropriate to cut resources to research and education. Rather, the objective should be to make the institutes and HEIs do more to deliver the required information that will facilitate the best possible decisions covering the changes in process that need to be made. In addition, reducing support for basic research erodes the educational and scientific basis for being able to perform applied research. This is not helped by the present financial situation at the RCN which affects the research funding that is available, particularly for the HEI Sector. The Research Council of Norway is the only funding agency for basic research in Norway and has few calls for basic research projects compared to calls on prioritised areas. As already highlighted, the success rates are extremely low. An anomaly is that the conditions of the grants themselves allow for hiring at most two Ph.D. candidates or post-doctoral researchers. This is too restrictive. In addition, there is no performance review as such, nor exit strategies for researchers performing poorly. Such limitations must be given urgent consideration. These considerations will be assisted by the availability of clear strategies.

The National Evaluation Committee noted that money from the fossil fuel industry will decrease over time and will ultimately end. However, Norway has a unique opportunity to turn around its economy by using the formidable education and research resources at their disposal.

3.2. Personnel

Having people with the right skills is essential to deliver the required information through strategically directed research and monitoring programmes. At the same time, science is very international, capitalising on global expertise. The National Evaluation Committee concluded that staffing is a significant issue. For example, many units reported difficulties in finding good staff. Currently, staff are mainly Norwegian, and it appears difficult to attract international staff (language, institute culture, faraway places), in particular to permanent and senior roles. Mentoring schemes for doctoral students should be further developed. There were examples of some excellent staff development programmes, especially in the Institutes, as well as international hiring programmes. However, these examples were isolated cases. It was not clear to the National Evaluation Committee if Norway is truly capable of drawing some of the top minds to the country, and wider, into science.

The current staff profile, especially in the HEI Sector, is top-heavy with many Professors and too few doctoral candidates. There is also a male domination amongst the professors/principal scientists be it at HEIs or Institutes. There is a need for a clear succession plan to be developed which should inform the skills that are required to tackle the key challenges facing Norway. There is a need to bridge the generation gap with the upcoming retirement of professors/principal scientists. Plans should further address the imbalance between male and female staff at senior grades.

The costs of a postdoctoral scientist and a doctoral candidate are the same with fellowships lasting two years whereas doctoral training programmes last three years. In addition, there are few temporary positions with most post-doctoral researchers being on permanent contracts. These issues, coupled with recruitment procedures being lengthy and administratively intense, are leading to difficulty in quickly recruiting excellent candidates, especially in areas where personnel are in high demand (e.g. AI).

The National Evaluation Committee found no clear consensus across units about the academic career path. Consideration needs to be given to how the talent pipelines, starting from the bachelor students, are organised. Actively putting individuals forward for awards encourages both the individual and the team of which they are a part. In addition, it helps in obtaining national and international recognition.

There has been some success in attracting international scientists to Norway. However, there remain barriers. There is a need to look creatively at those barriers. For example, to facilitate overcoming the problem of individuals not enjoying the dark winter, an idea could be to have guest professorships the role of which would be to undertake/lead field research during the summer and then return to their home institute/university to work up the data during the Norwegian winter.

3.3. Infrastructure

Infrastructure is generally well developed, and in some cases, it is top-notch with appropriately qualified technical staff ensuring that the equipment is maintained. Funding is always difficult, especially for large items such as a replacement ship. There is a role here for government, but this also requires clear criteria on what infrastructure is funded and why, and for how long (including operating costs). Such decisions can be facilitated by having well-developed, long-term research strategies as has been alluded to earlier in this report.

Infrastructure, especially that associated with marine and polar research and monitoring, is very expensive. This is because of the large capital purchase requirements, the inhospitable environments in which some of the research is conducted and the geographically remote locations which require considerable logistics to operate effectively. However, Norway sits in a geographically key area to study human-forced climate impacts. There are some excellent facilities that Norway should capitalise on. In addition, one Institute in particular (NPI) plays a strategically important role in the Antarctic. This location is logistically challenging due to both the hostile environment and distance from Norway, making the associated research and monitoring expensive. However, budgets must be realistic in terms of ensuring appropriate infrastructure is available to meet the strategic need.

An area that requires an urgent upgrade is the museum infrastructure. Norway has some spectacular collections. However, these are at risk as museum infrastructure is not prioritised by the universities of which they are a part. This has resulted in a degradation of the environment in which the collections are maintained, as well as in overcrowding.

The maintenance of long-term data series is fundamental to environmental research. This requires critical infrastructure that will hold non-digitised records as well as the vast quantity of digitised records that are associated with long-term data. Data must be appropriately curated, backed-up and accessible. This is not without cost and the need for datacentres. Access to super-computing is also required to operate some of the complex models being used in environmental research. Again, this needs a clear strategy covering both the Institute Sector and HEIs, which should include how the data can be open access. The National Evaluation Committee noted that there were some good examples of data being made available and associated web delivery of information (See Chapter 6).

There is some excellent national infrastructure that is made available to scientists from organisations beyond that which operates the infrastructure. There are good examples of cooperation, for example sharing of ship time or genome sequencing facilities. This has the added benefit of attracting international researchers in search of such infrastructure.

4. PhD training, Recruitment, Mobility and Diversity

4.1 Ph.D. training

The proportion of Ph.D. candidates is low compared to international standards, which may affect the talent pipeline. This is especially critical in the coming years as a generational change is underway at many units, and a national strategic approach is recommended. A challenge is the recruitment of international Ph.D. candidates, especially for the institutions located remotely, which applies to many of the smaller universities and institutes in Norway. The proportion of Ph.D. candidates relative to the total scientific staff is as low as 17-20% at some of the more remotely located universities. On average, only 35% of the employed researchers at HEIs have an international Ph.D. degree. The Norwegian research environments are therefore predominantly national, and the training of Ph.D. candidates correspondingly national. As this is a general trend across all evaluated institutions, it is assessed as a structural challenge for Norwegian Ph.D. education, and a strategic approach to internationalisation of the Ph.D. training should be considered. There are several national Ph.D. schools that offer courses to the students, and the students can develop their national network through these schools. These Ph.D. programmes could be more structured by, e.g., the requirement to undertake a period of study at a university outside of Norway during the Ph.D. Gender balance is good among Ph.D. candidates as 65% were women in 2021, but there continues to be a decline at higher levels with the lowest proportion of women being for professors (27%). For the Institute Sector, the overall percentage of women is 40% (no numbers for Ph.D. candidates as a separate group). The proportion of women at all levels, including Ph.D. candidates, is higher within Bioscience compared to other disciplines.

4.2 Recruitment

In Norway in 2021, across all disciplines, almost 7,000 people were employed as Ph.D. candidates and 2,000 were in post-doctoral positions. For comparison, the number of full professors was 4,500. This makes an average of two researchers per professor and only 1.5 Ph.D. candidates per professor, which is very few in an international comparison.

There has been strong growth in the number of employees during the last 10-year period. For some of the organisations the growth in employees has been more than 50%. This means that the educational and research capacity of the Norwegian HEI-system is significantly higher today than in the recent past. Among R&D personnel included in the evaluation, the age structure has been rather stable from 2013 to 2021 with only a small increase in age. In the HEI Sector, the average age was 42 years; for professors 58 years, for associated professors 49 years, for researchers/postdocs 39 years and for Ph.D. candidates 31 years. However, the share of R&D personnel over 62 years at the professor level rose from 31% in 2013 to 40% in 2021. In the Institute Sector, the average age was 45.3 years in 2013 and 46.5 years in 2021, while the overall share of R&D personnel older than 62 years rose from 6% to 12% between 2013 and 2021.

Despite the increase in hirings in the HEI Sector, many research units in Biosciences appear “top-heavy” with many professors and permanent staff, but few junior researchers and Ph.D. candidates. This is very unusual by international standards. It was not entirely clear to the National Evaluation Committee if this demographic is by design or is a symptom of problems, e.g., with hiring, the attractiveness and feasibility of doing a Ph.D., or the talent pipeline. As a result, several research groups are of sub-critical size, which does not allow them to successfully compete for large international grants, sustain a stable research strategy, or reach out across disciplines and institutional boundaries.

The general lack of early-career researchers could also be caused by the precariously low (compared to other industrialised countries) acceptance rates for third-party funded research from the RCN, which makes it difficult to obtain funding for Ph.D. candidates. This has a negative impact on the project and grant culture in Norway. The situation has been aggravated by a decline in the RCN budget over recent years in areas such as biotechnology, agriculture, and fisheries, despite the central importance of these topics for the green/blue economy and food systems of the future. This has not only limited scientific competition in Norway, but also weakened the talent pipeline, jeopardizing the sustainability of Norway's Biosciences research and development.

4.3 Mobility

On average, only 35% of the employed researchers at HEIs have an international Ph.D. degree, and the Norwegian research environments are therefore predominantly national. Many of the Ph.D. candidates continue as postdoctoral workers and researchers, indicated by a high percentage of staff with a national Ph.D. degree in this job category (56% in 2021). The degree of internationalisation is thus low both in the pipeline and in the subsequent job categories. In total, only 26% of the professors at Norwegian universities have an international Ph.D. The weak talent pipeline is a potential threat to the Norwegian system. With many professors retiring in the coming years (in Biosciences >40% were >62 years of age in 2021), relatively few (in international comparison) senior hires from abroad, and few own Ph.D. students, a strong human resource/succession plan is urgently required, which most units do not appear to have on their own. Stronger internationalisation, especially in the Institute Sector, seems advisable. So far, Norway does not really seem to be sufficiently visible on the radar of international top scientists as a great place to live and work. Here, one could consider a program for appointing "rising stars" as new faculty members before their predecessors retire. The temporal overlap would generate continuity and synergy and could be funded as a special national program administered by the RCN.

4.4 Diversity

The diversity in Bioscience in Norway follows the international observations with a relatively high proportion of women among Ph.D. candidates (65% in 2021) but the proportion of women declines at the more senior levels with only 27% of the professors being female. This problem seems to have been recognized. All institutions have gender diversity plans, and the number of women in senior posts has increased over time. There is an opportunity now, when many of the (male) professors retire, to increase the number of women at the professorial level.

While Norwegian Biosciences seem to be internationally comparable in terms of gender diversity, cultural diversity is low given the relatively low number of permanent staff at the universities and institutions with an international Ph.D. (<35%). Most institutions have diversity plans, but there is a need to focus more on cultural diversity issues to increase the diversity within the Biosciences. This could include an active use of search committees when hiring permanent staff, including a focused onboarding process for the researchers and their families. Furthermore, significant starting packages can increase the attractiveness of the positions to international researchers.

5. Research Cooperation nationally and internationally

5.1 Administrative units cooperation within and between different sectors

There is ongoing and extensive national research collaboration between some of the universities and institutes. Examples of close collaboration include NINA and NTNU; IMR and UiB; and NMBU and NIBR[8] . There is good collaboration between the Institute Sector and HEIs when located in the same city or co-located in the same area. The typical collaboration is through shared students at master or Ph.D. level, where the students spend time in both places. One example is NINA which is an Institute having its headquarters on the campus of NTNU. There are collaborations (e.g. SINTEF BTN and NTNU) through the education of students at Bachelor, Master and Ph.D. level.

Despite widespread collaboration among many HEIs and the Institute Sector, there appears to be limited collaboration across departments at the institution as well as across institutions at several of the evaluated administrative units. There is therefore potential to increase collaboration and in particular interdisciplinary research. Interdisciplinary research is considered of high importance to be able to solve the global challenges and collaboration within and between different sectors and can provide high quality and impactful research. One example is the existence of a dedicated centre/hub for Computational Biology which is only present at one university. Other universities could work more within this increasingly important topic or collaborate with the existing centre.

Norway has a large and modern pool of infrastructure, and there is collaboration across institutions, where the infrastructure is shared. Examples are the Ny-Ålesund Research Station, aquaculture facilities at HEIs and use of Norwegian research vessels. However, the collaboration seems to be based on primarily bilateral interactions and is ad hoc depending on available projects. A strategic approach is missing. There is more potential should a strategic plan be developed. Such a plan could also contribute to avoiding duplication of the work and to increasing interdisciplinarity.

5.2 Administrative units research cooperation nationally and internationally

Norway has many universities, and they are distributed across the entire country. This means that the universities can work with local themes and challenges and contribute to local society. Conversely, remote locations mean that it can be difficult to collaborate across institutions on a national and international level. This applies, for example, to the Institutes, which even though they are rather international in character, participating in international data gathering exercises and work in setting international standards (intergovernmental), they have primarily Norwegian staff and seem not to be striving for international leadership.

Despite relatively low numbers of international staff in the HEIs and the Institutes, the research is, to a large extent, published with international co-authors. In the period 2019-2021 75% of the Bioscience publications where co-authored with international colleagues. About 20% of the publications are co-authored with scientists from the USA. The next eight countries on the list are from Europe (8-19% of the publications). Research strategies for increasing internationalisation were tied to the individual institutions, whereas, there is a lack of a national strategy for internationalisation. The approach to internationalisation is thus less structured on a national level.

HEIs and the Institutes are involved in several important international initiatives. For example, the Institute of Marine Research (IMR) is collaborating with European Coastal States that are involved in the determination of fisheries quotas. This is because of the processes involved and the role of the International Council for the Exploration of the Sea (ICES) which operates committees that comprise

[8] Norwegian Institute for Urban and Regional Research

representatives from national institutes such as IMR. Examples were also presented of participation in other international processes such as the United Nations Intergovernmental Panel on Climate Change (IPCC). NPI is Norway's competent environmental authority in the Antarctic. Finally, Norway is involved in several of the EU roadmaps such as ELIXIR and EMBO.

6. Societal impact and the role of research in society, including Open Science

There is absolutely no doubting the societal impact that some individual research groups and administrative units have. Those that are supporting the regulation of major Norwegian industries, such as wild fisheries and aquaculture, have a very direct societal impact. Other units are providing a key Norwegian presence at international negotiations as well as providing the evidence-base used by regulators and the national government. That said, there is a tendency to use apparent drivers e.g. delivery of the UN Sustainable Development Goals (SDGs), as hooks on which to justify the research without clearly showing how the research will contribute to their delivery and thus societal change. In some respects, there was a disappointing lack of any sense of urgency associated with the climate and biodiversity crises, both of which will have a profound impact on Norway.

6.1 General reflections

Societal impact is not straight forward to assess. The societal impact of education provided by HEIs is evident. There are also examples (e.g., collection of wild fisheries data) where the impact of research and long-term monitoring programmes is evident, is policy relevant and has direct societal consequences. Direct policy impact is very welcome, but it depends on a body of basic and fundamental science, strong education and technological development, all of which are necessary to ultimately deliver the advice. This means that these aspects of the 'research and monitoring process' have a less clear and more indirect impact.

Many fundamental research programmes do not (and are not supposed to) have immediate societal impact with the primary outputs being publications in peer reviewed journals, the delivery time for which is variable and can be several years. This continues to be driven by the academic requirement for such publications to precede promotion. In addition, without clear, long-term research and monitoring strategies, many academics can only undertake research for which they obtain, at times competitive, funding. This is not unique to Norway, although it was noted that core funding for the HEIs can be as high as 70%. However, across the areas reviewed by the National Evaluation Committee, there was a distinct lack of strong, strategic leadership.

Some of the administrative units are provided with an annual letter of instruction / annual commissioning letter from a Norwegian Ministry. This gives some direction to the science and contributes to the knowledge-related needs of the Norwegian Government. What was not clear to the National Evaluation Committee was how these letters are formulated and the nature of any direct relations between the scientists and the ministers / politicians. This annual instruction from government to the institutes is of fundamental importance and a clear driver of the research and monitoring programmes. It is also the basis on which the research in the institutes has societal impact since the annual instruction provides direction on e.g. fisheries. The outcomes of the work delivered under the instruction letters provided many good examples (especially on policies, but also the economics) of very specific and direct societal impact. However, such a strong focus relating to year-on-year delivery of key programmes may limit the opportunity for wider, strategic thinking, on the basis that the nature of the formulation of the letters was unclear. Although it is recognised by governments, researchers, and wider society that there are issues (e.g. biodiversity and climate crises) that will have a significant impact on the people and economy of Norway, the sense of urgency on these national, and indeed global, issues are not apparent. Neither were the mechanism by which appropriate research and monitoring on these topics could be incorporate into the programmes of the administrative units.

Involvement of those who are going to be impacted by the outcomes of the research and monitoring should be considered. However, the actual involvement of groups / industries that will be impacted by the outcomes from the research programme was not significant; the process was more 'done to them rather than with them'.

Impact can include the creation of spin out companies and through patenting developed technology. Technology Transfer Offices (TTO) appear integral to the research sector, but there does not appear to be a strong desire amongst researchers to see the outputs from their research further developed. This leads the National Evaluation Committee to consider whether the TTOs are offering appropriate support.

A key tool for delivering impact is dissemination, be it through engagement events at the HEIs or institutes, peer reviewed publications, publications in the grey literature, HEI or Institute Sector websites and social media. In respect of peer reviewed publications, Norwegians contributed to more than 4,300 bioscience publications in 2021. This figure comes after a 10-year period of growth in Norwegian biosciences publications. However, there has been an even stronger growth in the general Norwegian publication output during this period. This means that the relative position of the field in the overall research landscape has weakened when based on publication volume.

Among the fifteen most common journals used by Norwegians for publications, two are pure 'open access' publishers. There has, over the last decade, been a move to open access publishing. This is reflected in where many of the administrative units now publish their research and monitoring outputs. In 2020, three out of four Norwegian Science and Technology publications were in open access journals. This compares to just over one third in 2013. For some of the administrative units they were publishing more than 90% of their papers in open access outlets, be they 'green' or 'gold'. NTNU-IBT, when you include self–archiving, make all their research publications openly available. Other administrative units were between approximately 62 - 80% open access. However, some administrative units had very poor tracking of open access publications or were still at the stage of very much encouraging open access publication. Overall, this is an area where the administrative units are doing well, some being on a par with the best organisations internationally.

In terms of open data, there were some excellent examples of research data management plans and training for researchers and students. There were examples of administrative units, having requirements for meta-data and storage of research data, following FAIR (Findable, Accessible, Interoperable and Reusable) principles. Assistance and training are provided to help researchers to use the archives, which is highly commendable. Data management plans are being implemented and the National Evaluation Committee noted that there are development plans for open science. However, maybe more attention could be given to international repositories and there were cases where the open data policies require further attention. The National Evaluation Committee noted that there are occasions when, for commercial reasons, data is not made publicly available.

Some exciting resources have been developed for use in schools and for the wider public, including innovative models for citizen science. For example, NORD-FBA support citizen science by organising open research days. In addition, they provide speakers for high-schools students. At UiO-NHM, citizen science is an established platform for communicating research with the public and stakeholders. This is to be commended. However, while the potential for impact of such resources and activities is evident, their actual impact was less clear.

6.2 Review of the EVALBIOVIT impact cases

The impact cases provided by the evaluated administrative units show some very good examples of impactful science delivered timeously. They also show the quality of the research and monitoring delivered across the HEI and Institute sectors. The outcomes of the review present both the basis of the impact cases, basically as presented in the Self-Assessments, followed by brief details of why these were selected for inclusion in the National Report. It should be noted that many of the impact

cases were highly valued by the reviewers at the administrative unit level and by the National Evaluation Committee, making it a challenge to select those highlighted below. However, the National Evaluation Committee found the following examples particularly impressive[9]:

Game-changing biotechnology for combatting the N2O emission from farmland
Faculty of Chemistry, Biotechnology and Food Science (NMBU) has developed a game-changing biotechnology for combatting the N2O-emission from farmland, enabling the agricultural sector to lower its climate footprint, and creating business opportunities for the biogas- and fertilizer-industries. The technology utilises non-denitrifying N2O-respiring bacteria (NNRB), which are nature's own sink for N2O. By growing their carefully selected NNRB-strains to high cell densities in organic wastes, they produce organic fertilizers which increase the abundance of NNRB in the soil, thereby reducing the N2O emission by 50-95%. This NNRB-technology has sparked significant interest from agronomic and industrial stakeholders, and they foresee that it will be adopted worldwide.
Reason for selection: This is an excellent example of how basic and applied research synergise. The societal impact is illustrated by the fact that VEAS (a wastewater treatment plant) scaled the NNRB technology up to pilot level and developed it further to produce new fertiliser products. With RCN support the project continues as the NOX2N (a fertiliser reducing nitrous oxide emissions) project, with multiple stakeholders on the advisory board.

Optical radiation: plant protection against fungal pest diseases
Research at the Faculty of Biosciences (NMBU) during the past 10 years has developed optical radiation as an efficient alternative to fungicides for controlling fungal diseases on crop plants. Environmentally friendly pest management solutions are needed to replace synthetic fungicides, which are increasingly being phased out world-wide. Combining UV light radiation with specific wavelengths have been implemented by the horticultural industry under greenhouse and field conditions in several countries. The integration of the technology on the Thorvald autonomous robotic platform, developed by the robotics group at NMBU (https://sagarobotics.com/crops/), made the technology available for practical usage in several countries, i.e., UK, US and Norway.
Reason for selection: This presents a project which has resulted in a very successful treatment for fungal pest diseases in crop plants with practical market impact in several countries. The trick was to apply the UV irradiation at night when the light-driven genome repair mechanisms of the fungi are not working. This was very effective against mildews even at low UV intensities. The photochemical and molecular mechanisms were worked out and suitable LED emitters for field use were designed. This project is also an example of cross-working since the end-product involved the NMBU Robotics Department and an industrial partner.

Applying genomics to advance aquaculture and manage wild populations of Atlantic salmon
Atlantic salmon are fish of great social and economic value in Norway and abroad. For 15 years the Faculty of Biosciences (NMBU) has pursued research aimed at building genomic resources allowing them to explore and understand the genome of this iconic species. The enabling genomics tools they have developed have been used by the breeding industry to boost genetic progress, target disease related problems and make step-change improvements in aquaculture. As well as supporting other researchers, their activities have produced essential knowledge regarding evolution in salmonids, improved the understanding of natural biodiversity and created novel tools supporting sustainable management of wild salmon populations.
Reason for selection: This impact case presents an example of outstanding basic science success which has been highly published and cited. Furthermore, this is an example of a long-term

[9] Summaries of the impact cases are taken from the self-assessments of the admin units

programme which has resulted in a range of outputs which have a potential global impact as well as serving a key Norwegian industry. This internationally collaborative research resulted in the publication of the first reference genome for salmon. Results from this research have been made publicly available on the salmobase website (salmobase.org). A further outcome is the identification of the genetic locus for resistance against an important virus.

Effect of climate change on biodiversity

The Ecology Group's Biogeography and Biodiversity unit at the Faculty of Bioscience and Aquaculture (Nord university), research informed the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) Working Group II; the leading world scientific body that informs the UN Conference of the Parties to the Paris Agreement (CoP) on the science behind climate change (UN SDG 13 Climate Action), a global crisis that needs urgent action. This included being first, lead and contributing AR6 authors, plus 21 peer-reviewed research papers (12 data analysis and 8 review papers). This contribution was recognised by being a co-recipient of 2022 "Gulbenkian Prize for Humanity".

Reason for selection: This impact case exemplifies research that had significant political impact with input to the IPCC and UNFCCC. Ultimately, this research contributed to the IPCC receiving, along with IPBES, a major international prize. The contribution from this group was conducted through an assessment of evidence, critical review of the literature and new analyses of biodiversity data. The analyses confirmed that shifts would occur in marine species distributions due to the impacts of climate change, specifically ocean warming. This illustrates very clearly an areas where Norwegian science has a very prominent international role.

Spin-off Syngens A/S

Department of Biotechnology and Food Science (NTNU) has establishment of a spin-off Syngens AS in November 2020 that operates at the intersection of artificial intelligence and synthetic biology.

Reason for selection: This impact case illustrates a formidable example of the power of interdisciplinary research at the administrative unit. Moreover, Syngens A/S received the Adolf Oiens's start-up award in 2021, a commercialisation grant from Innovation Norway.

From risk assessment to a system for regulation of salmon farming in Norway (the Traffic Light System)

The "Traffic Light System" (TLS) was developed to regulate an environmentally sustainable growth in the Norwegian salmonid industry, approved by the Norwegian parliament in 2016 and implemented by the Ministry of Trade, Industry and Fisheries (NFD) in 2017. The TLS is based on yearly scientific evaluations of the impact of the parasitic salmon louse from farmed salmon on wild salmonids along the Norwegian coast. Advisory and Research Program Unit, Institute of Marine Research, is a major contributor to TLS performing yearly monitoring of environmental status, suggesting indicators and acceptance criteria, and by development of impact models to complement field observations supported by peer reviewed scientific publications.

Reason for selection: This impact case is of outstanding importance for, and has impact on, society. Basically, infection of wild salmonids by parasites from farmed fish is of major concern due to ecological, environmental and economic reasons. This has resulted in the long-term evaluation of the impact of a parasitic salmon louse along the coast of Norway which has then been used as the basis of yearly risk assessments of Norwegian aquaculture. This contributes to the regulation of a key Norwegian industry.

Securing the pelagic large fish populations in the Northeast Atlantic – the mackerel story

The pelagic fish stocks in the Northeast Atlantic are vast resources, represent some of the largest fish stocks globally, and create societal impacts through employment, industrial and rural development and, most importantly, healthy nutrition for millions of people in Norway and internationally. The mackerel stock dramatically changed its spatial distribution, migration and aggregation patterns from

the mid-2000's – profoundly challenging assessments. Dedicated international research efforts were then undertaken, initiated and lead by the Institute of Marine Research scientists, including a new pelagic trawl survey and modern tagging-recapture method for quantitative abundance estimation and to understand major drivers for continued sustainable management of this valuable population.
Reason for selection: This impact case was selected because it illustrates the pronounced impact of research effort both on ecological modelling as well as on the international management of fish populations. The impressive monitoring data set allowed for a broad and holistic approach that resulted in international recommendations for the sustainable management of mackerel.

SEATRACK
Sustainable ocean management aims to conserve unique marine biodiversity while facilitating resource acquisition by humans. Such management is challenging and requires extensive knowledge of the distribution of marine organisms which are highly mobile and difficult to study. By using new and appropriate technology and through large-scale international collaboration since 2014, SEATRACK, developed by NINA and the Norwegian Polar Institute, have provided such knowledge for seabirds in the North Atlantic. Societal impacts at international and national levels are: 1) designation of a new large marine protected area (NACES) in the North Atlantic by OSPAR, 2) providing knowledge basis for national policies on marine conservation, 3) mitigation of conflicts caused by transition to renewable energy and sustainable offshore wind developments in Norway.
Reason for selection: This impact case is both an example of a carefully conducted monitoring programme that is using state-of-the-art technology to provide critical information which is carefully mapped on two websites and an example of close working by two Norwegian Institutes, namely NINA and NPI. The basis of SEATRACK is the mapping of seabird non-breeding distribution. Impact was realised after only two years of the SEATRACK programme. This is a multi-national programme that encompasses 56 study sites including colonies in Canada, Greenland, Russia, Norway, Iceland, the Faroe Islands, Ireland and the Unted Kingdom. The data has been used to establish a marine protected area in the North Atlantic by the OPSAR Commission. This critical information is carefully mapped on two websites. SEATRACK was presented as an impact case by both NPI and NINA.

Documenting fish welfare in commercial aquaculture
Fish welfare in aquaculture has been a key thematic research area for Nofima since the field began gaining prominence in the late 1990s. This research area is complex and multifaceted and has a wide-ranging impact upon the aquaculture industry both within Norway and beyond. Nofima aims to better document and ultimately improve the welfare of farmed fish via their research, outreach and dissemination. They have adopted an integrated and multi-disciplinary approach to ensure the operational and societal utility of their research, both at the fundamental and applied level. In this case study they outlined the approaches they have used to developing tools for helping external stakeholders document fish welfare (and health) in aquacultural settings, and how they have applied these to differing species, life stages, rearing systems, routines and operations. Specifically, they summarised how these tools have been compiled into operational toolboxes for commercial stakeholders in order to ensure that the tools are scientifically validated and fit for purpose for their farms. This case study outlined where their approach, in partnership with others, has had a large impact upon key Norwegian farmed fish species and also on how they have shaped how farmers and other interested stakeholders audit the welfare of the fish that are produced.
Reason for selection: This on-going impact case highlights the impact of Nofima's work with corporate stakeholders. It documents fish welfare (and health) in aquaculture settings and how these have been applied to differing species, life stages, rearing systems, routines and operations. This is an example of a very well-presented case study.

Monitoring and research on polar sea ice informing decision and policy makers and society
The impact of research and monitoring of polar sea ice (Arctic and Antarctic) and the

accumulated expertise at the unit informs processes that contribute directly to knowledge transfer for decision and policy makers and for informing the broader public. This expertise and knowledge is accumulated over longer periods of time which is also in line with the Norwegian Polar Institute's mandate towards the owners, which includes that their research and knowledge is used towards environmental management by their government. Researchers contribute to national and international assessments (AMAP, IPCC, etc.) in the subject lending their expertise to these products.
Reason for selection: This impact case illustrates an important contribution to national and international assessments (e.g. IPCC and AMAP) by a Norwegian institute. In addition, this shows that active engagement with the media can lead to national dissemination through the National Broadcaster (NRK) and newspapers, as well as internationally through the British Broadcasting Corporation (BBC), National Geographic and others.

PhyloNorway
The creation of the PhyloNorway genetic database (https://www.phylonorway.no/) by the Arctic university museum of Norway (UiT) provides a unique resource for environmental managers. It enables DNA sequences from environmental samples to be assigned to species with almost 100% identity - far above that possible with the Global databases. This allows eDNA to be used for ecological surveys with confidence that it has the power to identify all the species in Norway and Polar regions. The resource finally completed in 2020 is currently being used by several environmental agencies including the Norwegian Institute of Nature Research, NIBIO and in forensic science.
Reason for selection: The creation of the PhyloNorway genetic database by the NEAT research group provides a unique resource for environmental managers in Norway and specifically in the Arctic. It enables DNA sequences from environmental samples to be assigned to species with almost 100% identity - far above that possible with the Global databases. This allows eDNA to be used for ecological surveys with the confidence that it has the power to identify all species in Norway and the polar regions. This has been funded for a decade and provides a unique genetic database of vascular plant species for environmental managers and studies on biodiversity.

The impact of collection-based marine biodiversity studies
The scientific collections acquired from various species inventories are the "working capital" to which the University Museum of Bergen (UiB) adds scientific value by taxonomy-based processing work at different levels, making material available for in-depth studies by internal and external specialists. Various sorts of knowledge obtained from such studies will transform to biological insights with impacts beyond academia. They particularly wished to highlight their work addressing individuals and institutions involved in monitoring, management, and political decisions on environment and natural resources. Their work with DNA barcoding is directly relevant for the application of molecular methods in ecosystem management and monitoring.
Reason for selection: This is an excellent impact case which demonstrates a high level of societal impact, through its involvement in the Norwegian Biodiversity Information Centre species inventories. Research at the University Museum (UM) focuses on taxonomy, systematics, and evolution, using the comprehensive scientific collections acquired through species inventories. The research has led to biological insights with far-reaching impacts beyond academia, particularly in DNA barcoding which has been instrumental in ecosystem management and monitoring, as well as in policymaking. The museum's active collection work in this area has attracted guest researchers globally, with significant academic publications resulting from access to these collections. The work has been crucial in establishing a reference collection of DNA-barcoded marine animals in Norway. Moreover, this work has resulted from a partnership between UM, IMR and NPI.

Fishmortality – classification of cases
The case study comprises research undertaken to describe patterns of mortality throughout the life of farmed Atlantic salmon in Norway. Losses of fish during the sea-phase of production varies between units, and high mortality is not sustainable financially or for animal health and welfare reasons.

Targeted management factors to prevent loss of fish can be employed if the underlying causes of death are known. A new classification system for fish mortality was developed by researchers at the Faculty of Veterinary Medicine (NMBU) and is now implemented by the industry.
Reason for selection: The case study comprises research undertaken to describe patterns of mortality throughout the life of farmed Atlantic salmon in Norway. A new classification system for fish mortality was developed by researchers at NMBU and is now implemented by the industry. The impact depends on the risk factors identified and whether these risks can be mitigated within a realistic economic framework.

Handbook for environmental design in regulated salmon rivers
The handbook strongly impacted practises in both public management (the Norwegian Environment Agency and the Norwegian Water Resources and Energy Directorate) and in the hydropower industry. Today, most of the environmental impact studies in regulated rivers are based on the methodology developed in the diagnoses part of the handbook and win-win (for hydropower and fish) design solutions have been or are under implementation in several rivers. University continuing education courses on environmental design have been arranged as well as courses for hydropower companies. A Chinese translation has been published after an initiative from hydropower organisations in China. Research continues to expand the concept of environmental design to other fish species and ecosystem components. The handbook was developed in the EnviDORR project and the CEDREN research centre in the period 2007-2016. For the NINA scientists the main research contributions relate to the fundamentals of population regulation mechanisms for juvenile Atlantic salmon and how habitat and hydrological variables influence population bottlenecks and dynamics.
Reason for selection: This impact case presents the development of a guide for improving both the wild salmon population and the hydro generation of electricity on regulated rivers. Popularly referred to as ‘more salmon, more power’, cross-disciplinary research allowed the exploration of the opportunities for combining the interests of salmon production and power production. The result is a handbook with information on tools which can be used. An outcome of the implementation of the processes outlined in the handbook on one river has been the return of salmon production to pre-hydropower development levels and a small increase in hydropower production.

AfricanBioServices and other research in the South
The Department of Biology (NTNU) has a long tradition for building research capacity in the South. From 2010 to 2013 the department was engaged in a project related to the construction of a new road in northern Serengeti. In this project they built up capacity of Tanzanian researchers and students to independently assess impacts of such a road in a vulnerable area surrounding a national park. AfricanBioServices is another example of a research driven capacity building project. The project generated and collated, analysed, synthesized, and disseminated unprecedented amounts of data from the Greater Serengeti Mara Ecosystem.
Reason for selection: This was an impact case with high societal relevance and was based on collaborative interactions that IBI has with researchers in the northern Serengeti in Tanzania, focusing on assessing the impact on wildlife and biodiversity of diverse types of land use, such as the construction of roads. This programme has helped to raise the scientific capacity of both academics and local stakeholders, predominantly in Tanzania, but also in other countries.

The above 15 impact cases illustrate the diversity of research and monitoring programmes undertaken by the administrative units as well as the quality and relevance of this work. They further show collaborations, both national and international, and the achievements from long-term programmes.

7. Recommendations

1. ***Make sure all administrative units in this research area have coherent and synergistic strategies and implement mechanisms to coordinate them on the national level. A national strategy on Biosciences could help.***

Almost all research units in the Biosciences area perform work that is going to be key in achieving sustainability goals and transforming to a green/blue bioeconomy. To date, however, the potential is not fully realised. All units should develop clear strategies how to increase their performance. Scientific excellence and maximising impact should be guiding principles in developing the strategies. Focus, collaboration, diversity, and internationalisation are prerequisites. Coordination at the national level is necessary. The mechanism of coordination depends on the will to change and achieve excellence and impact. A national strategy for Biosciences, with clear goals and clear implementation processes with the right incentives, could help.

2. ***Create, through clear strategies, more direction and critical mass in the HEIs and Institute Sector as a whole, to achieve excellence in science***

Norwegian Biosciences come across as too fragmented and as not making the best use of the resources and state-of-the-art facilities they have. Research groups and units in Biosciences are scattered around the country, are generally quite small (in an international perspective) with weak strategies that are not aligned with each other and show limited cooperation. This evaluation shows that research excellence is not achieved to such a level as seems possible. More focus is needed in the research to achieve the next level and remain competitive with the Netherlands, Switzerland, Germany, the UK, etc., where a lot is happening in governance and in building clusters of excellence of critical mass. This focus needs to be promoted at the national level, as it will not emerge bottom-up. Clear goals and evaluation criteria need to be set, and choices need to be made on the topics that will be pursued.

3. ***Increase incentives to use the core funding to win additional competitive funding***

The high core funding for academic research in Norway is a true strength. However, the evaluation shows that the high core funding in some cases leads to limited efforts with winning competitive funding. Incentives should be increased to attract more competitive funding (especially for HEIs and especially from international sources). Not all universities have EU grant advisors – consideration should be given to sharing this resource across universities. Consideration could also be given to decreasing the core academic funding in Norway and increasing the budgets for competitive national funding, either by increasing competitive funding budgets at the RCN or by making part of base funding dependent on achievements in gaining competitive funding or on performance evaluation.

4. ***Generate incentives and programs to foster collaboration, both nationally and internationally***

To make the research system more than the sum of its parts (the research groups), more governance and synergy is needed. Incentives should foster this. This could be incentives (at the national level, but also at unit level) to promote sectoral cooperation (between groups in Biosciences, especially in areas that are unique strengths of Norway, such as aquaculture), but also interdisciplinary cooperation, like e.g., in computational life sciences and AI or in monitoring (Arctic) marine biology. This can be done by setting up well-funded interdisciplinary research centres with stringent excellence criteria. Cooperation strategies should include strong international partners.

5. ***Continue the support for Research Infrastructures and optimise their use***

Norway has a very well-developed system of support for Research Infrastructures (RI) at the national level with a national roadmap and a financing mechanism. This support should be continued.

However, even more attention could be paid to funding maintenance of the RI including regular upgrading of the RI to make sure that scientific innovation is continued. The RI in Norway include unique long-term data sets and museum collections. Researchers should make more use of these assets and attract greater recognition of the benefit of these assets to promote more secure funding for these RI.

6. Generate incentives and programs to make use of scientific results and increase economic and societal impact

- To generate more economic impact, there should be stronger support and the right systemic funding incentives for promoting entrepreneurship and start-up culture. Many units have given examples of commercially or economically relevant and promising results, and some units (although that could be better supported) hold significant patents. Only in a few cases, however, are these exploited by the founding of new companies. In most cases, the patents seem under-utilised, or the results are given to an existing corporation in the framework of a research collaboration. Given that Norway does not currently have significant biotech or pharma industries, which in itself is a growth-limiting factor for its Biosciences research, an actively supported start-up network could lay the foundation for changing this.
- To increase societal impact, it should be ensured that the voice from science to politics is institutionalised, so that the results of (bio)science are used for formulating policy in response to climate change and biodiversity loss as well as for economic transformation. Government and those generating the evidence through scientific research and (long-term) monitoring should be working closely together on a common goal. This could be facilitated by a standing advisory body to the government or the post of a National Chief Scientific Advisor.

7. Establish measures for a stronger talent pipeline, combining domestic education and hiring of international staff

The importance of the field of Biosciences for Norway cannot be understated, but the researcher population is ageing, there are too few Ph.D. candidates, and foreign researchers are inclined to leave Norway after their temporary contracts run out. This leads to enormous challenges in the human resources field. An integrated plan should be developed to address this issue. For this plan it is recommended to:

- Plan ahead (at least five years) before faculty members retire and use the degrees of freedom wisely, including to increase diversity in senior roles.
- Focus on increasing the number of Ph.D. candidates in general and of international scientists in particular. Research leaders (supervisors) should be encouraged to apply for national and international funding to hire Ph.D. candidates. Additionally, or alternatively, RCN could be given the funds to open dedicated (maybe even targeted) Ph.D. programmes to secure a talent pipeline.
- Develop creative programmes to attract staff at various stages of their career, such as visiting faculty programmes, national digitalisation and AI platforms, start-up incubators, (female) “rising star” programmes, incentives for early-career researchers, or national exchange programmes with top partners abroad that could be a mutual win and provide innovative ways of capitalising on the unique location and infrastructure of the Norwegian research units.
- Pay attention to retaining those (international) researchers in the system that have been attracted to Norway. This includes promotion of English as a language in teaching, in the research groups and as a (at least secondary) administrative language in the RCN and in the research units, taking account of the need for positions for the spouses of researchers, setting up (more) international schools for the children of researchers, etc.
- Encourage female Ph.D. graduates to continue their career in research e.g. by providing career mentoring programmes and targeted funding to minimize barriers for promotion to professorial positions (e.g. international post-doctoral placements, support for families).
- Continue efforts to increase diversity, especially among permanent staff.

8. Make use of science advisory boards to provide external review, advice and assistance with developing strategies

For more coherent strategies to be developed, the units should make systematic use of international scientific advisory boards (SAB). Such advisory boards are commonly used in many countries, but they seem scarce in Norway. A SAB could not only provide advice and an external view during a strategy process, but also be ambassadors for Norwegian science across the world, help review and evaluate scientific programmes and success on a more frequent basis than the large 10-year evaluations, nucleate a growing network, and improve the visibility of the outputs from the research and monitoring undertaken by both the academic and institute communities across Norway.

8. Evaluation of Biosciences 2022-2024

Introduction

The Research Council of Norway (RCN) has been given the mission by the Ministry of Education and Research to perform subject-specific evaluations. The evaluation of life sciences was conducted during 2022 - 2024. The evaluation of Biosciences took place between 2022 and early 2024. The evaluation of medicine and health takes place in 2023-2024 (Figure 1).

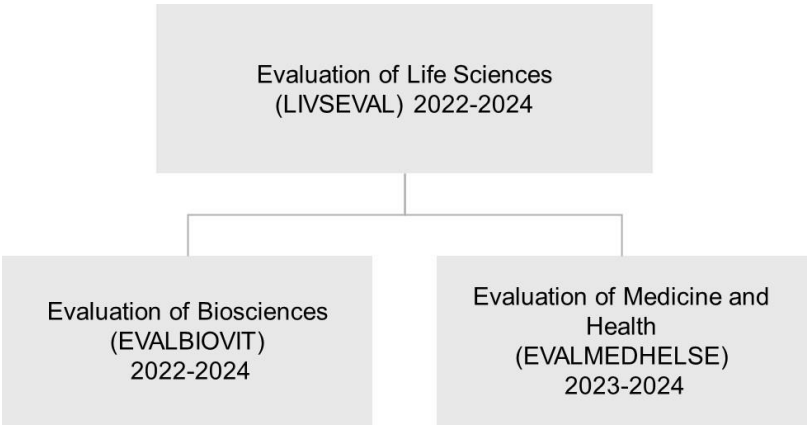


Figure 1. Evaluation of Life Sciences 2022-2024

The primary aim of the evaluation of life sciences is to determine and confirm the quality and the relevance of research performed at Norwegian Higher Education Institutions (HEIs), the Institute Sector and the health trusts. The evaluation shall result in recommendations to the institutions, the RCN and the ministries.

Each institution has a responsibility to follow up the evaluation's recommendations. The RCN aims to use the outcomes of the evaluation as a knowledge base for further discussions with the institutions on issues such as general plans and national measures relating to legal research. The RCN will use the evaluation in its development of funding instruments and in the advice, it gives to the Ministries.

Methods

Evaluation protocol

The RCN created the evaluation protocol (appendix), decided the assessment criteria and planned the evaluation process. The evaluation protocol was decided by the portfolio board of Life sciences April 2022.

Terms of reference

The terms of reference and assessment criteria were adapted to the institutions' own strategies and objectives. The institutions' terms of reference contained specific information about the research unit that the evaluation committee was to consider in its assessment (Appendix A in the evaluation protocol).

Registration of administrative unit

All Research Performing Organisations in the field of life sciences were invited to the evaluation. Twenty-two administrative units responded positively to participation in EVALBIOVIT (Table 1) and 68 administrative units are enrolled to the evaluation of medicine and health sciences (EVALMEDHELSE) in 2023-2024. Institutions enrolled to the evaluation by submitting Terms of reference for participating administrative unit in addition to research groups.

Table 1. Participation administrative units in EVALBIOVIT 2022-2023

Administrative unit (alphabetic order)	**Institution**
Computational Biology Unit (CBU)	University of Bergen (UiB)
Department for Biotechnology and Nanomedicine	SINTEF Industry
Department of biological sciences	University of Bergen (UiB)
Department of Biology	Norwegian University of Science and Technology (NTNU)
Department of Biosciences	University of Oslo (UiO)
Department of Biotechnology and Food Science	Norwegian University of Science and Technology (NTNU)
Department of Chemistry, Bioscience and Environmental Engineering	University of Stavanger (UiS)
Department of Natural history	Norwegian University of Science and Technology (NTNU)
Faculty of Bioscience	Norwegian University of Life Sciences (NMBU)
Faculty of Biosciences and Aquaculture	Nord university
Faculty of Biosciences, Fisheries and Economics	University of Tromsø (UiT)
Faculty of Chemistry, Biotechnology and Food Science	Norwegian University of Life Sciences (NMBU)
Faculty of Environmental Sciences and Natural Resource Management	Norwegian University of Life Sciences (NMBU)
Faculty of Science and Engineering	University of Agder (UiA)
Natural History Museum (NHM)	University of Oslo (UiO)
Norwegian Food Research Institute (Nofima)	Norwegian Food Research Institute (Nofima)
Norwegian Institute for Nature Research (NINA)	Norwegian Institute for Nature Research (NINA)
Research department	Norwegian Polar Institute (NPI)
The Advisory and Research Program unit	Institute of Marine Research
The Arctic University Museum	University of Tromsø (UiT)
The Faculty of Veterinary Medicine	Norwegian University of Life Sciences (NMBU)
University Museum of Bergen	University of Bergen (UiB)

Organisation

- *National committee*

The National Evaluation Committee consisted of the three chairs of the three administrative unit evaluation committees. The National Evaluation Committee was requested to compile a report based on the assessments and recommendations from the 22 independent evaluation unit reports.

- *Evaluation committees*

The administrative units were assessed by evaluation committees according to sectorial affiliation and/or other relevant similarities between the units. The evaluation committees had expertise in the main disciplines of the life sciences/Biosciences and various aspects of the organization and management of research and higher education. The committees consisted of 4-7 international evaluation members per evaluation committee.

- *Expert panels*

The administrative units enrolled their research groups to be assessed by expert panels divided by subjects and disciplines within the field of Biosciences (mainly non-human topics) across sectors. The expert panels consisted of four to six international experts per panel.

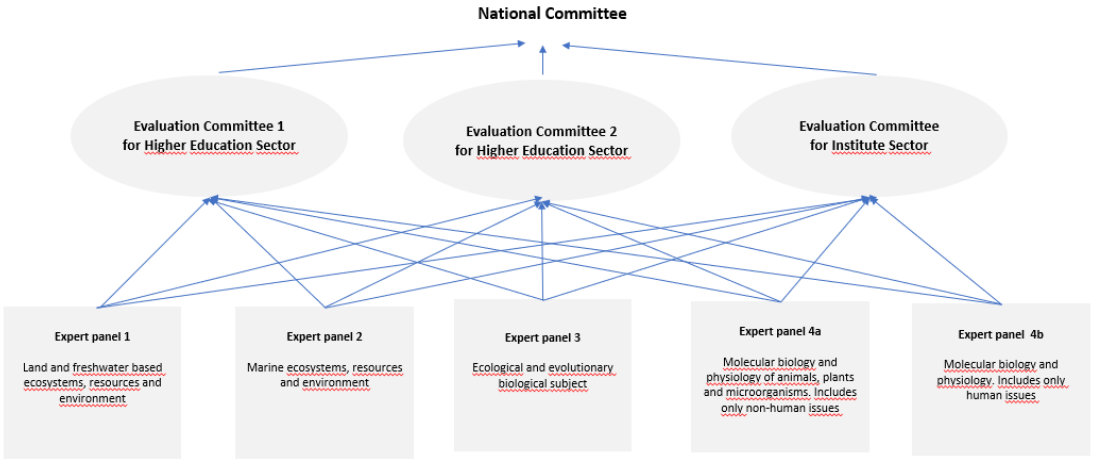


Figure 2. Organisation of the evaluation of Biosciences in three levels; expert panels, evaluation committees and the national evaluation committee.

- *External evaluation secretariat*

The Research Council has established an external academic secretariat for the evaluation. The external evaluation secretariat was responsible for the implementation of the evaluation process.

Data

The documentary inputs to the evaluation were:

- Evaluation Protocol Evaluation of life sciences in Norway 2022-2023
- Administrative Unit´s Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Panel reports from the Expert panels (five expert panel reports)
- Evaluation of biosciences in Norway: Publication and citation analysis – a national profile (*NIFU Working Paper; 2023:3*)
- Statistics for use in the evaluation of biosciences in Norway: Analysis of research personnel in 2013, 2017 and 2021 (*SSB Reports 2023/12*)
- Funding data – The Research Council´s contribution to Biosciences research (*RCN*)
- Extract from the Survey for academic staff and the Student Survey (*Norwegian Agency for Quality Assurance in Education (NOKUT)*)

Limitations

This national report of the evaluation of Biosciences in Norway 2022-2024 is the result of an extensive process of peer review of Biosciences at 3 levels of the Norwegian research system: the research group level, the administrative unit level (faculty/institute/centre/institution) and the national level.

At the lower levels of the evaluation, many comments have been made by those involved in the review panels and evaluation committees about the evaluation process, most of them focusing on the limited amount of time that evaluators could spend on each group or administrative unit evaluated, and the limited direct interaction that the expert panels had with the groups (only a self-evaluation report) and the evaluation committees with the administrative units (a self-evaluation report and an (online) interview of 1.5 hours with the (management) of the units). Although we share these concerns, we think that this design of the evaluation process has provided good quality inputs for a robust assessment at the national level. Important in achieving robust results has also been the composition of the National Evaluation Committee, consisting of the chairs of the committees that performed the administrative unit evaluations.

Improvements in future evaluations (without increasing costs) are:

- Improved data availability (especially for bibliometric data at the level of Norway where no distinction was made between Biosciences research and health research).
- Better instructions for the groups and administrative units preparing the self-evaluations (including more instruction on what the boundaries of groups are (for the current assessment, the sizes of groups differed from 5 to 500).
- Better calibration of scores (especially at research group level).
- Moving the interviews to earlier in the evaluation process, which will, earlier in the process, give better understanding of the administrative units and increase the time available for writing of the administrative unit reports.

It would also be good to undertake a discussion about the nature of participation and whether it should be voluntary or obligatory.

Appendices

- Evaluation protocol
- Description of expert panels, list of administrative units and research groups
- Composition of National Evaluation Committee EVALBIOVIT
- Scales for research group assessment
- References

The Research Council of Norway

Evaluation of life sciences in Norway

2022-2024

LIVSEVAL protocol version 1.0

By decision of the Portfolio board for life sciences April 5., 2022

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Introduction

Research assessments based on this protocol serve different aims and have different target groups. The primary aim of the evaluation of life sciences is to reveal and confirm the quality and the relevance of research performed at Norwegian Higher Education Institutions (HEIs), and by the institute sector and regional health authorities and health trusts. These institutions will hereafter be collectively referred to as Research Performing Organisations (RPOs). The assessments should serve a formative purpose by contributing to the development of research quality and relevance at these institutions and at the national level.

Evaluation units

The assessment will comprise a number of *administrative units* submitted for evaluation by the host institution. By assessing these administrative units in light of the goals and strategies set for them by their host institution, it will be possible to learn more about how public funding is used at the institution(s) to facilitate high-quality research and how this research contributes to society. The administrative units will be assessed by evaluation committees according to sectoral affiliation and/or other relevant similarities between the units.

The administrative units will be invited to submit data on their *research groups* to be assessed by expert panels organised by research subject or theme. See Chapter 3 for details on organisation.

Administrative unit	An administrative unit is any part of an RPO that is recognised as a formal (administrative) unit of that RPO, with a designated budget, strategic goals and dedicated management. It may, for instance, be a university faculty or department, a department of an independent research institute or a hospital.
Research group	Designates groups of researchers within the administrative units that fulfil the minimum requirements set out in section 1.2. Research groups are identified and submitted for evaluation by the administrative unit, which may decide to consider itself a single research group.

Minimum requirements for research groups

1) The research group must be sufficiently large in size, i.e. at least five persons in full-time positions with research obligations. This merely indicates the minimum number, and larger units are preferable. In exceptional cases, the minimum number may include PhD students, postdoctoral fellows and/or non-tenured researchers. *In*

all cases, a research group must include at least three full-time tenured staff. Adjunct professors, technical staff and other relevant personnel may be listed as group members but may not be included in the minimum number.

2) The research group subject to assessment must have been established for at least three years. Groups of more recent date may be accepted if they have come into existence as a consequence of major organisational changes within their host institution.
3) The research group should be known as such both within and outside the institution (e.g. have a separate website). It should be able to document common activities and results in the form of co-publications, research databases and infrastructure, software, or shared responsibilities for delivering education, health services or research-based solutions to designated markets.
4) In its self-assessment, the administrative unit should propose a suitable benchmark for the research group. The benchmark will be considered by the expert panels as a reference in their assessment of the performance of the group. The benchmark can be grounded in both academic and extra-academic standards and targets, depending on the purpose of the group and its host institution.

The evaluation in a nutshell

The assessment concerns:

- research that the administrative unit and its research groups have conducted in the previous 10 years
- the research strategy that the administrative units under evaluation intend to pursue going forward
- the capacity and quality of research in life sciences at the national level

The Research Council of Norway (RCN) will:

- provide a template for the Terms of Reference[10] for the assessment of RPOs and a national-level assessment in life sciences
- appoint members to evaluation committees and expert panels
- provide secretarial services
- commission reports on research personnel and publications based on data in national registries
- take responsibility for following up assessments and recommendations at the national level.

[10] The terms of reference (ToR) document defines all aspects of how the evaluation committees and expert panels will conduct the [research area] evaluation. It defines the objectives and the scope of the evaluation, outlines the responsibilities of the involved parties, and provides a description of the resources available to carry out the evaluation.

RPOs conducting research in life sciences are expected to take part in the evaluation. The board of each RPO under evaluation is responsible for tailoring the assessment to its own strategies and specific needs and for following them up within their own institution. Each participating RPO will carry out the following steps:

1) Identify the administrative unit(s) to be included as the main unit(s) of assessment
2) Specify the Terms of Reference by including information on specific tasks and/or strategic goals of relevance to the administrative unit(s)
3) The administrative unit will, in turn, be invited to register a set of research groups that fulfil the minimum criteria specified above (see section 1.2). The administrative unit may decide to consider itself a single research group.
4) For each research group, the administrative unit should select an appropriate benchmark in consultation with the group in question. This benchmark can be a reference to an academic level of performance or to the group's contributions to other institutional or sectoral purposes (see section 2.4). The benchmark will be used as a reference in the assessment of the unit by the expert panel.
5) The administrative units subject to assessment must provide information about each of their research groups, and about the administrative unit as a whole, by preparing self-assessments and by providing additional documentation in support of the self-assessment.

Target groups

- Administrative units represented by institutional management and boards
- Research groups represented by researchers and research group leaders
- Research funders
- Government

The evaluation will result in recommendations to the institutions, the RCN and the ministries. The results of the evaluation will also be disseminated for the benefit of potential students, users of research and society at large.

This protocol is intended for all participants in the evaluation. It provides the information required to organise and carry out the research assessments. Questions about the interpretation or implementation of the protocol should be addressed to the RCN.

Assessment criteria

The administrative units are to be assessed on the basis of five assessment criteria. The five criteria are applied in accordance with international standards. Finally, the evaluation committee passes judgement on the administrative units as a whole in qualitative terms. In this overall assessment, the committee should relate the assessment of the specific tasks to the strategic goals that the administrative unit has set for itself in the Terms of Reference.

When assessing administrative units, the committees will build on a separate assessment by expert panels of the research groups within the administrative units. See Chapter 3 'Evaluation process and organisation' for a description of the division of tasks.

Strategy, resources and organisation

The evaluation committee assesses the framework conditions for research in terms of funding, personnel, recruitment and research infrastructure in relation to the strategic aims set for the administrative unit. The administrative unit should address at least the following five specific aspects in its self-assessment: 1) funding sources, 2) national and international cooperation, 3) cross-sector and interdisciplinary cooperation, 4) research careers and mobility, and 5) Open Science. These five aspects relate to how the unit organises and actually performs its research, its composition in terms of leadership and personnel, and how the unit is run on a day-to-day basis.

To contribute to understanding what the administrative unit can or should change to improve its ability to perform, the evaluation committee is invited to focus on factors that may affect performance.

Further, the evaluation committee assesses the extent to which the administrative unit's goals for the future remain scientifically and societally relevant. It is also assessed whether its aims and strategy, as well as the foresight of its leadership and its overall management, are optimal in relation to attaining these goals. Finally, it is assessed whether the plans and resources are adequate to implement this strategy.

Research production, quality and integrity

The evaluation committee assesses the profile and quality of the administrative unit's research and the contribution the research makes to the body of scholarly knowledge and the knowledge base for other relevant sectors of society. The committee also assesses the scale of the unit's research results (scholarly publications, research infrastructure developed by the unit, and other contributions to the field) and its contribution to Open Science (early knowledge and sharing of data and other relevant digital objects, as well as science communication and collaboration with societal partners, where appropriate).

The evaluation committee considers the administrative unit's policy for research integrity and how violations of such integrity are prevented. It is interested in how the unit deals with research data, data management, confidentiality (GDPR) and integrity, and the extent to which independent and critical pursuit of research is made possible within the unit.

Research integrity relates to both the scientific integrity of conducted research and the professional integrity of researchers.

Diversity and equality

The evaluation committee considers the diversity of the administrative unit, including gender equality. The presence of differences can be a powerful incentive for creativity and talent development in a diverse administrative unit. Diversity is not an end in itself in that regard, but a tool for bringing together different perspectives and opinions.

The evaluation committee considers the strategy and practices of the administrative unit to prevent discrimination on the grounds of gender, age, disability, ethnicity, religion, sexual orientation or other personal characteristics.

Relevance to institutional and sectoral purposes

The evaluation committee compares the relevance of the administrative unit's activities and results to the specific aspects detailed in the Terms of Reference for each institution and to the relevant sectoral goals (see below).

Higher Education Institutions

There are 36 Higher Education Institutions in Norway that receive public funding from the Ministry for Education and Research. Twenty-one of the 36 institutions are owned by the ministry, whereas the last 15 are privately owned. The HEIs are regulated under the Act relating to universities and university colleges of 1 August 2005.

The purposes of Norwegian HEIs are defined as follows in the Act relating to universities and university colleges[11]

- provide higher education at a high international level;
- conduct research and academic and artistic development work at a high international level;
- disseminate knowledge of the institution's activities and promote an understanding of the principle of academic freedom and application of scientific and artistic methods and results in the teaching of students, in the institution's own general activity as well as in public administration, in cultural life and in business and industry.

In line with these purposes, the Ministry for Research and Education has defined four overall goals for HEIs that receive public funding. These goals have been applied since 2015:

1) High quality in research and education
2) Research and education for welfare, value creation and innovation
3) Access to education (esp. capacity in health and teacher education)
4) Efficiency, diversity and solidity of the higher education sector and research system

[11] https://lovdata.no/dokument/NLE/lov/2005-04-01-15?q=universities

The committee is invited to assess to what extent the research activities and results of each administrative unit have contributed to sectoral purposes as defined above. In particular, the committee is invited to take the share of resources spent on education at the administrative units into account and to assess the relevance and contributions of research to education, focusing on the master's and PhD levels. This assessment should be distinguished from an assessment of the quality of education in itself, and it is limited to the role of research in fostering high-quality education.

Research institutes (the institute sector)

Norway's large institute sector reflects a practical orientation of state R&D funding that has long historical roots. The Government's strategy for the institute sector[12] applies to the 33 independent research institutes that receive public basic funding through the RCN, in addition to 12 institutes outside the public basic funding system.

The institute sector plays an important and specific role in attaining the overall goal of the national research system, i.e. to increase competitiveness and innovation power to address major societal challenges. The research institutes' contributions to achieving these objectives should therefore form the basis for the evaluation. The main purpose of the sector is to conduct independent applied research for present and future use in the private and public sector. However, some institutes primarily focus on developing a research platform for public policy decisions, others on fulfilling their public responsibilities.

The institutes should:

- maintain a sound academic level, documented through scientific publications in recognised journals
- obtain competitive national and/or international research funding grants
- conduct contract research for private and/or public clients
- demonstrate robustness by having a reasonable number of researchers allocated to each research field

The committee is invited to assess the extent to which the research activities and results of each administrative unit contribute to sectoral purposes and overall goals as defined above. In particular, the committee is invited to assess the level of collaboration between the administrative unit(s) and partners in their own or other sectors.

The hospital sector

There are four regional health authorities (RHFs) in Norway. They are responsible for the specialist health service in their respective regions. The RHFs are regulated through the Health Enterprises Act of 15 June 2001 and are bound by requirements that apply to specialist and other health services, the Health Personnel Act and the Patient Rights Act. Under each of the regional health authorities, there are several health trusts (HFs), which can consist of one or more hospitals. A health trust (HF) is wholly owned by an RHF.

[12] Strategy for a holistic institute policy (Kunnskapsdepartementet 2020)

Research is one of the four main tasks of hospital trusts.[13] The three other mains tasks are to ensure good treatment, education and training of patients and relatives. Research is important if the health service is to keep abreast of stay up-to-date with medical developments and carry out critical assessments of established and new diagnostic methods, treatment options and technology, and work on quality development and patient safety while caring for and guiding patients.

The committee is invited to assess the extent to which the research activities and results of each administrative unit have contributed to sectoral purposes as described above. The assessment does not include an evaluation of the health services performed by the services.

Relevance to society

The committee assesses the quality, scale and relevance of contributions targeting specific economic, social or cultural target groups, of advisory reports on policy, of contributions to public debates, and so on. The documentation provided as the basis for the assessment of societal relevance should make it possible to assess relevance to various sectors of society (i.e. business, the public sector, non-governmental organisations and civil society).

When relevant, the administrative units will be asked to link their contributions to national and international goals set for research, including the Norwegian Long-term Plan for Research and Higher Education and the UN Sustainable Development Goals. Sector-specific objectives, e.g. those described in the Development Agreements for the HEIs and other national guidelines for the different sectors, will be assessed as part of criterion 2.4.

The committee is also invited to assess the societal impact of research based on case studies submitted by the administrative units and/or other relevant data presented to the committee. Academic impact will be assessed as part of criterion 2.2.

[13] Cf. the Specialist Health Services Act § 3-8 and the Health Enterprises Act §§ 1 and 2

Evaluation process and organisation

The RCN will organise the assessment process as follows:

- Commission a professional secretariat to support the assessment process in the committees and panels, as well as the production of self-assessments within each RPO
- Commission reports on research personnel and publications within life sciences based on data in national registries
- Appoint one or more evaluation committees for the assessment of administrative units.
- Divide the administrative units between the appointed evaluation committees according to sectoral affiliation and/or other relevant similarities between the units.
- Appoint a number of expert panels for the assessment of research groups submitted by the administrative units.
- Divide research groups between expert panels according to similarity of research subjects or themes.
- Task the chairs of the evaluation committees with producing a national-level report building on the assessments of administrative units and a national-level assessments produced by the expert panels.

Committee members and members of the expert panels will be international, have sufficient competence and be able, as a body, to pass judgement based on all relevant assessment criteria. The RCN will facilitate the connection between the assessment levels of panels and committees by appointing committee members as panel chairs.

Division of tasks between the committee and panel levels

The expert panels will assess research groups across institutions and sectors, focusing on the first two criteria specified in Chapter 2: 'Strategy, resources and organisation' and 'Research production and quality' The assessments from the expert panels will also be used as part of the evidence base for a report on Norwegian research within life sciences (see section 3.3).

The evaluation committees will assess the administrative units based on all the criteria specified in Chapter 2. The assessment of research groups delivered by the expert panels will be a part of the evidence base for the committees' assessments of administrative units. See figure 1 below.

The evaluation committee has sole responsibility for the assessments and any recommendations in the report. The evaluation committee reaches a judgement on the research based on the administrative units and research groups' self-assessments provided by the RPOs, any additional documents provided by the RCN, and interviews with representatives of the administrative units. The additional documents will include a standardised analysis of research personnel and publications provided by the RCN.

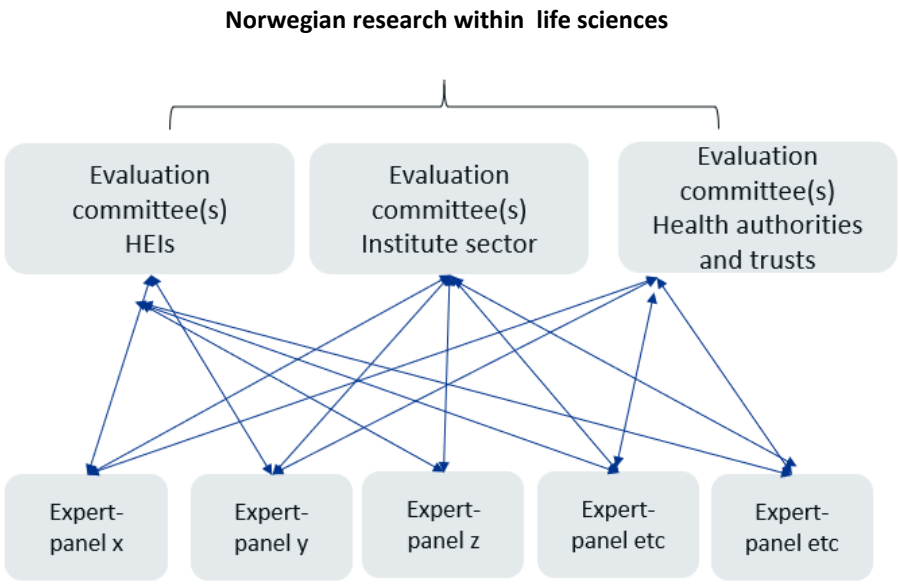

Figure 1. Evaluation committees and expert panels

The evaluation committee takes international trends and developments in science and society into account when forming its judgement. When judging the quality and relevance of the research, the committees shall bear in mind the specific tasks and/or strategic goals that the administrative unit has set for itself including sectoral purposes (see section 2.4 above).

Accuracy of factual information

The administrative unit under evaluation should be consulted to check the factual information before the final report is delivered to the RCN and the board of the institution hosting the administrative unit.

National level report

Finally, the RCN will ask the chairs of the evaluation committees to produce a national-level report that builds on the assessments of administrative units and the national-level assessments produced by the expert panels. The committee chairs will present their assessment of Norwegian research in life sciences at the national level in a separate report that pays specific attention to:

- Strengths and weaknesses of the research area in the international context
- The general resource situation regarding funding, personnel and infrastructure
- PhD training, recruitment, mobility and diversity
- Research cooperation nationally and internationally
- Societal impact and the role of research in society, including Open Science

This national-level assessment should be presented to the RCN.

Appendix A: Terms of References (ToR)

[Text in red to be filled in by the Research-performing organisations (RPOs)]

The board of [RPO] mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess [administrative unit] based on the following Terms of Reference.

Assessment
You are asked to assess the organisation, quality and diversity of research conducted by [administrative unit] as well as its relevance to institutional and sectoral purposes, and to society at large. You should do so by judging the unit's performance based on the following five assessment criteria (a. to e.). Be sure to take current international trends and developments in science and society into account in your analysis.

a) Strategy, resources and organisation
b) Research production, quality and integrity
c) Diversity and equality
d) Relevance to institutional and sectoral purposes
e) Relevance to society

For a description of these criteria, see Chapter 2 of the life sciences evaluation protocol. Please provide a written assessment for each of the five criteria. Please also provide recommendations for improvement. We ask you to pay special attention to the following [n] aspects in your assessment:

1. …
2. …
3. …
4. …

…

[To be completed by the board: specific aspects that the evaluation committee should focus on – they may be related to a) strategic issues, or b) an administrative unit's specific tasks.]

In addition, we would like your report to provide a qualitative assessment of [administrative unit] as a whole in relation to its strategic targets. The committee assesses the strategy that the administrative unit intends to pursue in the years ahead and the extent to which it will be capable of meeting its targets for research and society during this period based on available resources and competence. The committee is also invited to make recommendations concerning these two subjects.

Documentation
The necessary documentation will be made available by the life sciences secretariat at Technopolis Group.

The documents will include the following:

- a report on research personnel and publications within life sciences commissioned by RCN
- a self-assessment based on a template provided by the life sciences secretariat
- [to be completed by the board]

Interviews with representatives from the evaluated units
Interviews with the [administrative unit] will be organised by the evaluation secretariat. Such interviews can be organised as a site visit, in another specified location in Norway or as a video conference.

Statement on impartiality and confidence
The assessment should be carried out in accordance with the *Regulations on Impartiality and Confidence in the Research Council of Norway*. A statement on the impartiality of the committee members has been recorded by the RCN as a part of the appointment process. The impartiality and confidence of committee and panel members should be confirmed when evaluation data from [the administrative unit] are made available to the committee and the panels, and before any assessments are made based on these data. The RCN should be notified if questions concerning impartiality and confidence are raised by committee members during the evaluation process.

Assessment report
We ask you to report your findings in an assessment report drawn up in accordance with a format specified by the life sciences secretariat. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to the [administrative unit] and RCN by [date]. The [administrative unit] should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the life sciences secretariat no later than two weeks after receipt of the draft report. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the board of [the RPO] and the RCN no later than two weeks after all feedback on inaccuracies has been received from [administrative unit].

Appendix B: Data sources

The lists below shows the most relevant data providers and types of data to be included in the evaluation. Data are categorised in two broad categories according to the data source: National registers and self-assessments prepared by the RFOs. The RCN will commission an analysis of data in national registers (R&D-expenditure, personnel, publications etc.) to be used as support for the committees' assessment of administrative units. The analysis will include a set of indicators related to research personnel and publications.

- **National directorates and data providers**
- Norwegian Directorate for Higher Education and Skills (HK-dir)
- Norwegian Agency for Quality Assurance in Education (NOKUT)
- Norwegian Agency for Shared Services in Education and Research (SIKT)
- Research Council of Norway (RCN)
- Statistics Norway (SSB)

National registers

1) R&D-expenditure
    a. SSB: R&D statistics
    b. SSB: Key figures for research institutes
    c. HK-dir: Database for Statistics on Higher Education (DBH)
    d. RCN: Project funding database (DVH)
    e. EU-funding: eCorda
2) Research personnel
    a. SSB: The Register of Research personnel
    b. SSB: The Doctoral Degree Register
    c. RCN: Key figures for research institutes
    d. HK-dir: Database for Statistics on Higher Education (DBH)
3) Research publications
    a. SIKT: Cristin - Current research information system in Norway
    b. SIKT: Norwegian Infrastructure for Bibliometrics
    (full bibliometric data incl. citations and co-authors)
4) Education
    a. HK-dir/DBH: Students and study points
    b. NOKUT: Study barometer
    c. NOKUT: National Teacher Survey
5) Sector-oriented research
    a. RCN: Key figures for research institutes
6) Patient treatments and health care services
    a. Research & Innovation expenditure in the health trusts
    b. Measurement of research and innovation activity in the health trusts
    c. Collaboration between health trusts and HEIs
    d. Funding of research and innovation in the health trusts
    e. Classification of medical and health research using HRCS (HO21 monitor)

Self-assessments

1) Administrative units
    a. *Self-assessment covering all assessment criteria*
    b. Administrative data on funding sources
    c. Administrative data on personnel
    d. Administrative data on the division of staff resources between research and other activities (teaching, dissemination etc.)
    e. Administrative data on research infrastructure and other support structures
    f. SWOT analysis
    g. Any supplementary data needed to assess performance related to the strategic goals and specific tasks of the unit

2) Research groups
    a. *Self-assessment covering the first two assessment criteria (see Table 1)*
    b. Administrative data on funding sources
    c. Administrative data on personnel
    d. Administrative data on contribution to sectoral purposes: teaching, commissioned work, clinical work [will be assessed at committee level]
    e. Publication profiles
    f. Example publications and other research results (databases, software etc.) The examples should be accompanied by an explanation of the groups' specific contributions to the result
    g. Any supplementary data needed to assess performance related to the benchmark defined by the administrative unit

The table below shows how different types of evaluation data may be relevant to different evaluation criteria. Please note that the self-assessment produced by the administrative units in the form of a written account of management, activities, results etc. should cover all criteria. A template for the self-assessment of research groups and administrative units will be commissioned by the RCN from the life sciences secretariat for the evaluation.

Table 1. Types of evaluation data per criterion

Evaluation units / Criteria	Research groups	Administrative units
Strategy, resources and organisation	Self-assessment Administrative data	Self-assessment National registers Administrative data SWOT analysis
Research production and quality	Self-assessment Example publications (and other research results)	Self-assessment National registers
Diversity, equality and integrity		Self-assessment National registers Administrative data
Relevance to institutional and sectoral purposes		Self-assessment Administrative data
Relevance to society		Self-assessment National registers Impact cases
Overall assessment	*Data related to:* *Benchmark defined by administrative unit*	*Data related to:* *Strategic goals and specific tasks of the admin. unit*

Description of expert panels, list of administrative units and research groups

- 3 sector-specific evaluation committees (in total 18 committee members)
- 97 research groups, including seven research groups evaluated by expert panels in EVALNAT 2022-2023
- 5 international expert panels (in total 25 panel members)

Expert panels description

Panel 1 **Land and freshwater based ecosystems, resources and environment**	Land environment and freshwater ecosystems, structure, function, variation and change, sustainable harvesting, biological diversity, value creation and environmental benefits. Includes impacts from climate change, environmental impacts and pollution etc. to the terrestrial environment, fresh water and air. Management perspectives such as ecosystem services, land use and sustainability, etc.
Panel 2 **Marine ecosystems, resources and environment**	Structure, function, variation and change of marine ecosystems, sustainable harvesting, biological diversity, value creation. Includes impacts from climate change, environmental impact, and emissions to the marine environment, etc., and management perspectives such as ecosystem services, land use and sustainability, etc.
Panel 3 **Ecological and evolutionary biological subject**	Applications with emphasis on basic studies in evolutionary biology and ecology subjects including how Climate change can affect these.
Panel 4a **Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human issues**	Studies of basic molecular biology and physiology in animals, plants and microorganisms, i.a. species that are important for aquaculture, agriculture, nutritional biology, genetics, and breeding. Animal health and welfare, "omics" - methods, biotechnology, bioinformatics and computational biology.
Panel 4b **Molecular biology and physiology. Mainly human issues**	Studies of anatomy, physiology, neurobiology, toxicology, pharmacology, embryology, nutritional physiology, pathology, veterinary sciences, microbiology, immunology, cell biology, biochemistry, genetics, genomics, biotechnology, bioinformatics and computational biology.

List of administrative units and research groups

Administrative unit (alphabetic)	Evaluation Committee	Research group	Expert panel
Computational Biology Unit, UiB	Committee 2 Higher Education Sector	Computational Biology Unit (CBU)	Panel 4b Molecular biology and physiology. Mainly human topics
Department for Biotechnology and Nanomedicine, Sintef Industry	Committee for Institute Sector	Department for Biotechnology and Nanomedicine	Panel 4b Molecular biology and physiology. Mainly human topics
Department of biological sciences , UiB	Committee 2 Higher Education Sector	Environmental- and aquaculture-biology (EAB)	Panel 3 Ecological and Evolutionary biological subject
		Fish health	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Fjord Coast	Panel 2 Marine ecosystems, resources and environment

Administrative unit (alphabetic)	Evaluation Committee	Research group	Expert panel
		Microbiology	Panel 3 Ecological and Evolutionary biological subject
		Molecular biology	Panel 1 Land and freshwater based ecosystems, resources and environment
		Terrestrial Ecology Research Group (TERG)	Panel 3 Ecological and Evolutionary biological subject
		Theoretical Ecology Group (TEG)	Panel 4b Molecular biology and physiology. Mainly human topics
Department of Biology, NTNU	Committee 1 Higher Education Sector	Animal Physiology Section	Panel 2 Marine ecosystems, resources and environment
		Centre for Biodiversity Dynamics (CBD)	Panel 3 Ecological and Evolutionary biological subject
		Environmental Toxicology (ENVITOX)	Panel 2 Marine ecosystems, resources and environment
		Marine Sciences	Panel 2 Marine ecosystems, resources and environment
		MOLSYSBIO	Panel 1 Land and freshwater based ecosystems, resources and environment
		Multiscale biology (MSB)	Panel 4b Molecular biology and physiology. Mainly human topics
Department of Biosciences, UiO	Committee 2 Higher Education Sector	Aqua	Panel 3 Ecological and Evolutionary biological subject
		Biochemistry and Molecular Biology (BMB)	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Centre for Ecological and Evolutionary Synthesis (CEES)	Panel 2 Marine ecosystems, resources and environment
		Genetics and Evolutionary Biology (EVOGENE)	Panel 3 Ecological and Evolutionary biological subject
		Physiology and Cell Biology (FYSCELL)	Panel 4b Molecular biology and physiology. Mainly human topics
Department of Biotechnology and Food Science, NTNU	Committee 2 Higher Education Sector	BiopolBiomat	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Food Science	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Industrial and Environmental biotechnology	Panel 4b Molecular biology and physiology. Mainly human topics
Department of Chemistry, Bioscience and Environmental Engineering, UiS	Committee 2 Higher Education Sector	Circular Economy	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
		One Health	Panel 4b Molecular biology and physiology. Mainly human topics
Department of Natural history, NTNU	Committee 1 Higher Education Sector	Dep. Of Natural History (IHN)	Panel 3 Ecological and Evolutionary biological subject
Faculty of Bioscience, NMBU	Committee 2 Higher Education Sector	Breeding, Genetics and Food Production Systems	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Ethology and animal environment	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics

Administrative unit (alphabetic)	Evaluation Committee	Research group	Expert panel
		Genetics and Plant Breeding	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Genome Biology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Nutrition and Physiology in Monogastric Animals	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Plant Biology and Plant Biotechnology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Plant Protection and Food Crops	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Ruminant Nutrition and Physiology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
Faculty of Biosciences and Aquaculture, Nord university	Committee 2 Higher Education Sector	Animal Science	Panel 2 Marine ecosystems, resources and environment
		Aquaculture and Algae and microbial Technology	Panel 2 Marine ecosystems, resources and environment
		Ecology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Genomics	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
Faculty of Biosciences, Fisheries and Economics, UiT	Committee 2 Higher Education Sector	Arctic chronobiology and physiology (ACP)	Panel 2 Marine ecosystems, resources and environment
		Arctic Marine System Ecology (AMSE)	Panel 1 Land and freshwater based ecosystems, resources and environment
		Freshwater Ecology Group (FEP)	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Microorganisms and Plants (MP)	Panel 1 Land and freshwater based ecosystems, resources and environment
		Northern Populations and Ecosystems (NPE)	Panel 2 Marine ecosystems, resources and environment
		Norwegian College of Fishery Science (NCFS)	Panel 4b Molecular biology and physiology. Mainly human topics
Faculty of Chemistry, Biotechnology and Food Science, NMBU	Committee 2 Higher Education Sector	Bioinformatics & Applied Statistics (BIAS)	Panel 1 Land and freshwater based ecosystems, resources and environment
		Biotechnology	Panel 4b Molecular biology and physiology. Mainly human topics
		Food quality and sustainability (SciFood)	Panel 4b Molecular biology and physiology. Mainly human topics
		Microbiology	Panel 4b Molecular biology and physiology. Mainly human topics
		Natural Product Chemistry and Organic Analysis	Panel 4b Molecular biology and physiology. Mainly human topics
		Nitrogen	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023

Administrative unit (alphabetic)	Evaluation Committee	Research group	Expert panel
Faculty of Environmental Sciences and Natural Resource Management, NBMU	Committee 1 Higher Education Sector	Ecology and Natural Resource Management	Panel 1 Land and freshwater based ecosystems, resources and environment
		Environmental Chemistry (ESC))	Panel 1 Land and freshwater based ecosystems, resources and environment
		Renewable energy and forest sciences	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
		Soil and Water Section (SWS)	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
Faculty of Science and Engineering, UiA	Committee 1 Higher Education Sector	Centre for Coastal Research	Panel 2 Marine ecosystems, resources and environment
Natural History Museum, UiO	Committee 1 Higher Education Sector	EDGE	Panel 3 Ecological and Evolutionary biological subject
		Evolution and Paleobiology Group (EPA)	Panel 3 Ecological and Evolutionary biological subject
		Frontiers in Evolutionary Zoology (FEZ)	Panel 3 Ecological and Evolutionary biological subject
		Geo-Ecology Research Group (GEco)	Panel 1 Land and freshwater based ecosystems, resources and environment
		Integrative Systematics Of Plants and Fungi (ISOP)	Panel 1 Land and freshwater based ecosystems, resources and environment
		Norwegian Center for Minerology (NORMIN)	Panel 3 Ecological and Evolutionary biological subject
		Norwegian Center for Paleontology (NORPAL)	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
		Sex and Evolution Research Group (SERG)	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
Nofima, Nofima	Committee for Institute Sector	Nutrition and feed technology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Breeding and Genetics	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Fish health	Panel 2 Marine ecosystems, resources and environment
		Industrial economics	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		Production biology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
Norwegian Institute for Nature Research, NINA	Committee for Institute Sector	Cervids and domestic reindeer	Panel 1 Land and freshwater based ecosystems, resources and environment
		Coastal ecology and seabirds	Panel 2 Marine ecosystems, resources and environment
		Ecological condition and nature index	Panel 1 Land and freshwater based ecosystems, resources and environment
		Ecosystem accounting and environmental economics	Panel 1 Land and freshwater based ecosystems, resources and environment
		Freshwater ecology	Panel 1 Land and freshwater based ecosystems, resources and environment

Administrative unit (alphabetic)	Evaluation Committee	Research group	Expert panel
		Human-Carnivore coexistence	Panel 1 Land and freshwater based ecosystems, resources and environment
		Innovative methods, GIS and big data	Panel 1 Land and freshwater based ecosystems, resources and environment
		Pollination ecology and enthomology	Panel 1 Land and freshwater based ecosystems, resources and environment
		Renewable energy	Panel 1 Land and freshwater based ecosystems, resources and environment
		Restauration ecology and nature-based solutions	Panel 2 Marine ecosystems, resources and environment
		Salmonids	Panel 1 Land and freshwater based ecosystems, resources and environment
		Terrestrial ecology	Panel 1 Land and freshwater based ecosystems, resources and environment
Research Department, Norwegian Polar Institute	Committee for Institute Sector	Biodiversty and ecotoxiocology	Panel 2 Marine ecosystems, resources and environment
		Ocean Sea Ice Geology Geophysics	Evaluated in an expert panel in the Evaluation of Natural Sciences (EVALNAT) 2022-2023
Institute of Marine Research	Committee for Institute Sector	Barents and Polar Seas	Panel 2 Marine ecosystems, resources and environment
		Coastal ecosystems	Panel 2 Marine ecosystems, resources and environment
		Environmental impacts of Aquaculture	Panel 2 Marine ecosystems, resources and environment
		Future Aquaculture	Panel 2 Marine ecosystems, resources and environment
		Global development	Panel 2 Marine ecosystems, resources and environment
		Marine processes	Panel 2 Marine ecosystems, resources and environment
		North Sea	Panel 2 Marine ecosystems, resources and environment
		Norwegian Sea	Panel 2 Marine ecosystems, resources and environment
		Safe and healthy seafood	Panel 2 Marine ecosystems, resources and environment
Arctic University Museum, UiT	Committee 1 Higher Education Sector	NEAT-Norwegian Centre for eDNA of Arctic Ecosystems Through Time	Panel 3 Ecological and Evolutionary biological subject
Faculty of Veterinary Medicine, NMBU	Committee 1 Higher Education Sector	PARAFAG-Infection biology and nutrition	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		PARAFAG-Pharmacology and Toxicology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		PrePat-Dept. of Preclinical Sciences and Patology	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
		ProdMed-Dept. of Production Animal Clinical Sciences	Panel 4a Molecular biology and physiology of animals, plants and microorganisms. Mainly non-human topics
University Museum of Bergen, UiB	Committee 1 Higher Education Sector	Biosystematics and Paleobiology (UMBIO)	Panel 3 Ecological and Evolutionary biological subject

Composition of National Evaluation Committee EVALBIOVIT

The Committee consisted of the chairs of the three evaluation committees:

- Colin Moffat, Robert Gordon University, leader of the National committee/chair of committee 3
- Marianne Holmer, University of Southern Denmark, chair of committee 1
- Ivo Sbalzarini, TU Dresden & Max Planck Institute of Molecular Cell Biology and Genetics, chair of committee 2

Geert van der Veen, Managing Partner, Technopolis Group, was secretary to the committee.

Scales for research group assessment

Use whole integers only – no fractions!

Organisational dimension

Score	Organisational environment
5	An organisational environment that is outstanding for supporting the production of excellent research.
4	An organisational environment that is very strong for supporting the production of excellent research.
3	An organisational environment that is adequate for supporting the production of excellent research.
2	An organisational environment that is modest for supporting the production of excellent research.
1	An organisational environment that is not supportive for the production of excellent research.

Quality dimension

Score	Research and publication quality	Score	Research group's contribution Groups were invited to refer to the Contributor Roles Taxonomy in their description https://credit.niso.org/
5	Quality that is outstanding in terms of originality, significance and rigour.	5	The group has played an outstanding role in the research process from the formulation of overarching research goals and aims via research activities to the preparation of the publication.
4	Quality that is internationally excellent in terms of originality, significance and rigour but which falls short of the highest standards of excellence.	4	The group has played a very considerable role in the research process from the formulation of overarching research goals and aims via research activities to the preparation of the publication.
3	Quality that is recognised internationally in terms of originality, significance and rigour.	3	The group has a considerable role in the research process from the formulation of overarching research goals and aims via research activities to the preparation of the publication.
2	Quality that meets the published definition of research for the purposes of this assessment.	2	The group has modest contributions to the research process from the formulation of overarching research goals and aims via research activities to the preparation of the publication.
1	Quality that falls below the published definition of research for the purposes of this assessment.	1	The group or a group member is credited in the publication, but there is little or no evidence of contributions to the research process from the formulation of overarching research goals and aims via research activities to the preparation of the publication.

Societal impact dimension

Score	Research group's societal contribution, taking into consideration the resources available to the group	Score	User involvement
5	The group has contributed extensively to economic, societal and/or cultural development in Norway and/or internationally.	5	Societal partner involvement is outstanding – partners have had an important role in all parts of the research process, from problem formulation to the publication and/or process or product innovation.
4	The group's contribution to economic, societal and/or cultural development in Norway and/or internationally is very considerable given what is expected from groups in the same research field.	4	Societal partners have very considerable involvement in all parts of the research process, from problem formulation to the publication and/or process or product innovation.
3	The group's contribution to economic, societal and/or cultural development in Norway and/or internationally is on par with what is expected from groups in the same research field.	3	Societal partners have considerable involvement in the research process, from problem formulation to the publication and/or process or product innovation.
2	The group's contribution to economic, societal and/or cultural development in Norway and/or internationally is modest given what is expected from groups in the same research field.	2	Societal partners have a modest part in the research process, from problem formulation to the publication and/or process or product innovation.
1	There is little documentation of contributions from the group to economic, societal and/or cultural development in Norway and/or internationally.	1	There is little documentation of societal partners' participation in the research process, from problem formulation to the publication and/or process or product innovation.

References

- Evaluation Protocol Evaluation of life sciences in Norway 2022-2024 (*Research Council of Norway, 2022*)
- 22 Administrative Unit´s Evaluation reports
- Administrative Unit's impact cases
- Panel reports from the Expert panels (five expert panels)
- Evaluation of biosciences in Norway: Publication and citation analysis – a national profile *(NIFU Working Paper; 2023:3)*
- Statistics for use in the evaluation of biosciences in Norway: Analysis of research personnel in 2013, 2017 and 2021 *(SSB Reports 2023/12)*
- Funding data – The Research Council´s contribution to Biosciences research (*RCN*) (2023)
- Extract from the Survey for academic staff and the Student Survey (*Norwegian Agency for Quality Assurance in Education (NOKUT)*) (2023)

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