EVALNAT
Evaluation of natural sciences in Norway 2022-24

National Report

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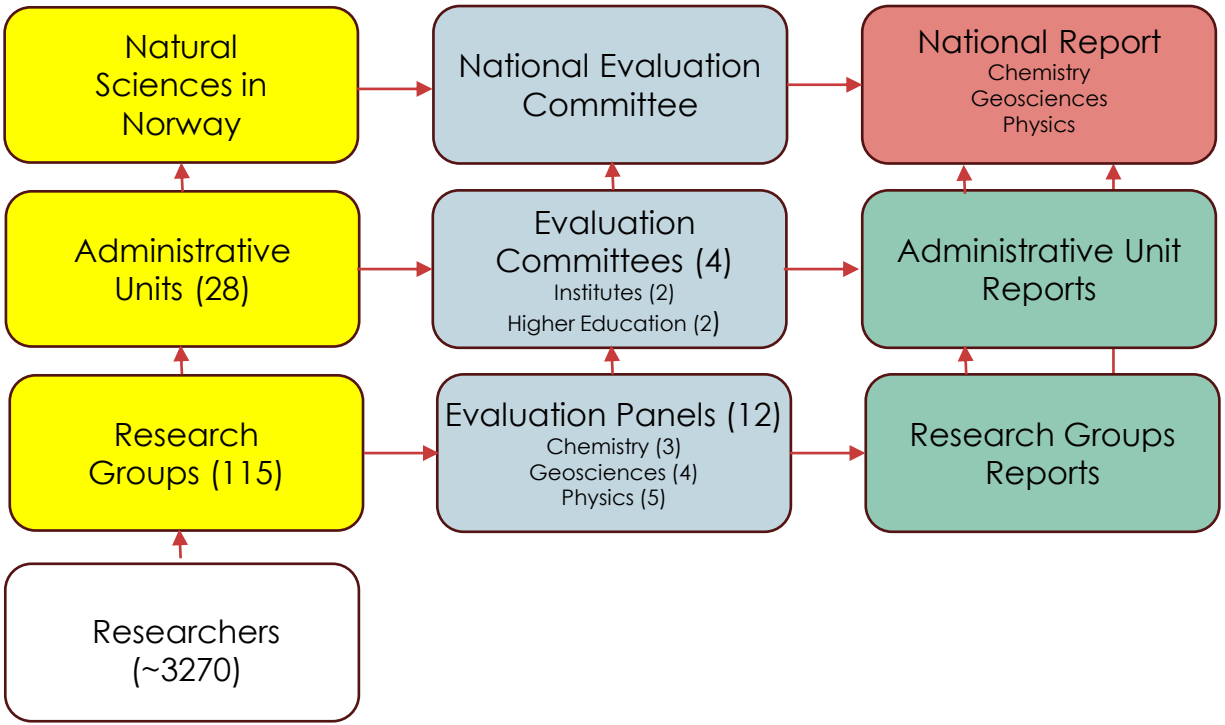
The aims of the evaluation

- The primary aim of the evaluation of Natural sciences is to assess the quality and the relevance of research performed at Norwegian Higher Education Institutions and across the Institute Sector
- It 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

Structure of the EVALNAT process



The national evaluation committee

Professor **James Kirchner** (chair) ETH Zurich, Switzerland	Professor **Ilenia Rosetti** University of Milano, Italy
Professor **Mat Collins** University of Exeter, United Kingdom	Professor **Florencia Canelli** University of Zurich, Switzerland
Professor **Stewart Clarke** Durham University, United Kingdom	Professor **Amelie Hagelauer** Fraunhofer Research Institution, Germany

Dr Erik Arnold, Senior Partner, Technopolis Group, was the secretary to the committee.

Natural sciences are crucial for Norway

- Understanding how the natural world works, and how we interact with it
- Historically have supported industrial development
  - e.g marine, maritime, metals and process industries
  - Together with engineering, underpinned oil and gas boom
- Key to maintaining Norway's high-skill, high-wage, high-welfare economy while tackling new challenges such as climate change, decarbonisation, strategic materials ...
- Requires that Norway keeps up with international developments in science and their application
- Major contributors to the Long-Term Plan's competitiveness, sustainability and quality goals

Natural sciences overall

- Compared with world patterns of scientific publication:
  - Norway has a high share of geosciences output
  - Roughly an average share of physics publications
  - And a share of chemistry publications below the average
- All three disciplines contain a mixture of stronger and weaker research groups
- National research infrastructure is strong, and researchers have good access to international facilities
  - These sciences depend heavily on scientific equipment to do good research
  - Strong national infrastructure also boosts Norwegian participation in international research and R&D collaborations

Chemistry

Strengths	Weaknesses
• Very strong groups in catalysis, energy conversion, materials, chemical engineering & process systems engineering, theoretical chemistry • Some peaks of excellence for quality of scientific outcome • Excellent equipment and shared infrastructure • Good participation in European projects and international partnerships, with some groups particularly visible • Substantial funding from private companies (especially for institutes sector) • High impact on companies involved (especially by the institute sector) • Activities meet important UN SDGs	• Weak groups (with some exceptions) in organic chemistry and biochemistry, analytical chemistry, environmental chemistry • Some groups are small or fragmented and poorly organised • Strategy often unclear, limiting performance • Scientific productivity generally well below international norms • In some cases, limited number of PhDs and post-docs • Outreach and communication to the general public is almost never considered
Opportunities	**Threats**
• Excellent infrastructure and equipment foster international partnerships and participation in collaborative projects • Availability of critical raw materials in Norway offers research, exploitation and commercial opportunities • Strong competences in Catalysis, chemical engineering and material science from oil & gas work can easily be reapplied to search challenges in green and energy transitions • Very strong network of companies, used to collaborate with universities and research institutes	• Limited institutional research funding for Institutes limits basic research and can make it harder to participate in EU projects • High share of external funding at research institutes exposes groups to risk • Limited attractiveness for employment in geographically peripheral Universities

Geosciences

Strengths	Weaknesses
• Strong research groups, especially in areas of geoscience relevant to understanding and mitigating climate change and other environmental challenges • Norway is internationally recognised as a leader in geosciences, enabling strong international collaboration and attracting high levels of international funding • Numerous and diverse research institutes provide important services to Norwegian society (e.g., in hydrology and natural hazards) • Norwegian geoscience groups not only enjoy good physical infrastructure, including research vessels, but develop and maintain databases critical for monitoring and research • Some research groups (particularly those previously focused on oil and gas) are re-orienting their work to new needs, providing a basis for growth and restructuring in areas of social as well as scientific relevance	• Some organisations are resistant to restructuring and to doing more work in areas of societal need • The large number of free-standing research institutes involved means that university-institute links are weaker than they could be • High reliance on external funding, and a shortage of permanent posts in the universities, make scientific careers in Norway less attractive • Many units are reliant on winning funding from competitive grant schemes and thus invest a lot of time and energy into this, to the detriment of pursuing long-term strategic aims
Opportunities	**Threats**
• The geosciences have been growing in Norway over the period being evaluated, producing more work of societal relevance and making it easier to adapt organisations to new needs • Many areas of research that have historically supported the growth of oil & gas and other important Norwegian industries can also be applied to climate change mitigation and adaptation, and to meeting other societal challenges	• Need to preserve fundamental research and core research competences while evolving to meet new needs • High capital and running costs of the needed infrastructure – especially ships but also aircraft, satellites, and high-performance computing – offer potential targets for funding cuts, which would make it difficult or impossible to conduct research that is critical to tackling climate change and other societal challenges

Physics

Strengths	Weaknesses
• Areas such as particle, high energy and some areas of condensed matter physics are very strong • Some peaks of excellence for quality of science • Strong links with international infrastructures, especially CERN and ESA • Good participation in European projects and international partnerships • Some groups are reorienting their work towards new scientific and societal challenges, restructuring into fields such as quantum, sustainability and climate, materials science and biophysics, which provide bases for growth and development • Larger groups and departments are well placed to deliver strong teaching at all levels • High impact on society, for example via more efficient solar cells, faster cancer diagnostics, low-carbon energy solutions	• Some groups are small or fragmented and poorly organised, so they miss opportunities to use scale and scope to reduce their vulnerability, have difficulty in spanning both fundamental and applied aspects of research themes, and the emergence of new research fields becomes a treat rather than an opportunity • Strategy often unclear, limiting performance • Lack of interest by some groups in societal needs and ways to connect them to the research effort • Low proposal success rates and high 'bureaucratic' costs associated with obtaining research funding
Opportunities	**Threats**
• Excellent infrastructure and equipment combined with good access to international research organisations provide opportunities to increase both national and international collaboration • Opportunities to increase both national and international collaboration, which would be enhanced by better group strategy and a clearer national strategy on physics infrastructure • A more strategic approach at both levels, including more focus on interdisciplinary research, is needed to restructure and modernise the overall physics portfolio • Better strategies and management would increase both the quality and relevance of research, focusing effort on important scientific objectives and attention on the needs of problem-owners in society and ways to work with them to generate socio-economic impact • Clearer research strategies, better mentorship and quality control of proposals should imply a need to write fewer, better proposals to obtain external funding	• Existing organisational structures can impede restructuring and development, especially at the older universities • Scattered or inadequate buildings are in some places obstacles to growth and development • Difficulty of attracting students and junior academics in physics, especially in more peripheral areas • The high proportion of external funding may become a longer-term risk

Natural sciences research funding in Norway

- RCN funding has grown in Geosciences and to a lesser extent in chemistry; physics funding has been flatter
- Research depends heavily on external funding
  - University sector research is well supported by institutional funds overall (69% of research costs), though natural sciences need more equipment than most disciplines
  - Research institutes considered here had 6-20% institutional funds
- The state is the primary patron of natural sciences research
  - Norway lacks the big research foundations seen in some other countries
  - Hence recent funding changes and uncertainties undermine research strategies and planning
- RCN supports natural sciences through both PI-initiated and thematic programmes
  - Though success rates in PI-initiated funding are very low

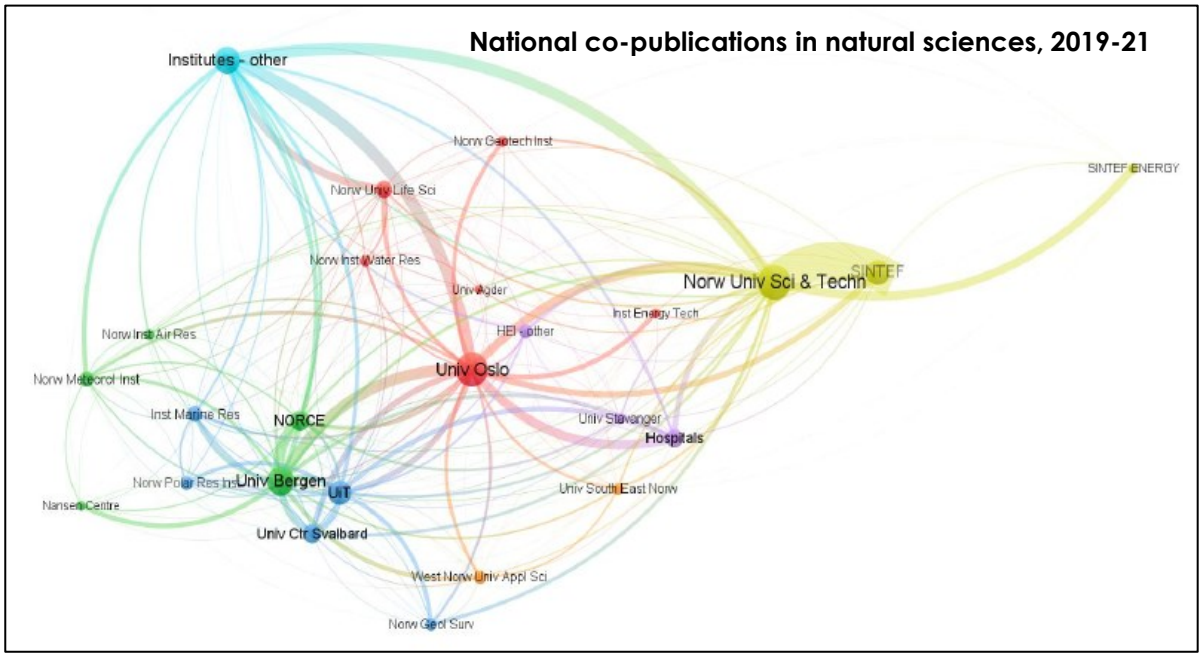
Personnel

- There was only patchy information in the self-assessment reports on personnel, mobility, and career development
  - Good-practice policies seemed largely to be in place, but there was little information on compliance
- The ratio of PhD students to professors (2.1:1) was somewhat lower than the international norm
- Small research groups were especially vulnerable to loss of senior personnel
- Despite many professors being close to retirement, there was little planning for succession or group restructuring
- It was becoming harder to recruit:
  - MSc and PhD students in physics and especially chemistry
  - Post-docs and junior faculty (especially foreigners) in the North of Norway

There has been progress on gender equality, but ethnic/cultural diversity is less well explored

- In the university research groups evaluated, women were
  - 33% of researchers overall (compared with 39% in the institutes)
  - 39% of PhD students
  - 33% of Post-docs
  - 35% of assistant professors
  - 21% of full professors
- In most of the university administrative units, women produced fewer author shares than men
- Some organisations were proud of their internationalism but took no account of their (lack of) ethnic diversity
- Few administrative units claimed to have comprehensive Equality, Diversity and Inclusiveness frameworks, and there were no useful data

National research cooperation seems strong, and Norway punches above its weight internationally



Karlstrøm, H. & Aksnes, D. W., 2023c. Evaluation of natural sciences in Norway: Publication and citation analysis – a national profile, Working Paper No 2023:2, Oslo: NIFU

Societal impact

- Much Norwegian natural sciences research is oriented to applications and can rely on strong, established links with industry
  - Especially in the institutes but also in the universities
- Research groups provided many, often convincing case studies of their societal impact
- A few university research groups, however, fail to understand the importance of their impact on social and economic development, and the need to describe it to maintain their legitimacy with tax-payers
- More broadly, groups and units could usefully do more dissemination of results, demonstrating the importance of science to the general public

Open Science

- Good progress on open access publication

	Archived ('green') Open Access	'Gold' Open Access	Not Open Access
Universities	48%	32%	20%
Research institutes	40%	37%	23%
Total	44%	35%	22%

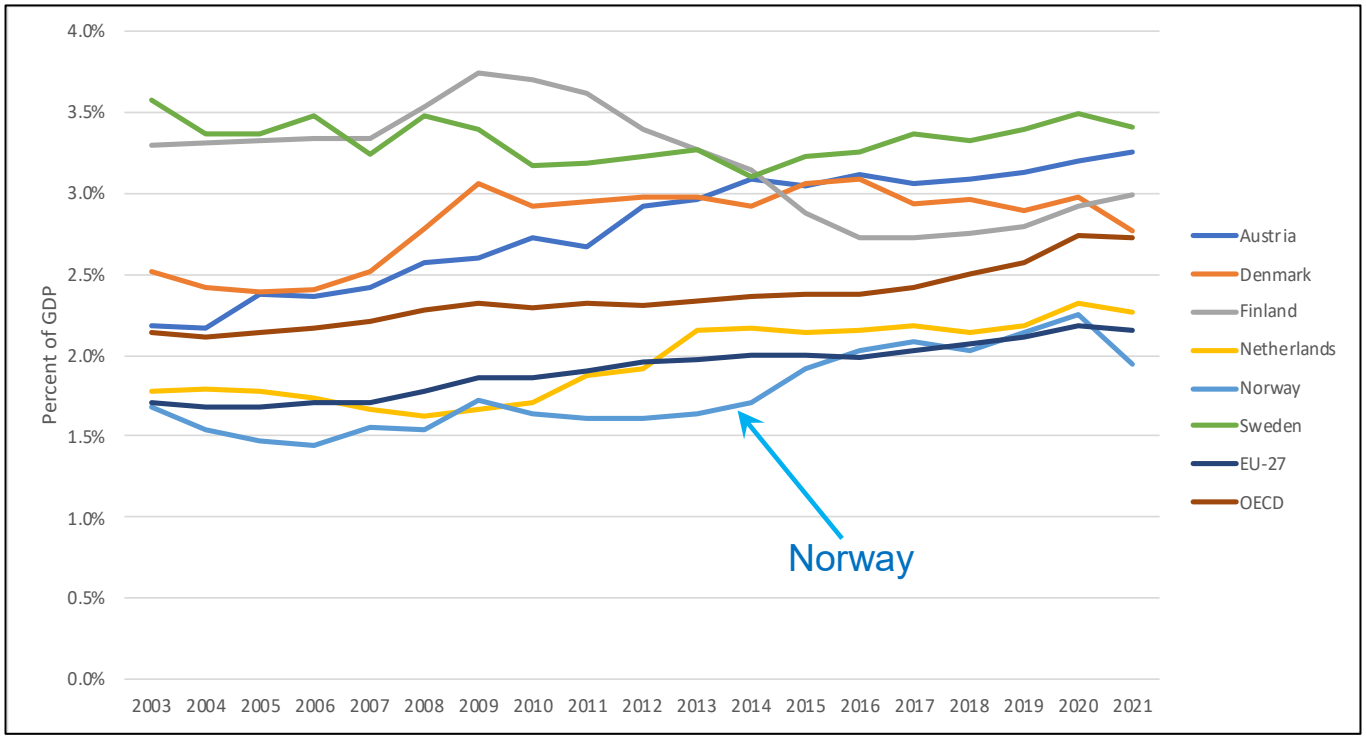
Source: (Karlstrøm & Aksnes, 2023a) (Karlstrøm & Aksnes, 2023b; Research Council of Norway, 2023)

- Many good statements about open data, but the self-assessment did not provide enough consistent data on implementation for the evaluators to reach any conclusions

Recommendations

- Develop a national plan to evolve and increase quality in Norwegian chemistry research
- Reduce funding uncertainty while maintaining competition in external funding
- Remove barriers to evolution in the structure of Norwegian natural science to address changing needs, improving incentives, research strategies, governance and human resource management
- Increase gender equality by making the research environment more hospitable to women
- Understand and address women's disadvantages in publication and the low level of diversity among Norwegian natural science researchers

Recommendations



GERD as a percentage of GDP for Norway and comparator countries, 2003-2021