Forskningsrådet

Evaluation of Natural Sciences 2022-2024

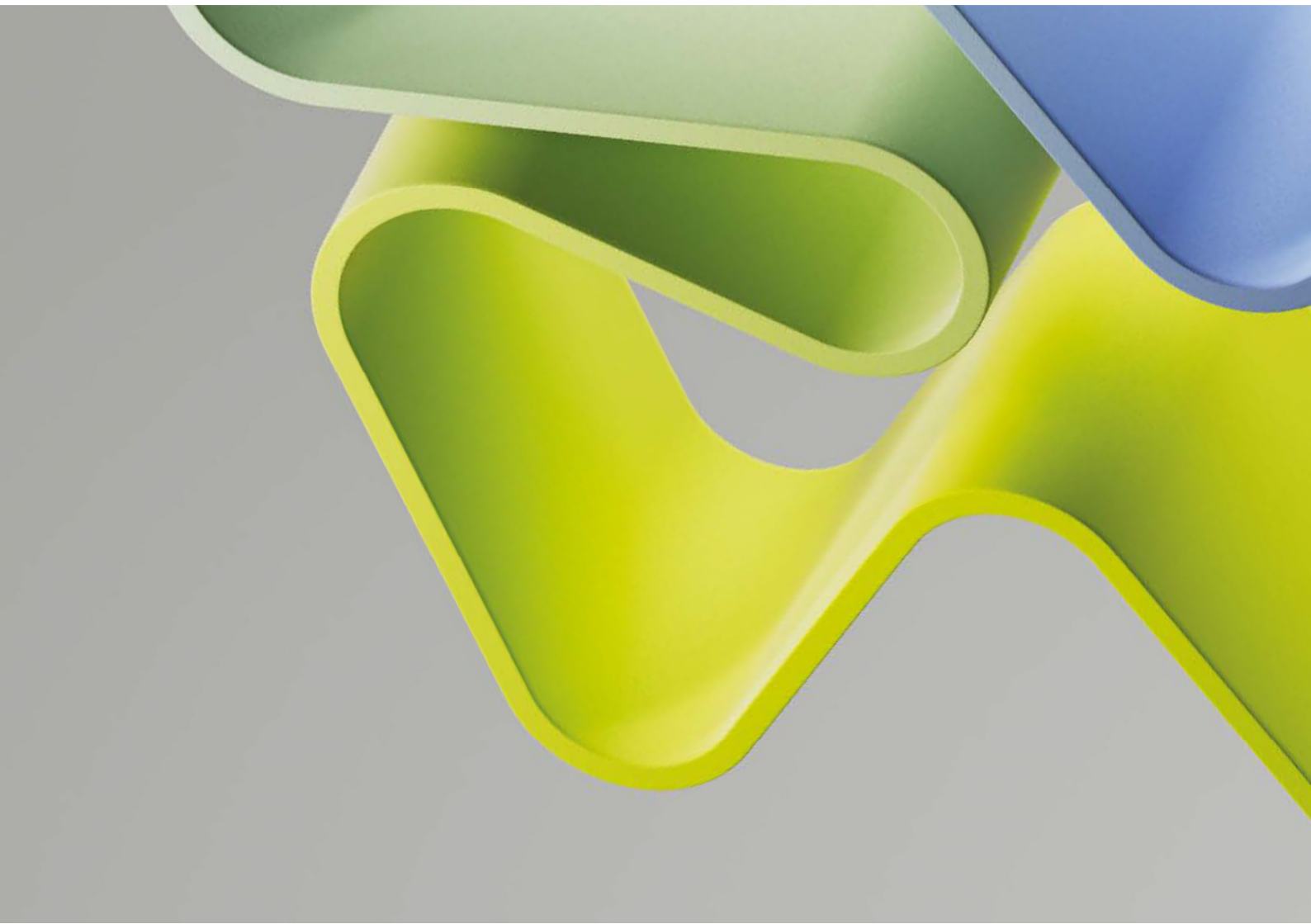
Evaluation report

Department of Energy Resources

Faculty of Science and Technology

University of Stavanger

January 2024



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Statement from Evaluation Committee II

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within natural sciences in 2022-2023 and submitted a report for each administrative unit:

- Department of Chemistry, Norwegian University of Science and Technology
- Department of Physics, Norwegian University of Science and Technology
- Department of Chemical Engineering, Norwegian University of Science and Technology
- Department of Materials Science and Engineering, Norwegian University of Science and Technology
- Department of Geoscience, University of Tromsø
- Department of Chemistry, University of Tromsø
- Department of Physics and Technology, University of Tromsø
- Department of Energy Resources, University of Stavanger
- UNIS – The University Centre in Svalbard

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the Evaluation Committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

Professor **Amelie Hagelauer** (chair)

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IFP Energies Nouvelles, France

Professor **Christian Ruegg**

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Professor **Guido Mul**

University of Twente, The Netherlands

Professor **Sigridur Suman**

University of Iceland, Iceland

Description of the administrative unit

University of Stavanger – UiS
Department of Energy Resources – IER

The administrative unit
The unit employs 34.2 FTE research staff out of which 6 are professors, 6.4 associate professors, 17 postdocs and PhD students, 0.8 adjunct personnel and 4 temporary researchers. IER education and research focus area is in energy, energy transition and achievement of climate goals. IER consists informally of four competence group areas that partly overlap: geosciences, reservoir engineering, computational engineering and decision making.

The belonging research groups
IER consists of one research group.

The administrative unit works in relation to the unit's strategies
The Department of Energy Resources' strategy for 2022-2030 states that the main focus is Energy, which aligns with the general university strategy areas "Energy and Green transition". Within Energy, the research activities are directed towards improved subsurface understanding for the utilization of the subsurface for energy production, security and the green energy transition, beyond petroleum (e.g., geothermal, energy and disposal storage).

The department competence includes several areas of expertise relevant for the subsurface (geosciences, reservoir, modelling and decision making). Synergies between the different scientific staff is encouraged to integrate these competences in the research projects. Competence is adapted based on the strategic focus and the development of the energy sector and its transformation. Most of the existing competence, which traditionally was focused mostly on petroleum, is being expanded to the current challenges within subsurface CO2 and hydrogen storage, geothermal energy, digitalization and other fields, such as near surface geophysics.

The unit works in relation to the belonging sector
Key activity is dissemination of knowledge towards society for building the general knowledge to understand the challenges and available solutions in energy, energy transition and achievement of climate goals. Some activities include school visits, political conferences, technical\business conferences, articles in local newspapers and social media. The unit also has been awarded EU and minister of education projects to build and map of the competence needs for the transforming energy sector. The new national petrosenter (NCS2030) has been a driver to increase the outreach activities over the last year as it symbolizes cooperation between the government, industry and academia to achieve the energy security and climate goals.

Where the unit will be in the future
According to the IER strategy for 2022-2030, IER's main goal in the field of research is to have a good reputation both nationally and internationally. The general research focus of the department is likely to have a higher focus on other energy resources than on petroleum in 2030 if the present energy trend in society is continued. Based on the current staff competence and resources, the immediate strategy within the field of energy resources leans towards improved subsurface understanding for a holistic utilization of the subsurface for the energy transition.

Overall assessment

IER-UiS has a long-standing excellent reputation in subsurface geology applied to energy problems. This department has a very good international reputation for efficient collaboration with industry. This department is going through a complex management period about energy transition and climate change. Nevertheless, the skills available in this department will be essential in the coming years to manage the energy transition. The skills developed in this department will be crucial for CO2 storage projects (CCUS). Ongoing research about CO2 storage is focused on water management. This is an important aspect, but the competencies of IER-UiS could also be very useful in a more global way concerning CCUS, notably in collaboration with other Norwegian universities. The experience of IER-UiS could also play an essential role in the mass storage of H2, should this prove necessary in Norway, for both salt cavern storage (the classic way of storing H2 in the subsurface) and aquifer storage (which remains a challenge requiring numerous feasibility studies). The skills developed at IER can also easily be applied to geothermal aspects even if today, this subject does not seem very well defined about the future objectives.

The main difficulty that IER-UiS faces is declining student numbers, which creates challenges in ensuring a good balance between teaching and research.

The Evaluation Committee considered the points raised by the unit in their Terms-of-Reference document and have commented on those throughout the report where applicable. Comments on interaction with the national research Centre NCS2030 are provided in Section 1.2. Organisation of research.

Recommendations

This administrative unit is in complete transition following the way of energy transition, but time is needed to succeed in teaching and to make research devoted for energy transition. This transition should be helped and should be done by capitalizing on the previously acquired knowledge and experience. Changing from oil & gas exploration and production research to environment-friendly research is not something that can be done in a few days. At this stage, whether UiS can maintain the high-quality research objectives of previous decades by adopting an approach more focused on societal and environmental objectives, supported by sufficient resources and skills, will depend on the sustainability of the department's public and industrial funding.

It should be absolutely avoided not to help this unit of applied science to succeed in this transition and to take advantage of the experience of what was acquired mostly in collaboration with industry to move forward, with the industry, toward new energetic perspectives. The Evaluation Committee recommends favouring more public funding to facilitate the period of transition of this unit, notably to help this department to maintain a stable number of PhD candidates.

To favour more EU-funding (in particular ERC-grants) in the coming years, IER-UiS should identify specific well-planed and well sequenced scientific projects in good agreement with the competence and past-experiences focussed on scientifically promising subjects in line with environmental and social aspects.

The Evaluation Committee encourages IER-UiS to try to better blend into the national and international scientific fabric. More interactions with other institutions should notably be encouraged about CCUS. Possibly, contributions to marine surveys with other institutions should also

help to enlarge interactions and collaborative research between academia and industry. Research about fluids, hydrate, slope stability and their links with climate change should be useful for environmental and risk aspects, and they can also be managed in close interaction with industry. Digitalization and AI are also ways of progress.

The Evaluation Committee encourages IER to maintain its high publication output by trying to publish in journals with a better citation rate. It seems important for IER-UiS to ensure that research projects are well aligned with the teaching provided within the department, by ensuring that teaching programmes remain attractive to the younger generation by offering job prospects while being driving and responsible in environmental and climate protection aspects. In particular, it is necessary to maintain and to reorient the master programme toward CO_2 neutral ways of producing oil & gas.

1. Strategy, resources, and organisation of research

IER has a comprehensive strategy towards research and innovation. The organisation of research is appropriate to achieve the stated objectives. Research staff composition is coherent and fits well with the objectives of this department. IER secures a significant level of external funding, including contract research from industry.

1.1 Research Strategy

The research strategy of this department was and is still focussed on subsurface studies. The traditional orientation of the IER was focused on oil & gas exploration and production but this department is now tending to be oriented toward Energy and Green transition, with a focus on subsurface understanding for energy production, security and the green energy transition, beyond petroleum (e.g., geothermal, energy and disposal storage). This department is facing a difficult period of transition between the time of conventional oil and gas exploration and production toward green energy, notably with challenges about subsurface CO_2 and H_2 storage, and geothermal energy. Digitalization is also a new challenge as well as other fields, such as near surface geophysics. Cross-sectorial collaboration about risk and economics, and engineering areas such as biochemistry and construction are also promoted for more interdisciplinary approaches towards society challenges such as hydrogen storage, environment, and economics.

The strengths of this administrative unit (geology, geophysics, reservoir) are mostly due to its proximity to the energy oil and gas industry, but at the same time this makes challenging the evolution of the activity of this administrative unit in the near future, which needs to move forward towards a green energy transition. There is also a problem of societal image and reputation which needs to be managed.

This duality between energy needs, potential funding from the industry, and also finding jobs for students but at the same time the necessity for energy transition makes things complex to manage at IER-UiS.

Carbon Sequestration Utilization and Storage (CCUS) is a subject which can help to capitalize the oil and gas experience of IER-UiS to move forward in the energy transition. During the questions addressed to this administrative unit it was mentioned that they focus their research toward water management, but it is only a restricted aspect and research about this subject should be enlarged.

H_2 storage problems are also addressed even if the geology of Norway is not very favourable for such mass storage. Indeed, hydrogen storage could be a challenge for Norway because there is a high potential for electricity production for which a part can be converted by electrolysis to H_2. However, the geology of Norway is not very favourable for H_2 mass storage since there is no important salt

layers (salt caverns being the classical place for mass storage of H_2), except in North Sea but this offshore location makes the feasibility quite challenging.

CCUS and H_2 storage could both potentially contribute to maintain good funding rates. The perspectives about geothermal research are from the available documents relatively vague.

Current and future strategic development must offer new areas for permanent positions and must cope with the replacement of retiring staff. Skills are adapted in line with the strategic direction and evolution of the energy sector and its transformation. As a result, even though the focus is on the subsurface, a new skill set much broader than oil is considered.

1.2 Organisation of research

IER-UiS consists informally of four competence group areas that partly overlap: geosciences, reservoir engineering, computational modelling and decision making.

The administrative unit is perfectly conscious of how they should evolve to maintain best practice. The head of the department is also director of NCS2030, helping to improve alignment and coordination of the administrative unit and synergies with other departments and research institutions.

The department's strategy is built around clear objectives and actions that are re-evaluated every three years. This makes it easy to redirect if necessary. An internal committee, representing the department's various competencies, is responsible for evaluating achievements every 1.5-2 years and adjusting if necessary.

1.3 Research funding

During the evaluation period, the department succeeded in obtaining both public and industrial funding, and in particular the department is one of the university's units that has benefited from the most external funding compared to public funding (more than 70%). Industrial funding rate of IER is still high even if this department is in complete transition but one might expect that difficulties should come because of the change of research orientation. Notably, difficulties to find PhD grants are rising especially because of the increase of PhD salaries.

1.4 Use of infrastructures

Infrastructure and investment are limited. The Faculty of Science and Technology has a research infrastructure relevant to the needs of the department, including laboratories for basic geoscientific analyses (thin sections, microscopes, electron microscopes), reservoir analyses (core analyses, pressure cells.), and powerful computer systems with state-of-the-art software (industry standard) and access to a network of servers. Depending on the type of research project, access to national and international infrastructures is possible, especially when special analyses (e.g., geochemistry, provenance) or access to national IT infrastructure are required. Costs depend on whether the project is a collaboration or a service. To access to top level infrastructures IER-UiS is largely dependent on collaborations with other institutions.

1.5 National and international collaboration

The department's policy is to encourage collaboration at all levels. National and international collaboration has been one of the department's key drivers, given the vast network of researchers (many of whom have international training and experience in the hydrocarbon field), and it has been crowned with success. Petrocenters and industrial consortia have, or have had, a vast national and international network of collaborators, which is fundamental to project development and results.

Cross-sector collaboration in the fields of risk and economics, as well as in other engineering fields such as biochemistry and construction, is also growing. The result is more interdisciplinary approaches to societal challenges such as hydrogen storage, the environment, and the economy. IER is collaborating (research and teaching) with several Norwegian universities (Svalbard, Oslo, Berge, Tromso). IER is also collaborating with international institutions, notably the University of Moscow, the Geological Survey of Denmark, the University of Texas at Austin, and the University of Houston. Note that the increasing international collaborations is indicated by more international co-authors.

1.6 Research staff

About 2/3 of the staff activity is dedicated to research and 1/3 is dedicated to teaching and administration. IER education and research focus area is in energy, energy transition and achievement of climate goals. Research staff composition is coherent and fits well with the objectives of this department.

2. Research production, quality and integrity

The quality of the research output is good and the intensive collaboration with industry has not had a negative effect on the scientific production, although, publishing is mostly in industry oriented journals. This has some effect on the citation scores.

The administrative unit’s research integrity and management strategy are well outlined, and actions are taken in this regard.

2.1 Research quality and integrity

Research group overall assessment

The standard reference at the IER-UiS department is that 40% of the time is spent on education, 40% in research and 20% in administration. This department is a very good unit which has a lot of experience in research and is still making very good research. But this unit is directly facing (as the whole world) the problem of managing the energy transition. This unit has good results from collaborations with industry via consortia with a large national and international network of collaborators. This department has a high activity in Geosciences turned toward Oil & Gas industry. The scientific production is very good with an increase of publications since 2018 (45 in 2018 to 69 in 2021) in good journals mostly industry oriented, and respecting DORA-declaration. Worth to be noted is the good ratio Number of publications/FTE > 1.72 and increasing international co-authors during the last decade. Because the publications are mostly made in applied scientific journals, the citations per publication is not very high but this is compensated by the fact that these journals are more read than pure science journals. IER-UiS should publish more in high impact journals to get a better recognition within the academic world.

IER-UiS also organizes activities, like school visits, political conferences, technical conferences, articles published in newspapers and social medias. IER-UiS also favours different actions of innovation and commercialisation.

Mobility is encouraged by covering expenses related to sabbatical (all applications have been granted). This is fully covered (salary, travel- and mobility costs) and is granted by the faculty based on a set of well-defined criteria set out in the call. These are (among others) quality of application, mobility plan, relevance to strategic areas, synergies to other research projects, gender balance career development. Applications within the unit are prioritized by the head of administrative unit.

Research group: Energy Resources

The group's organisation and strategy function well but much of the information provided is generic or vague. The group's publications are generally excellent in terms of originality, significance and rigour, appearing in good quality energy sector journals where they have attracted moderate numbers of citations. IER's research is dominantly industry funded and we therefore conclude that it is of significant economic value to Norwegian society. Overall, the group is performing at a very strong level for supporting the production of excellent research.

2.2. Open Science

UiS signed the DORA declaration and committed to the FAIR principles. In 2022, UiS also signed the NOR-CAM agreement.

The department has an open policy following the University and government policies. Open access publications are obligatory in all publicly financed projects, and it is encouraged in all externally sponsored projects. Research data and implementation of the FAIR principles is work in progress and will be implemented when applicable. Many of the researchers have developed open source softwares that are freely accessible. In addition to institutional agreements at national level, the TN faculty has established annual funding of around 1 MNOK for the coverage of open access publications. This funding is managed by UBIS according to a predefined application and approval procedure. In addition, UBIS has set up two local open access publishing platforms for scientific literature: "Open Journal Systems (OJS)" for journals and "Open Monograph Press (OMP)" for e-books. However, open peer review is not provided for at institutional level. During the period of evaluation, we observed an increase of open access publications.

3. Diversity and equality

Only 20% of the staff are female. The department has only one female professor (out of six) and more female associate professors (23% female). Future recruitments should take care of a better gender balance. The average age of the staff of this department is relatively old (50 years). There is obviously a need for younger staff.

UiS is active to propose several actions directed towards early-stage career researchers such as 'PhD Get Started' an introductory course held once every semester, and soft skills workshops offered to the PhD candidates.

4. Relevance to institutional and sectorial purposes

The department's teaching and research focuses on energy and the energy transition. Consequently, one of the key activities is the dissemination of knowledge to society to develop the general knowledge needed to understand the challenges and solutions available. The new National Petroleum Center (NCS2030) has been the driving force behind the increase in awareness-raising activities over the past year, as it symbolizes the cooperation between government, industry, and academia to achieve energy security and climate goals.

At administrative level, the new petroleum center (NCS2030) and the innovation programme are being developed to bridge the gap between researchers and the innovation program.

5. Relevance to society

The main contributions of the IER are to strengthen skills and research in understanding the subsurface, sustainable resource use and achieving climate objectives. The Norwegian continental shelf is the main generator of value creation for Norwegian society and plays a fundamental role in the energy sector. Consequently, all the department's activities are of crucial importance, not only for Norway, but also for society in general. All study programmes are designed to develop fundamental and advanced skills in understanding the subsurface with a view to the energy transition. Existing research projects and skills focus on a holistic approach of the subsurface for a sustainable energy system in a long-term energy mix scenario (oil & gas, geothermal, hydrogen and CO_2 storage).

Comments to impact case 1

IOR Petrosenter National Center. IOR processes are of economic and strategic importance for the efficient and environmentally friendly development of underground oil and gas resources. In the case of the Norwegian continental shelf, more than 50% of hydrocarbons are probably still to be found in subsurface, and IOR methods can help to produce some of them. If applied correctly, they will increase value creation for the state and, ultimately, for society, notably if they are managed with CO2 injection which could equilibrate the carbon balance.

Comments to impact case 2

NCS2030 Petrosenter (launched in 2022). These activities are in good match with the objectives of IER-UiS as they address major energy and climate challenges facing society today:

- Sustainable use of the subsoil as an energy system, where oil and gas, CO2 storage, hydrogen storage and geothermal energy are studied with a view to developing sustainable energy centres reusing existing infrastructure
- Zero-emission net production: Development of skills and technologies to reduce emissions from hydrocarbon production, with a focus on CO2 use and storage, efficient drainage and reduced water production and use.
- Digitization: Development of skills and technologies to optimize processes within the underground energy system and improve decision-making to achieve sustainability.
- Society: analysis of the evolution of energy markets, societal acceptance, and the impact of technological development on the energy transition.
- Awareness: Informing and educating society about the challenges and developing solutions to achieve sustainability.

- Education: Building the skills of the new generation of underground professionals for the energy sector, with a comprehensive understanding that the public and private sectors can use to achieve energy and climate goals over the coming decades.

This case study demonstrates a significant contribution to understanding and supporting energy transition.

Comments to impact case 3

LoCRA. This project provides one of the best regional compilations of the Lower Cretaceous subsurface and its evolution in the Greater Barents Sea. The project results have been and are being used by oil and gas companies and the Norwegian Petroleum Directorate to assess resource potential and reduce exploration risks in this interval.
In addition, the project has trained a large number of PhD and Masters students with relevant skills and knowledge, who have been or are employed in the public and private sectors.

List of administrative unit´s research groups

Institution	Administrative Unit	Research Groups
University of Stavanger	Department of Energy Resources	Energy resources

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of Administrative Unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol (see appendix Evaluation Protocol) that guided the process
- Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys

After the documentary review, the Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the Administrative Unit. The Committee shared the interview questions with the Administrative Unit two weeks before the interview.
Following the documentary review, the Committee interviewed the Administrative Unit in an hour-long virtual meeting to fact-check the Committee's understanding and refine perceptions. The Administrative Unit presented answers to the Committee's questions and addressed other follow-up questions.

After the online interview, the Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary with minor adjustments.

Limitations

The Committee judged the information received through documentary inputs and the interview with the Administrative Unit sufficient to complete the evaluation.

Appendices (link to website)

1. Description of the evaluation of EVALNAT
2. Invitation to the evaluation including address list
3. Evaluation protocol
4. Self-assessment administrative units
5. Grading scale for research groups

Website: https://www.forskningsradet.no/tall-analyse/evalueringer/fag-tema/naturvitenskap/

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