The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

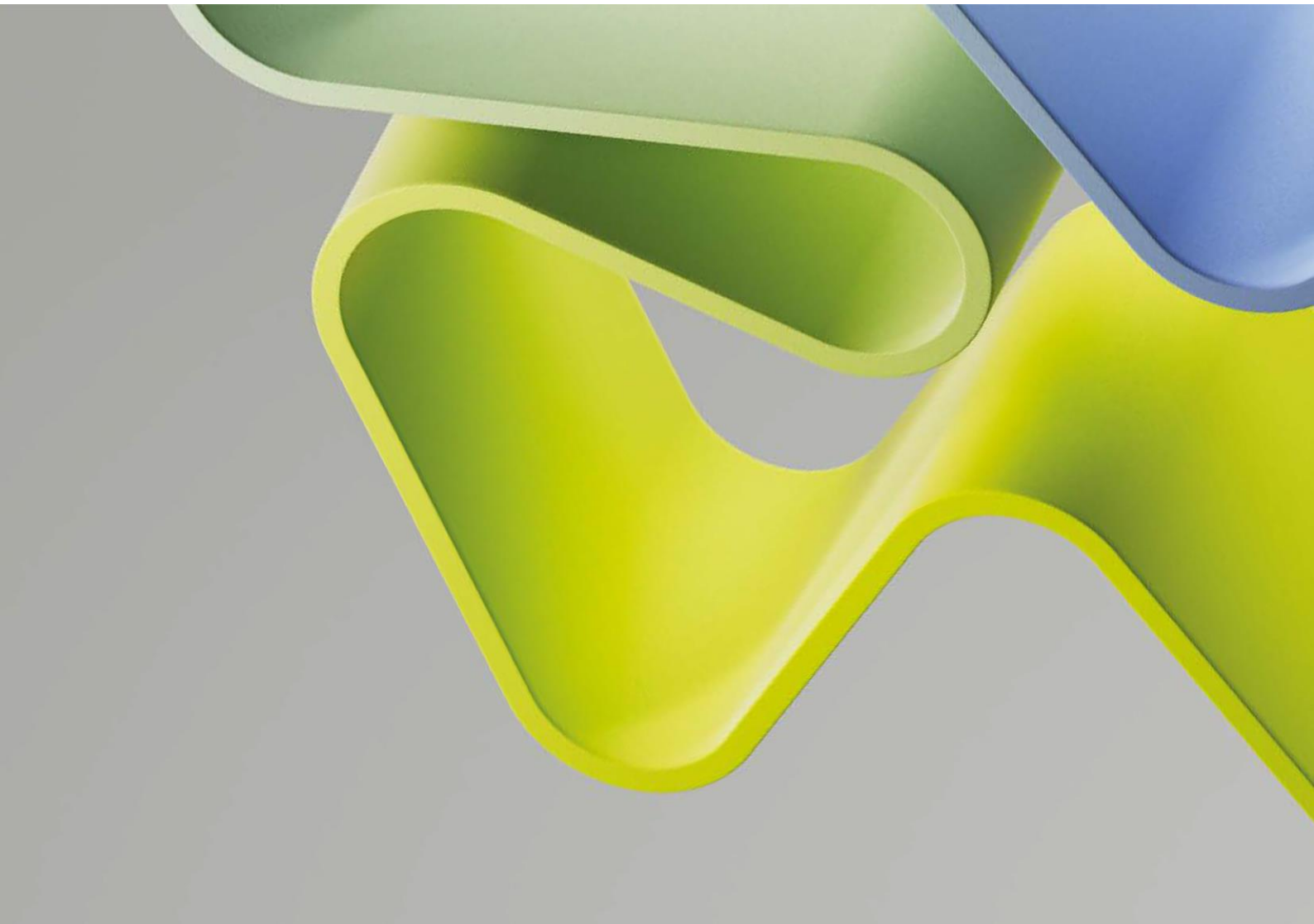
Evaluation Report for Administrative Unit

Administrative Unit: **Department of Energy and Petroleum Engineering**

Institution: **Norwegian University of Stavanger (UiS)**

Evaluation Committee Higher Education Institutions 4

December 2024



Contents

Statement from Evaluation Committee Higher Education Institutions 4

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions/research institutes within Mathematics, ICT and Technology 2023-2024 and has submitted a report for each administrative unit:

- Department of Building, Energy and Material Technology, UiT the Arctic University of Norway
- Department of Architecture and Technology (IAT), Norwegian University of Science and Technology (NTNU)
- Department of Civil and Environmental Engineering (DCEE), Norwegian University of Science and Technology (NTNU)
- Department of Geoscience (IGV), Norwegian University of Science and Technology (NTNU)
- Department of Structural Engineering (KT), Norwegian University of Science and Technology (NTNU)
- Department of Manufacturing and Civil Engineering (IVB), Norwegian University of Science and Technology (NTNU)
- Department of Energy and Process Engineering (EPT), Norwegian University of Science and Technology (NTNU)
- Department of Built Environment (BE), Oslo Metropolitan University (OsloMet)
- Department of Energy and Petroleum Engineering (IEP), University of Stavanger (UiS)
- Department of Mechanical and Structural Engineering and Material Science (IMBM), University of Stavanger (UiS)
- Department of Process, Energy and Environmental Technology (PEM), University of South-Eastern Norway (USN)

The conclusions and recommendations in this report are based on information from the administrative units (self-assessment), digital meetings with representatives from the administrative units, bibliometric analysis and personnel statistics from the Nordic Institute for Studies of Innovation, Research, and Education (NIFU) and Statistics Norway (SSB), and selected data from the National survey for academic staff in Norwegian higher education and the National student survey (NOKUT). The digital interviews took place in the autumn 2024.

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

The Evaluation Committee has consisted of the following members:

Professor Claudio Mazzotti, University of Bologna (Chair)

Professor David Baglee
University of Sunderland

Professor Elsa de Sá Caetano
University of Porto

Professor Sebastian Geiger
TU Delft

Professor Per Heiselberg
Aalborg Universitet

Professor Mohamed Pourkashanian
University of Sheffield

Description of the Administrative Unit

The scientific staff of the Department of Energy and Petroleum Engineering at the Norwegian University of Stavanger (UiS) consists of 6 professors, 10 associate professors, 2 postdocs, 21 PhD students, 14 engineers, and 5 researchers (Nov. 2024). The gender balance is disproportionate, with a predominance of male employees.

The staff operates within a decentralised organisational structure, where each researcher specialises in a specific area and reports directly to the Head of Department. Close dialogue within the group allows experimentally focused staff to collaborate with those focused on modelling and theory, and vice versa. The team of professors and associate professors, with educational backgrounds in mathematics, physics, chemical engineering, mechanical engineering, and petroleum engineering, applies their expertise to the two main application areas that define the research groups:

- Drilling and Well Technology (DWT)
- Energy Technology (ET)

The administrative unit focuses on technological improvements in the drilling and well domain and clean energy solutions from energy system level to component level. In the drilling and well domain, focus is on new materials for ensuring leak free wells, models for fluid flow in wells and the use of AI for improved and automated drilling. The energy technology group focus on technologies and methods for decarbonisation; use of hydrogen in gas turbines, production of low-emission hydrogen, geothermal energy for heating and cooling and energy system integration and optimisation using AI tools. Developing research infrastructure for piloting green solutions is a key objective, with continuous efforts to enhance it. The university prioritises green transitioning, making the Faculty of Science and Technology, and the department, crucial for sustainable energy technologies, environmentally friendly solutions, circular economy, and resource utilisation. Planned research aims to address major societal challenges, promote sustainable development, and improve resource management, necessitating cooperation with both public and private sectors.

The administrative unit prioritises fostering strong national and international partnerships through joint research projects, networks, knowledge sharing, exchange programs, and funding collaborations. Formal agreements and regular conferences facilitate these efforts. The unit is committed to industrial collaborations, demonstrated by a portfolio of externally financed research projects that bridge academia and industry. Permanent staff members with secondary positions in companies further enhance these connections, aiming to ensure the unit’s work is relevant, impactful, and mutually beneficial.

Overall Assessment

The Department of Energy and Petroleum conducts research on energy technology (geothermal, H2 value chain, energy systems) and petroleum technology (plugging and abandonment of oil wells, improved drilling). This research is aligned with the wider university ambitions and the university's priority research area related to the energy transition. The department follows the university and faculty strategies, policies, and processes, which are sound and sensible. However, the department has no own strategy or action plan that determines how it aims to implement the overarching strategies of the faculty and university.

The research focus of the department is broadly aligned with Norwegian's long-term plans and has links to the United Nation's Sustainable Development Goals. There are aspects of the research that are of societal relevance to Norway and may have been undersold such as the cost-effective plugging and abandonment of old oil wells, which is a major issue in every country with hydrocarbon resources. The department's location in Stavanger and its proximity to the Norwegian offshore industry has the potential to offer further opportunities to engage in industry collaborations. This opportunity is further exacerbated by 4 adjunct professors who are mainly based in industry.

The department is comparatively small in terms of staff numbers (18 permanent academic staff, 21 PhD candidates, and 8 postdocs as per the self-assessment) but boasts a broad spectrum of skills that are assigned to two research groups (drilling and well construction group, energy systems group). The department follows a PI-centric model, i.e. the research is not driven by a thematic approach within the groups but dependent on the interest and initiatives of individual academics that report directly to the department head. The PIs are largely responsible for identifying research opportunities, attracting funding through participation in national and European research consortia, and establishing the national and international links to enhance the department's visibility. Some cross-over between the academics and other disciplines at the faculty is emerging (e.g., exploring the use of geopolymers in construction sector, using knowledge of pumps and pipes in oil fields for health care applications). The networks of the PIs have resulted in good links with other Norwegian research institutes, particularly NORCE and SINTEF, as well as with some institutes in Europe, especially through participation in EU funded research consortia.

The department is responsible for a rather high teaching load. The drilling and well group delivers significant teaching relevant to the petroleum sector and has committed itself to deliver additional vocational training for Norway's offshore oil and gas industry. The energy systems group has recently set up new BSc related to battery technology. These study programmes are demand driven, i.e. the department has responded to the needs of the Norwegian industry. It is not clear, however, if the significant teaching load is a strategic choice as it impacts the department's ability to engage in high-profile research and stretches resources while providing little additional value in terms of an increased department budget or new staff positions.

One apparent challenge for the department is its size. One the one hand, the relatively small staff number has the advantage that it allows for short (and informal) communication pathways and provides flexibility for individual academics to engage in research projects on an ad-hoc basis, using their personal connections and collaborations. Individual academics are hence given freedom to pursue their own research interests. On the other hand, the research groups appear not to be acting as coherent groups with a shared vision or thematic approach. There is also a high degree of specialisation and lack of overlap in skills between academics, which creates a risk of losing key teaching and research skills if people leave.

Furthermore, it can be difficult to reach a critical mass and external visibility when conducting research in a specific field, although this particular challenge can be mitigated to some degree by participating in university-wide research initiatives.

The department size combined with the significant teaching load also impacts the overall ability of the department to engage in research. First, the expert panels judged the research output to be of mixed quality but not internationally leading despite relatively large number of publications. Second, the self-assessment indicates that the department has around 10M NOK/year base funding and 17M NOK/year research funding overall. These two numbers amount to less than 1M NOK/year external research funding per academic, which is below international standards. Third, while the department has some good laboratory facilities and is part of several national and international research networks, it appears to lack the human resources to lead national research infrastructure or the development of bids for major research consortia funded by European programmes such as Horizon Europe, ERC, or the Clean Energy Technology Partnership.

The small size of the department was given as the main reason why the department is not developing its own strategy. As discussed in the interview, the department does not see the need to create and implement a coherent strategy (incl. benchmarks, KPIs, implementation) but follows the university and faculty strategies instead. These strategies provide the basic operational standard for each department. What is not clear is if the faculty does not encourage departments to develop their own strategies as there is at least one further Administrative Unit from this faculty without its own strategy. While the choice to not develop a departmental strategy is, to some degree, understandable as the faculty, not the department, is in control of the budget and key decisions, it also bears risks. First, the university landscape for petroleum-oriented departments is changing rapidly, with many departments having now moved towards broadening and diversifying their research and teaching portfolio beyond more traditional hydrocarbon exploration and production topics. Although the department is starting to work more on sustainable energy topics and has increased its staff size in this area, not having a strategy in place to future-proof the department creates the risk of “missing the boat” and falling behind other departments. Second, and related to the previous risk, is that the alignment with priority research areas and the Norwegian long-term plan can become coincidental, not strategic.

The department’s current approach seems to be reactive, where individual academics take advantages via opportunities that arise through their own networks rather than pro-active, where the department provides leadership in the field and creates new opportunities for the academics. Third, the lack of a bespoke strategy can create tensions when trying to balance the considerable teaching obligations with the desire to conduct high-impact research and lead major research bids such as SFI programmes, Horizon Europe funded consortia, or ERC grants. There is no strategy in place how the teaching load can be turned into new opportunities for the department, e.g. through the recruitment of new staff (although it was noted during the interview that the department recently hired two staff members to support the new study programme in battery technology). Last, the lack of strategy can impact the succession planning and recruitment at the department, especially considering that some staff are expected to retire and that the department suffers from a poor gender balance.

The Terms of Reference for the administrative unit is attached to the report. 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.

Recommendations

1. It is recommended that the department should reconsider the need for developing its own strategy and creating an action plan to implement it. While it is acknowledged that the budget and key decisions are controlled at the faculty level, it appears prudent to have a strategy and vision in place for the department, considering a rapidly changing university landscape, where cross-disciplinary collaboration around major research and teaching themes becomes increasingly important. It is also noted that, although at least one other Administrative Unit from this faculty does not have a bespoke strategy either, there is at least one other department within the faculty that has developed a comprehensive strategy and action plan to implement it. A strategy that is supported by the entire department therefore not only provides direction for the academics and incentivises them to collaborate without curtailing their academic freedom or agility to respond to opportunities when they arrive, it also enables the department to highlight its teaching and research successes, develop robust mentoring and coaching methods that enable academics to thrive (e.g., by pursuing high-profile grants like ERC grants), or identify opportunities for long-term growth (e.g., by leading Horizon Europe or SFI bids). These are key aspects that would help to ensure that the department's efforts are recognised and supported by the faculty, e.g. through the provision of new positions that foster growth in new opportunities.
2. Such a strategy development could start with a series of away days, horizon scanning activities, and/or workshops to identify new thematic and cross-cutting research opportunities for the department, opportunities (or the need for) investing in new research infrastructure, or opportunities for pursuing major research grants, be it on an individual basis (e.g., ERC grants) or group basis (e.g., leading an SFI bid). Such activities could be facilitated and/or supported by an external advisory board. It has been noted in the interview that the department does not see the need for an advisory board but seeks input on a broader basis. However, a committed advisory board can be a "critical friend" that provides overarching feedback by stress-testing the strategy and supporting the department externally, for example when requesting strategic investments for the faculty.
3. Independent of an advisory board, it appears to be pertinent to collate the relevant data (e.g., research income per group and PI, graduation/completion statistics of MSc and PhD students, number of sabbaticals, mobility of students and staff, etc.) to identify areas of strength and weakness so that strategic about future teaching and research endeavours, succession plans, etc. can be made. Such data was missing in the self-assessments but may well be available at the department already.
4. It is also strongly recommended to ensure that governance at the department is transparent and inclusive. While the size of the department allows for short, and often informal, communication and decision-making, especially between professors (as discussed in the interview), there is the risk that decisions are not transparent and exclude certain functional groups (e.g., PhD students and early career researchers) or underrepresented groups (e.g., female researchers considering the poor gender balance in the department).
5. A sound department-wide strategy will also ensure that there is a good approach to sustainable and proactive succession planning, which is of particular importance when addressing the gender balance in the department and supporting long-term research and teaching directions.
6. In short, it is recommended to invest time and energy to proactively future-proof the department because there continue to be exciting opportunities to diversify teaching and research in the energy sector (e.g., via SFI, Horizon Europe, or ERC grants) and enhance the visibility of the department, for example by broadening the scope to

other subsurface and geo-resources aspects or including data science. This could, however, mean that the department puts less emphasis on the PI-centric model but pursues a thematic research approach instead. There should also be natural synergies to collaborate with the Department of Energy Resources to define thematic research areas in the energy sector. Other universities have successfully adopted such a thematic and cross-cutting approach to research with positive impact on student numbers that led to new staff recruitment as well as a growth in research income and quality.

7. Importantly, the development of departmental strategies also needs to be fully supported by the faculty, which may require a more decentralised approach where more responsibilities and budget controls are devolved to the individual departments. For example, departments such as this one that are heavily involved in teaching need to see the reward for their efforts, for example in the form of teaching assistants or lecturers that free up time to pursue more research and pro-actively create strategic opportunities. There may also be the opportunity to consider merging departments to create an economy of scale, i.e. increase efficiency and synergy in research, teaching, and administration. For example, the department of Energy Resources and this department have many complementary skills and activities that could continue to grow in a single department. Such a larger department would naturally allow for a more thematic approach to research, create critical mass and redundancy in case staff leave, and reduce administrative overburden.

1. Strategy, Resources, and Organisation of Research

The department does not have its own strategy but instead follows the high-level strategy of faculty and university, mostly contributing to the energy theme (renewable energy, CCS, ocean energy, hydrogen, low-emission oil & gas) with ambition to conduct application-inspired research that focuses on real-world societal challenges. Such a focus on sustainable and affordable energy is a very sensible approach given the urgency of the energy transition. This focus is also very well aligned with United Nation’s Sustainable Development Goal 7 (clean, secure, and affordable energy for all).

The department provides two reasons for the choice to not have its own strategy: First, the budget and key decisions are controlled at the faculty level. Second, the department is too small to warrant the development of its own strategy. Instead, the key strategy for the department is to give the academics maximum freedom and trust that their self-motivation will move the department forward. The department uses publication points, externally funded research income, and the development of research infrastructure as measures of success. However, it has not provided benchmark numbers that indicate if the department views itself as being on track with own targets.

The department consists of two research groups (drilling and well technology group and energy technology group) which benefit from close collaboration with NORCE and SINTEF as well as links to other European universities. As per the self-assessment, 18 permanent academic staff (plus 4 adjunct staff) operate across these two groups in a decentralised way, reporting directly to the head of department. This approach gives maximum freedom and flexibility to individual academics but creates less incentive for academics to work collaboratively, which can result in a lack critical mass to tackle major energy research themes in an interdisciplinary way. This is apparent in the research group assessments, which indicate that the two groups are not research groups in the traditional sense that work jointly on a common research theme. Instead, individual academics work on individual topics with a relatively small number of students and postdocs, following a PI model rather than thematic approach.

The policy and processes for allocating internal resources and supporting grant applications are determined by the university. The department follows these policies and processes and utilises the relevant support mechanisms that are centrally available at the university. These policies and processes are sound and at the standard of what should be expected from a modern university. If the department has to make strategic choices, a committee of professors is established that provides a proposal. Alternatives are discussed at research group meetings and the final decision is determined by vote.

1.1 Research Strategy

As noted above, the department does not have its own research strategy but instead follows the university and faculty strategies, which provide a basic operational framework for the department. This framework defines the minimum standards to which the department and its research groups should aspire to, for example to offer research-led teaching or conduct research at a level that allows PhD candidates to graduate. The strategy is adapted at the department level by giving maximum freedom to the academics and relying on their self-motivation to deliver good research and teaching. It is not clear if the faculty does not encourage the departments to develop their own strategy as there is at least one other Assessment Unit from this faculty without its own strategy.

Although the choice not to pursue its own strategy is understandable considering the size of the department and the fact that key decisions are controlled at the faculty level, not having a coherent strategy at the department level can put the department at risk considering the rapid changes in the national and international university landscape, especially at more traditional petroleum-focused departments that are diversifying their research and teaching portfolio beyond oil and gas. Having said this, the department has made a strategic decision to continue focusing on petroleum research and teaching, recognising the importance of delivering well-trained graduates to the Norwegian offshore industry and the fact that oil production from the Norwegian continental shelf will not cease before 2050.

The lack of research (and teaching) strategy is also apparent in the research groups that are not research groups in a traditional sense but are more akin to a relatively loose grouping of academics with little overlap in skills who appear to be working largely in isolation. As discussed in the interviews, the department chose to organise itself in these groups to provide a contact structure for potential collaborators from industry and academia. As noted above, this PI-centric model is a result of the department’s approach to provide maximum freedom and flexibility for the individual academics to pursue their own research interests rather than incentivising them to work collaboratively. It is noted that the self-assessment of the energy technology group presented the work of only one academic. This reinforces the view that the groups are not working jointly on a thematic approach but are dominated by individual academics.

While such a PI-centric model has the aim that the department can work effectively within the faculty and university strategic framework, it also makes the department vulnerable: key knowledge can be lost if a staff member leaves; the department can lack critical mass and visibility in key research areas, especially in hydrogen or geothermal energy where other departments have established major large-scale research centres; staff can be stretched too thinly to deliver both, high-quality teaching and high-quality research. To some degree, the department is able to mitigate these risks, for example by relying on personal connections and collaborations to participate in larger EU consortia that create critical mass around a given research theme or by participating in university-wide research initiatives.

Overall, the department and groups/PIs seem to be more reactive where they try to take advantages of opportunities if and when they arise, with the new study programme in battery technology being a prime example.

Recommendations

- As noted above, the department is strongly encouraged to reconsider the need to adopt its own strategy or at least have a clear action plan in place that enables the department to implement the strategy of the faculty and university, including tracking the progress via benchmarks and KPIs. A departmental strategy would not only give direction and clarity to the academics, it would also enable the department to future-proof and balance its research and teaching activities. Most importantly, the department would showcase that it has a clear vision that is fully engaged with the university and faculty strategies and hence could be in a very strong position to influence budgets and decision-making processes at the faculty. An overarching advisory board that acts as a critical friend internally by stress-testing the strategy and supports the department externally could be very useful in this endeavour.

- The research groups should be incentivised to collaborate and explore the benefits of following a thematic approach where they have critical mass that enables them to work collaboratively on bigger and more strategic projects. Such collaborations could also include thematic topics that involve a close partnership with the Department of Energy Resources. The department argued that it organised these research groups as landing points for future collaborations. However, if collaborations are reliant on personal connections and arise opportunistically when staff respond to calls for proposals, then there may not be a need for research groups and the additional administrative layer they bring.

- If not readily available, comprehensive data should be collected and tracked to analyse the financial performance, research income at the group and PI level, PhD completion statistics, research student numbers, utilisation of university opportunities (e.g., mobility schemes, sabbatical, empowering female researchers, etc.) to make more informed decisions about future investments and showcase how the department's current track record creates new opportunities for the faculty that need to be adequately resourced, e.g. via new positions or upgrading of laboratories.

- The department should be clear what its unique strengths and selling points and then create clarity where its main focus will lie and present this focus proudly to the external world: is the focus on delivering high-quality teaching for the energy industry across a broad spectrum of study programmes which is supported by some level of research to ensure that teaching remains research-led, or is the aim to achieve a balanced portfolio consisting of a smaller number high-quality study programmes complemented by several high-quality and high-impact research activities.

- The development of departmental strategies also needs to be supported and encouraged by the faculty, which may mean that the faculty has to devolve more responsibility to the departments and provide more autonomy when it comes to decision-making processes and budgets. The current centralised approach where departmental efforts, especially with respect to delivering large courses, are not providing direct benefits to the departments create the risk of hindering growth and success in research as creating new, high-profile research opportunities needs time, effort, and long-term strategic thinking. The faculty should also consider if merging some departments would not create better synergies, critical mass, and efficiencies through reduced administrative overheads; in this regard, the Department of Energy Resources and the Department of Energy and Petroleum Engineering have abundant complementarity and synergy that may benefit from consolidation under a single structure, as is already common in many other similar universities across the world (e.g., Texas A&M, UT Austin).

1.2 Organisation of Research

Research within the department is decentralised and follows a PI model, with PIs reporting directly to the department head. The self-assessment states that PIs and department head make joint decisions to see if project applications are a fit to the department and aligned with the faculty strategy. Communication pathways are short and informal in the department. Where strategic research decisions are made, a committee develops a proposal, alternatives are discussed, and a vote is cast. This approach is favoured by the department as it caters to its size and the fact that much of the decision-making processes are controlled by the faculty while providing maximum flexibility to respond quickly to opportunities and builds upon existing links of the PIs.

However, as noted above the PI-centric model bears several risks: research may not always be conducted with critical mass; the department is more vulnerable when staff leave, and skills are missing to continue research (and teaching) in a specific topic (although staff usually stay until retirement so succession can be planned with ample lead time); staff are not necessarily incentivised to work collaboratively across the department (although it is noted that some collaborative activities seem to have taken place more recently, e.g. through the Future Energy Hub); there are less opportunities for the department as a whole to increase its visibility, e.g. by hosting workshops and conferences around a research theme or working with professional societies to shape the future of a research theme. There is also the risk that decision making processes in the department may not always be transparent and inclusive (just because a leadership group perceives that the communication is frequent and transparent does not necessarily mean that everyone feels empowered to contribute to the decision making).

The department follows the processes and polices set forth by the university when it comes to recruitment, career development, mobility, internationalisation, research ethics, support for female researchers, etc. These processes and policies are sound and commensurate with a modern, forward-looking university. It should be noted that there are several good initiatives available at the university level (incl. data that show their impact). However, the self-assessment lacks data and evidence that shows how the department participates in these initiatives, so it is unclear if they bring any benefit to the department.

PhD candidates have the opportunity to take obtain training to enhance their PhD journey. This training is organised at the faculty level. There is no data at the department that shows how PhD candidates benefit from these courses, e.g. if they have a positive impact on completion times, wellbeing and mental health, or the overall research culture at the department. New academics need to complete formal training before they can supervise PhD candidates.

MSc students participate in research through their individual projects which they can conduct in partnership with industry, or which are supervised by the academics in the groups. It is very positive to see that some MSc projects are of a quality where the results are published in peer-reviewed journals.

Overall, the current research structure supports the broad and high-level research objectives and strategy set forth by the faculty.

<u>Recommendations</u>

- Collect relevant data to analyse and monitor how the department benefits from university initiatives so that opportunities arising from these initiatives can be pursued proactively.

- Continue to foster an environment that encourages and incentivises interdisciplinary collaborations around key research themes to create critical mass and mitigate the risk of creating skill gaps in case that key staff leave. This could be achieved by giving a higher priority to awarding department-funded PhD scholarships to projects that support new collaborations.
- Identify opportunities where the department as a whole, and in partnership with other departments at the university, can increase its visibility by hosting workshops and conferences or partnering with professional societies to shape the future direction of a specific research theme.
- Ensure that the decision-making processes and communications are truly transparent and inclusive, i.e. the entire department feels empowered to contribute to the decision-making processes and everyone knows that their voice is heard and input valued. Informal communications and decision-making always bear the significant risk that functional groups (e.g., early career researchers) or underrepresented groups (e.g., female researchers) are repeatedly excluded and disenfranchised.

1.3 Research Funding

As per the self-assessment, over 60% of the external department funding comes from RCN. Research council funding provides scientific independence and enables the department to focus on fundamental discovery science rather than contract research funded by industry. Over the assessment period, 71 proposals have been submitted and 31 were funded, which is a good ratio.

There is surprisingly little direct collaboration and funding from industry in the form of joint-industry projects, despite the proximity to the Norwegian offshore industry and the stated departmental ambition to conduction application-oriented research that delivers real-world solutions (which typically need some input and collaboration with industry). However, RCN projects often involve some level of industry collaboration, including the provision of in-kind or cash contributions. Funding from the EU is also available at the department but plays a smaller role in the overall research budget.

On average, research funding appears to contribute to over 60% of the total department budget (17M NOK vs 10M NOK internal funding). However, it is not clear if the 10M NOK include costs for permanent staff or are funds that support research internally, for example through departmental PhD scholarships (it seems to be the latter). Internally funded PhD students are distributed via internal competition. There is indication that external research funding has increased in recent years, but no details are given why this is the case or if this increase is going to be permanent.

On a per-head basis of 18 permanent academics who are attracting 17M NOK per year, the average research income less than 1M NOK per year which is below national and international standards. This gap can probably be explained by the significant teaching load, which leaves less time to focus on the acquisition of research grants.

Research funding details are difficult to reconcile and attribute to the individual groups or even individual academics based on the self-assessment. The interview revealed that there is some imbalance: on the one hand, 4 (associate) professors have not been involved in project proposals in the last 4 years. On the other hand, 3 (associate) professors have been involved in 10 or more project proposals in the last 4 years. The expert panel reports for the individual research groups also indicate that the energy technology group may be more adapt in winning research grants on a per-head basis, certainly when it comes to EU funding. There is a need to encourage all academics to submit proposals to diversify the

research grant portfolio and rely less on a small number of highly active researchers to win proposals as this makes the department less vulnerable.

Recommendation

- The department should consider developing a coaching/mentoring scheme that has two main aims. First, it should support the less research-active academics in the department to submit, and eventually win, research bids to be less reliant on a small number of staff to acquire most of the research grants. Second, it should support early career researchers to identify opportunities for developing strong bids for ERC grants, especially if these proposals are embedded in a more thematic and cross-disciplinary research approach that is based on horizon scanning activities. Such mentors/coaches do not necessarily have to come from the department but could be recruited through the research networks of the senior academics in the department.
- The department should define ambitions for future research income and set some quantitative targets and benchmarks. Funding from industry located in Stavanger should also be pursued more proactively as industry is still willing to invest into research that supports their business.
- The department should evaluate if a collaborative and thematic approach to research could help to strengthen and diversity its grant income which would provide resilience by reducing the reliance on a small number of highly active research staff.

1.4 Research Infrastructures

The self-assessment is terse in its description of research infrastructure and only briefly mentions access to and participation in the NorPA Lab, Ullrig Test Centre, and Open Drilling Lab. While no detailed information is given how these facilities benefit the research, the impact case study mentions that a new cement plug was tested at the Ullrig Test Centre and the drilling and well technology group leads work packages in the NorPA lab. The energy technology group seems to benefit from access to 10 geothermal wells, but no details are given about these wells or how the data generated from the wells impacts the group's research. All these facilities could be rather unique and a key asset for the department when seeking new collaborative funding opportunities, e.g. through EU-funded consortia.

The department has a dedicated lab manager. The self-assessment mentions that the dialogue between head of department and research group enables possibilities for experimentally focused staff to conduct their research. The expert panel reports mention that research groups have support from the host institution in form of laboratories. However, there is limited detailed information about the equipment available in the laboratory, neither on the department website nor in the self-assessment.

As per the self-assessment, funding to access national and international research infrastructure is limited, unless costed into research projects. The department does not participate in international research infrastructure, but no information is given as to why.

Recommendations:

- Ensure that there is clarity and data how department laboratories are used by students and staff for research and teaching. Such an analysis should help to make informed decisions which facilities need to be maintained or upgraded to ensure continued support of research and teaching activities (e.g., through new investments by the faculty or industry), help to decide if there are any facilities that can be decommissioned, and help to decide if strategic partnerships with international research infrastructures should be pursued.

- Consider showcasing the laboratory facilities and the resulting research impact on the departmental website (e.g., via short videos) to improve external visibility. These showcases can also be used to identify new opportunities for collaborating with other European universities in EU-funded consortia.

1.5 National and international collaboration

The department has particularly good cooperation with NORCE and SINTEF through the drilling and well technology group, which also participates in some national research centres and activities such as the NorPA Lab. In addition, the department maintains collaborations with other departments at the university to work on university-wide research themes. Somewhat surprisingly, collaborations with the Department of Energy Resources are not mentioned explicitly although one would expect natural synergies and complementary expertise to be available across both departments.

The energy technology group participates in several EU projects where it collaborates with a number of European universities. The drilling and well technology group is not involved in as many EU projects and appears to have less prominent links to European universities.

Like many petroleum-focused departments, the department has developed links to Brazil as a result of the pre-salt oil field discoveries and Equinor's activities in Brazil.

Several research projects also involve collaborations with industry at the national and international and international level.

The self-assessment suggests that there are preferred partner universities for MSc and PhD mobility, although it is not clear if these are strategic partnerships or more ad-hoc exchanges that are based on research contacts by individual academics

Overall, these are appropriate national and international collaborations considering the relatively small size of the department. The department clearly is a trusted partner in national and international research initiatives but there is no evidence that the department is viewed as a leader that creates new opportunities for collaboration at a national and international level for other research institutions.

<u>Recommendations:</u>

- Continue to maintain the personal links with national and international research institutions but also explore if such collaborations could not be formalised to provide strategic partnerships for research and teaching that allow the department to broaden its portfolio. By utilising strategic partnerships, the department could draw on complementary expertise that can help to open up new research activities in a thematic area; for example, the department's broad expertise in plugging and abandonment should make the department be a sought-after partner for many other universities globally that are working on similar oil field decommissioning challenges or are investigating how to repurpose depleted oil and gas fields for future CO2 storage. Synergies and complementary expertise with the Department of Energy Resources should be explored (if they not already exist) to strengthen the momentum around specific research themes and build resilience.

1.6 Research staff

The department has a management group consisting of the head of department, an office manager, and a lab manager. As per the self-assessment, the department consists of 18 permanent academic staff and 4 adjunct professors. Together they supervise 22 PhD students and 8 postdocs, which is a relatively low number on a per-head basis. MSc

students also contribute to the research at the department via their thesis work, but no information is given how many MSc students are enrolled in the department.

The staff numbers are anticipated to be stable and the only changes are expected when staff retire. In this case, new staff will be appointed with a view to support the relevant research and teaching activities in the department. For example, the number of petroleum-focused staff has decreased in recent years while the staff numbers in sustainable energy technologies have increased. The energy technology group has suffered from staff fluctuations and has recently lost the majority of its PhD students and all postdocs. The impact of these staff losses is not discussed in the self-assessment.

Staff are expected to follow the widely applied 40-40-20 workload model (incl. a maximum number of BSc/MSc thesis supervision), but the self-assessment gives the impression that workload can be skewed towards teaching, leaving less room to develop research projects. It is not clear if newly hired academics are given a reduced teaching load to jump-start their research career. In this regard it is particularly noteworthy that 3 staff members of the energy technology group have developed a new BSc programme on battery technology, which is a major commitment and undoubtedly will stretch these academics.

The university holds annual review meetings with their staff but there is less clarity as to how far these meetings will also involve personal development options. There seems to be no mentoring/coaching system in place for new staff at the department

Recommendations:

- If the department decides to adopt its own strategy or an action plan to implement the faculty and university strategy, ensure that these are linked to a sound succession plan.
- Create a mentoring and coaching programme for new academics. Ensure that new academics are given a reduced teaching load and have preferred access to internal PhD student funding so that they can jump-start their research (e.g., via ERC starting grants that then lead to consolidator and advanced grants later on).
- Review teaching activities to ensure that teaching can be delivered efficiently (e.g., cut courses that regularly attract only a very small number of students) to free up time for research (especially considering the new teaching and vocational activities at the department which increase teaching loads further).

1.7 Open Science

The department follows open science policies set out by the university, which are standard for modern universities. The department benefits from open access publication funds available at the university and makes papers available as open-access pre-prints.

The percentage of open access publications by the department has increased since 2017 but still, 45 to 55% of the papers published each year are not open access.

Software that is developed at the department appears not to be distributed as open source and is only available “upon request”, although some software solutions such as the open drilling lab can be acceded online.

The university follows the FAIR data storage principles but there is no information how the department curates and releases its data as open access.

Recommendations

- Be more proactive in sharing code and data as open access as this enhanced the visibility and impact of the research. The “upon request” approach is no longer timely, especially for research council funded projects.
- Create a landing page on the department website that serves as a one-stop-shop to access papers, datasets, and code via the relevant repositories. Feature key success stories on this landing page.

2. Research production, quality and integrity

The department’s research broadly focuses on energy transition challenges. Within the energy technology group, the focus is on energy system integration, heat pumps and geothermal energy, and the hydrogen value chain. Within the drilling and well technology group, the focus is on plugging and abandonment, and low-emission drilling.

As noted above, researchers have a broad range of skills but lack overlap and follow a PI model rather than a collaborative and thematic group approach. The department acknowledges that this makes them vulnerable of losing a specific skillset if a staff member leaves. However, the department also anticipates that most staff changes will come via retirements so succession plans can be established with sufficient lead time.

The assurance of research quality and integrity is based on well-defined university processes and policies, including an experienced academic advising the department on research ethics.

2.1 Research quality and integrity

Both groups regularly publish in high-quality journals but the quality appears to be variable across the groups and some of the publications are in lower-quality journals.

The publication quantity amounts to 47.2 author shares (2020-2022 average). The citation impact, in terms of the share of 10% most cited publications (5.2%) and mean normalised citation score 2019-2021 (75, mean=100) are rather low.

The expert panel reports view the publications of the drilling and well technology group as not being state-of-the-art or agenda setting although the research is, in principle, of national and international interest. In contrast, the expert panel reports indicate that the publications from the energy technology group are a good mix of detail-oriented problem solving and wider system perspectives. However, all 11 example publications for this group came from a single PI which leaves no room to judge the research quality across the entire group.

There should be opportunities for both research groups to write fundamental or review papers that are agenda-setting, for example by highlighting the basic science that underpins the more applied research in their respective fields and identify opportunities for future research.

The expert panels recommended that both groups should improve the quality of their research outputs overall and establish goals for the quantity and quality of the publications.

Research group DRILLING & WELL TECHNOLOGY overall assessment

The expert panel believes that a key strength of the drilling and well technology group is that its members have educated a reasonable number of people including MSc and PhD

students as well as post-doctoral researchers. Members of the group have a very broad range of skills including experimentalists and computer scientists.

The expert panel concludes that major weakness of the group is the absence of a formal research group structure, which has resulted in a general lack of strategy. From the information provided in the self-assessment report, it appears that staff time has been funded by teaching commitments and this has meant there has not been either the time or incentive to attract significant research income or take the lead in the submission of research proposals. On the positive side, despite the teaching commitments, research group members still have found time to publish a significant number of academic papers, several of which have appeared in international journals that have a broad readership.

The group does not manage national research facilities although it is heavily involved with two of the NorPALabs work packages that are led by NORCE. The university has several laboratories (i.e. rheology, drillbotics laboratory etc), which support the research at the group.

A major risk group is the world-wide reduction in the number of students focussed on petroleum-related careers, which renders the group highly vulnerable in terms of its ability to attract sufficient funding required to operate. The lack of overlap of skills also makes the group, and any students that they supervise, vulnerable to staff losses. These risks are further exacerbated by the lack of strategy.

Overall, the expert panel agreed that the research group has a moderate performance across the research criteria. The group conducts research that is of national importance but lags behind its international peers. A strength of the group that is has, and continues to train future professionals, although the decline in petroleum-related student numbers and introduction of fees for overseas students at Norwegian universities raises concerns about the viability of future educational activities for the group.

Research group ENERGY TECHNOLOGY overall assessment

The research group has a clear focus on energy technology, with three distinct areas of research: the hydrogen value chain, heat pump supported geothermal energy, and energy system integration with AI-based technologies. This indicates that the group's research areas are aligned with the needs of society to transition to green energy, and the group has collaborated with non-academic stakeholders and demonstrated some technologies. The group has also participated in several national and international projects and has published papers in medium to good quality journals. However, the group lacks clear goals and benchmarks, and there is an imbalance between the three research constellations. Also, there is a significant loss of staff in 2024, with 5 of the 8 PhD students graduating and all the postdoctoral students leaving, and the group's financing overview is difficult to assess. It is difficult to say anything on the goal fulfilment, as no clear goals are stated. The overall assessment is that the group is performing well, but lack of integration between the three research constellations in the group, with one dominant senior researcher representing all the publication in the self-assessment. The research quality is adequate by national standards but does not reach the level of being internationally recognised.

3. Diversity and equality

The department follows the EDI policies and processes set out by the university, which has also signed up to several EU legislative in this regard. These policies and processes are sound and commensurate with the expectations from a modern university but only provide a

framework that needs to be put in place by the departments in their day-to-day activities. Unfortunately, it is unclear how the EDI policies impact the day-to-day activities at the department, e.g. when it comes to recruitment or aspects related to social and psychological safety.

Gender balance at the department is poor and below the NIFU averages, even when considering the challenges of achieving gender balance in STEM subjects. Only one permanent academic is female, all postdocs are male, and the data in the self-assessment suggests that even the PhD community has a below-average gender balance. The committee also noted that this department was the only one represented only by male academics during the interview stage.

Unfortunately, there is little evidence in the self-assessment that the department seeks to proactively change this situation beyond what is embedded via recruitment policies at the university level. Indeed, the NIFU data suggests that gender balance has not changed over the last 10 years and may even be going backwards. This is very concerning and not commensurate with a modern, forward-looking department.

The NIFU data indicates that around 40% of the professors will reach retirement age soon. This provides a timely opportunity for the department to achieve better gender balance among its staff, but also means that if this opportunity is missed, the gender imbalance will consist for decades to come.

Recommendation

- The department must show its unequivocal commitment to EDI and social safety, through self-reflection, external training, and clear actions that demonstrate that the department takes EDI and social safety seriously and adopts university policies in its day-to-day activities. As noted above, this also includes communication and decision-making processes at the department which, due to their informal nature, bear the risk of being exclusive.
- Recruitment strategies and succession planning must immediately focus on diversity and gender balance, otherwise inequalities will be locked in for decades to come.

4. Relevance to institutional and sectorial purposes

Given the departments strong track record in education, its main contribution to institutional and sectorial purposes is through the high-quality education of BSc and MSc students. At the institutional level, the faculty receives study points for students graduating from the department. At the sectorial level, the (offshore) energy industry in Norway benefits from well-trained students.

Recently, the department has responded to industry demands by providing vocational training for the oil and gas industry which opens new entry routes to a university education. The department remains fully committed to oil and gas training based on its assessment that the Norwegian oil and gas industry will continue to need well-educated graduates in petroleum sciences until 2050. The department also has setup a BSc programme in battery technology to address a growing skill gap for the Norwegian battery industry.

Research is aligned with the relevant institutional aims and industry needs but there is less evidence that the research translates to innovations that are change business practice or impact policies; patents and spin-out companies emerging from the department are limited if not absent. However, the drilling and well technology group may have underrepresented its

industry impact in the field of plugging and abandonment as this is a crucial challenge in many mature basins impacting many oil producing nations.

5. Relevance to society

The main contribution of the department to society is the continuous provision of new graduates for the (offshore) energy industry in Norway, which is a critical industry sector. Here, the vocational training in oil and gas and the new battery technology BSc are particularly noteworthy, although they create additional teaching loads that will impact the ability of the department to deliver research.

Overall, education and research at the department are aligned with the university research priorities, the Norwegian long-term plan, and help to address the United Nation's Sustainable Development Goals.

The department participates in some positive outreach activities such as Stavanger AI lab or Future Energy Hub, although level of involvement is not clear.

5.1 Impact cases

New Cementitious Material for Oil Well Cementing Applications – SafeRock

The impact case highlights the results from a 3-year research project focusing on improved, low-emission cementing of oil wells; a pilot was tested successfully at the Ullrig Test Site and has reached TRL5.

This case study is not demonstrating impact in the sense that it has changed industry practice or generated revenues, but it is excellent that a pilot has been tested successfully. The case study also claims that 26M tonnes of CO2 per year can be saved once the technology is implemented. However, this claim remains unsubstantiated until the technology reaches higher TRL and is used widely in industry.

The idea to apply the new cements to the construction industry is intriguing but so far only a concept that has not been demonstrated yet and therefore has not generated impact.

The training of PhD students, the publication of research results, the development of follow-up research projects and new collaborations, which are given as examples of impact, are the basic expectations for a successful research project and likely do not go beyond what was promised in the research proposal.

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 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 (only for HEI's)

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 three 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 that the Administrative Unit's self-assessment report was insufficient to assess all evaluation criteria fully, and some information gaps remained after the interview with the Administrative Unit. The information gap refers mostly to the relationship between the department and faculty, i.e. how much autonomy the faculty provides for each department to develop its own strategy and make independent budget decisions.

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
Norwegian University of Stavanger (UiS)	Department of Energy and Petroleum Engineering	Energy Technology - ET
		Drilling and Well Technology (DWT)

Terms of Reference (ToR) for the administrative unit

The board of University of Stavanger mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess the UiS Department of Energy and Petroleum Engineering based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by the UiS Department of Energy and Petroleum Engineering 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 mathematics, ICT and technology 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 4 aspects in your assessment:

1. The balance between time spent on research, on teaching, and on administrative tasks, in a national and international context. If possible, suggest actions that may be taken to adjust this balance to national and international standards.
2. The national and international visibility and brand of the group/institution. If possible, suggest actions that may be taken to strengthen the visibility. Does the brand and visibility correctly represent the actual scientific quality?
3. The research group's potential for acquiring EU-funding, in particular ERC-consolidator/advanced grants within the coming 10-year period. If possible, suggest actions that can be taken to develop this potential.
4. The use of, and future needs for, local/national/international research infrastructure. If possible, suggest actions that can be taken to consolidate/develop existing activities: Laboratories and laboratory equipment, HPC, membership of international consortia and large scale experimental facilities.

In addition, we would like your report to provide a qualitative assessment of the UiS Department of Energy and Petroleum Engineering 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 mathematics, ICT and technology secretariat at Technopolis Group.

The documents will include the following:

- a report on research personnel and publications within mathematics, ICT and technology commissioned by RCN
- a self-assessment based on a template provided by the mathematics, ICT and technology secretariat

Interviews with representatives from the evaluated units

Interviews with the UiS Department of Energy and Petroleum Engineering 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 UiS Department of Energy and Petroleum Engineering 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 mathematics, ICT and technology secretariat. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to the UiS Department of Energy and Petroleum Engineering and RCN. The UiS Department of Energy and Petroleum Engineering should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the mathematics, ICT and technology secretariat within the deadline given by the secretariat. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the board of University of Stavanger and the RCN no later than two weeks after all feedback on inaccuracies has been received from the UiS Department of Energy and Petroleum Engineering.

Appendices

1. Description of the evaluation of EVALMIT
2. Invitation letter to the administrative unit including address list
3. Evaluation protocol
4. Template of self-assessment for administrative unit (short-version)

The Research Council of Norway

Norges forskningsråd
Besøksadresse: Drammensveien 288
Postboks 564
1327 Lysaker

Telefon: 22 03 70 00

post@forskningsradet.no
www.forskningsradet.no

Publikasjonen kan lastes ned fra
www.forskningsradet.no/publikasjoner

Design: [design]
Foto/ill. omslagsside: [fotokreditt]

ISBN 978-82-12-04146-2 (pdf)