The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

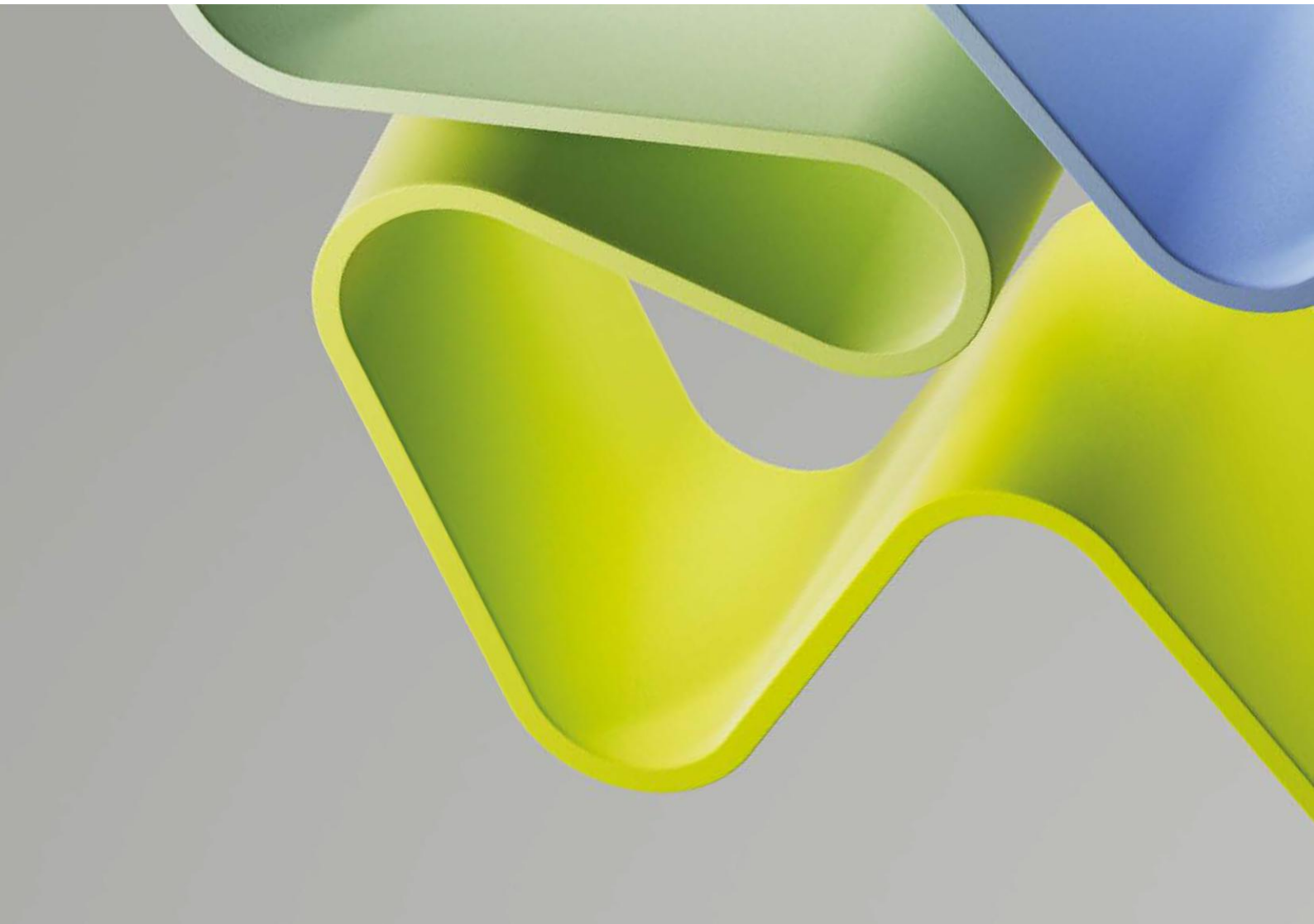
Evaluation Report for Administrative Unit

Administrative Unit: SINTEF Industry

Institution: SINTEF Industry

Evaluation Committee Institutes

December 2024



Contents

Statement from Evaluation Committee Institutes

The members of this evaluation committee have evaluated the following administrative units at the research institutes within Mathematics, ICT and Technology 2023-2024 and has submitted a report for each administrative unit:

- NORCE Energy and Technology, Norwegian Research Centre (NORCE)
- SINTEF Community
- SINTEF Digital
- SINTEF Industry
- SINTEF Energy
- SINTEF Ocean
- SINTEF Manufacturing
- Norwegian Computing Center (NR)
- Energy and Energy Technology (ENET), Institute for Energy Technology (IFE)
- Simula Research Laboratory (SIMULA)
- Human and organisational factors (HOF), Institute for Energy Technology (IFE)

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 consisted of the following members:

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Description of the Administrative Unit

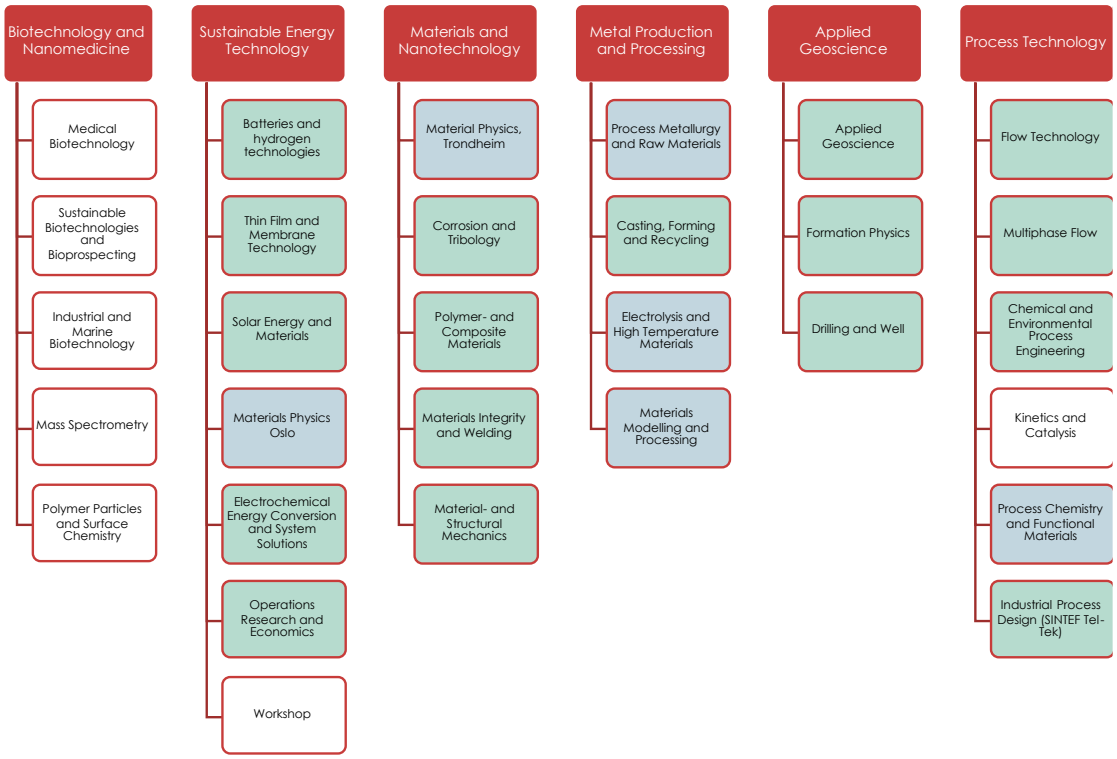
This page presents an overview of the organisation of SINTEF Industry in relation to the Evaluation of Mathematics, ICT and Technology (EVALMIT) to provide further context for this evaluation report.

SINTEF is an independent non-profit research foundation. The foundation is comprised of six research institutes, one of which is SINTEF Industry, and five further units, overseen by a central management team.

SINTEF Industry is comprised of six departments and 30 research groups, plus a workshop (see figure below). The research groups submitted for consideration for the EVALMIT are distributed between the institute's departments. In the figure below, the shaded boxes indicate the research groups which are under consideration for the EVALMIT SINTEF Industry Unit Evaluation Report.

The evaluation of SINTEF Industry research groups was undertaken in both the evaluation of the Natural Sciences (EVALNAT) and EVALMIT. Those research groups evaluated under EVALNAT are shaded blue, those evaluated under EVALMIT are shaded green. All research groups in the Biotechnology and Nanomedicine department were evaluated as part of EVALBIOVIT, but were not brought into consideration of this evaluation report.

Figure 1 SINTEF Industry and EVALMIT research groups



Note: Research groups evaluated under EVALNAT shaded blue, groups evaluated under EVALMIT shaded green

As part of the EVALMIT evaluation of SINTEF Industry, the evaluation committee reviewed all the research group reports, and the Admin Unit Report prepared by the EVALNAT Institutes I Committee.

The unit submitted for consideration under EVALMIT (i.e., the 23 research groups) may be subject to strategies, processes and services implemented at the level of the department, institution or whole organisation. The Evaluation Committee has been instructed to consider only the research groups in scope for EVALNAT and EVALMIT and the data and documentation provided by the unit (e.g., the unit self-assessment reports). As of 2022, SINTEF Industry employed 536 staff, of which 74% (406) were scientific staff, 16% (83) were technical staff and 7% (47) were part of management/administration.

SINTEF Industry states that their strategy is able to be more dynamic and operational than that of Corporate SINTEF. Their strategy is based on collaboration with companies, developing advanced infrastructure using high scientific competence. They offer expertise in fields of materials technology, advanced materials, nanotechnology, applied chemistry and biotechnology, applied geoscience, circular economy and industrial economics and optimisation. They work in a multidisciplinary context with national and global companies in many industries. They identify 17 prioritised research areas which best reflect their market strategy, requiring cooperation between research groups within the unit. With more than 90% of their income from contracts won in open competition, they position themselves close to industry. The offer of their advanced laboratory infrastructure to industry is also crucial for attracting and recruiting new scientists. Their collaboration with universities is of strong strategic importance, allowing them to be aware of new scientific developments.

In their self-assessment report, SINTEF Industry identifies four different roles they have in contributing to their sector: 1) Developing new technological solutions and knowledge with their clients. 2) Creating new products and companies (Often, their own IP results in the spawning of a new company, such as the company Hydrogen Mem-Tech working with hydrogen separation and CO2 capture). 3) Developing and running research infrastructure important to Norway's research community (The unit's infrastructure is available for any industry client or higher education institution to use). 4) Contributing to debate and politics with advice and knowledge. (Policymakers use the knowledge informed from SINTEF Industry. Also, their projects are digitally available and searchable for policymakers to base their policies on. Norway's government strategy for circular economy mentions SINTEF's projects 18 times.) They note that their employees hold positions in a number of advisory bodies to the EU research programmes, such as Process4Planet and Hydrogen Research Europe.

In their self-assessment report, SINTEF Industry names several strengths and opportunities that better position them for the future. They note that their flexible and dynamic culture allows them to respond to volatile external conditions and allows them to find opportunities in new and existing markets. They mention their experience in establishing spin-off companies based on their own IP, such as Hystar and NaDeNo Nanoscience, and also their perception as an attractive employer especially among students. SINTEF Industry highlights their attractiveness as a research partner for both Norwegian and international collaborators, operating at a range of TRL levels. They also note their positions on advisory bodies to influence the agenda of EU research programmes. In terms of weaknesses and threats, they emphasise their low level of basic funding from RCN which may prevent them in pursuing 'blue sky' ideas, creating more startups, or retraining employees in declining markets such as oil and gas. They also state that the current strong focus on reduced emission goals by 2030 may affect the necessary development for technologies to meet the 2050 emission goals, as well as reduced research funding due to global volatility, the energy crisis and dependence on China for raw materials.

Overall Assessment

This overall assessment covers a summary of the evaluation committee's findings and the self-assessment report by SINTEF Industry, covering the evaluation of SINTEF Industry in relation to the submitted Terms of Reference (TOR, see table below), the strengths and weaknesses of SINTEF Industry, future prospects in relation to plans and visions described in the strategy and self-evaluation for SINTEF Industry and its current performance.

We first provide a short summary with headline conclusions from the evaluation, next reflect on the specific requests in the TOR as provided by SINTEF Industry and finally, give recommendations to SINTEF Industry on improving its performance and developing future research strategies.

SINTEF Industry has a long-term, well recognised and strong reputation in the Norwegian and European R&D sectors. This large administrative unit is application-driven and has many rich research infrastructures and is therefore a valuable partner for the industrial sector.

SINTEF's research topics are well aligned to the industrial needs and the societal challenges in Norway and in an international scope. The innovation output, research performance and impact of SINTEF Industry on the economic environment is good to excellent. However, from a scientific point of view the output is average to good, and scientific dissemination can be labelled weak.

Its project portfolio is developing towards future research topics with a more sustainable scope, and also the administrative unit's volume is increasing, therefore the large variety of research topics covered by many research groups of SINTEF Industry should be better matched with a broad range of interesting future projects and existing and new collaborators. This can only be done, if well managed by the departments' management.

With the high number of collaborations, assumingly due to the large volume of the unit, the overall coherence of R&D by SINTEF Industry is affected which calls for a new framework which enhances the transparency of this administrative unit for its management and its collaborators. Given the current labor markets, SINTEF Industry must develop effective strategies to retain key staff members in a highly competitive R&D market.

Below we respond to the specific requests in the TOR as provided by SINTEF Industry, see the following table.

Specific request from the Terms of Reference	**Response from the evaluation committee**
Research groups with a clear, well-defined and complementary core scientific competence are adequate to serve its markets in the short and long term.	A large variety of research topics covered by many research groups can be matched with a broad range of interesting projects and collaborators that potentially can yield a high quality of research if well managed by the departments' management. On the other hand the quality of the research groups is diverse and varies from an excellent performance to a weak reputation. Furthermore, the breadth of research topics covered by the research groups as well as TRL levels (from 2 to 8 - 9) may lead to lack of focus of research conducted by SINTEF Industry. The expert panels for EVALMIT provide a specific evaluation of the research groups, which are summarised in the appendix of this report.
Adequate and relevant collaboration with universities and other research institutes,	SINTEF Industry has many collaborations, which are good to excellent. However, the high number of collaborations, assumingly due to the large size of the unit, affects the

particularly through participation in various centres of excellence and innovation (e.g. SFIs, FMEs, and National Research Infrastructures) as well as EU projects.	overall coherence of R&D by SINTEF Industry. It is recommended to develop a framework which enhances the transparency of this administrative unit regarding collaborations with universities and research institutes as well as the public visibility of collaborations.
Adequate and relevant cross-disciplinary collaboration with other parts of the SINTEF organisation.	From the self-assessment report and the interview with SINTEF Industry, the evaluation committee observed that many cross-disciplinary collaborations take place with other parts of the SINTEF organisation but that a clear strategy concerning these cross-disciplinary collaborations is lacking. Supposedly they enhance the innovation capacity of the administrative unit and serve to better utilise existing expertise in different parts of the SINTEF organisation. However, the manner through which cross-disciplinary collaboration is established and how it is stimulated is not documented.
Adequate and relevant collaboration with industry.	SINTEF Industry has established very good impactful collaborations with industry; however, it struggles with transitioning from the oil and gas industry to the cleantech industry.
Access to necessary experimental and/or theoretical infrastructure, including excellent technical staff.	SINTEF Industry has excellent research infrastructures, and worldclass, unique experimental infrastructures; however, it must develop effective strategies to retain key staff members in a highly competitive R&D market.
A project portfolio with a well-balanced mix of competence-building projects and industrial innovation projects and an adequate peer-reviewed and popular scientific dissemination.	The five impact cases provided by the self-assessment report reflect a balanced mix of activities across TRL levels. These case studies suggest that SINTEF Industry builds competencies and provides support innovation trajectories to its partner companies. That is very promising, also for future projects and enhancing competitiveness. However, the number of peer-reviewed publications per employee is at the lower end; this is probably due to industrial collaboration under strict non-disclosure agreement (NDA). Additionally, the self-assessment report omits information on widespread scientific dissemination.
Well-developed scientific network and expert contributions to the national and international scientific community.	From the high number of national and international collaborations and the excellent research infrastructures in SINTEF Industry it is concluded that the scientific network of SINTEF Industry is well developed. Please continue in this way.
Appropriate organisation in terms of size of research groups, human and economic resources, adequate mixture of leading expertise and broad competence, to fully exploit the organisational opportunities for the institute.	Given the breath of this TOR, it is recommended to read Section 1 of this report which covers the evaluation committee's response to all these topics.

Recommendations

Recommendations to SINTEF Industry on improving its performance and developing future research strategies are given below.

1. SINTEF Industry needs a management tool to grow and shrink its research groups in the light of its prioritised research areas and the needs of society. This tool could be also used by the management of this administrative unit for monitoring of activities and progress of the departments and research groups. This will result in a more efficient, better communicated and cost-effective operation of SINTEF Industry

2. There is a need to explain why the prioritised research areas are considered to be important to SINTEF Industry and the process for identifying new prioritised research areas beyond 2024, and their effect upon the near-future strategy and organisation of research in the departments and research groups of SINTEF Industry.
3. Consider mechanisms for clustering collaboration so that they become more articulated within the embedding of broader strategic scope of the unit.
4. In this context it is recommended to develop a framework which enhances the transparency of this administrative unit regarding collaborations with universities and research institutes as well as the public visibility of collaborations.
5. Improve recruitment and career development strategies to decrease the gender imbalance in this unit, in particular in the management and at senior research positions. Better communicate recruitment and career development strategies, procedures and opportunities that are in place.
6. Develop a plan for efficient and effective spending of its basic grant for training of employees regarding new skill sets and proposal writing, as well as for the recruitment of employees with new skills that are needed for SINTEF Industry. In this context, develop a plan on how to retain key researchers in essential R&D directions, in particular given the transition of this administrative unit from oil industry led projects to sustainable technology projects.
7. It is recommended that SINTEF Industry will proceed with its successful R&D project acquisition.
8. Given the low success rates of proposals submitted for European funding it is recommended to not expand upon the 12.5% share of this type of grants in the overall R&D budget, and thereby reducing R&D budget planning risks in the future.
9. From this perspective, it could be useful to further explore within SINTEF Industry how specific groups and departments contribute to acquisition of R&D budgets to improve performance.
10. For an organisation that collaborates with industry on a daily basis, SINTEF Industry should consider how the contribution of industry to the overall R&D budget could be enhanced to a more common share (for other research institutes in Europe) of 60%.
11. SINTEF Industry should explore how its research data platform (DSN) can be operated to true open science standards.
12. Develop a policy to increase the number of (open access) publications per employee; currently, this research output is weak and does not reflect the advertised aimed excellence of this unit.
13. Reduce the broad stretch of research topics covered by SINTEF Industry's Research Groups and the very wide range in TRL level (from 2 to 8, even 9) and of research quality. Otherwise, there is the risk of a lack of focus and a reduction of the quality of research conducted by SINTEF Industry in the long run.
14. At a Research Group level, it is recommended to provide consistent information about specific projects, budgets, publications, number of various types of personnel (management, researchers and other) and their diversity (gender, age, international background). Additionally, specific details are needed on the research topics covered by these groups. Otherwise, the organisation of SINTEF Industry will appear to be disorganised.

Finally, it is observed that SINTEF Industry struggles with a transition from collaborations with oil industry to companies working sustainable energy technologies. SINTEF Industry should look for new forms of funding, eventually through spin-offs, in order to contribute more substantially to a sustainable industry and society.

1. Strategy, Resources, and Organisation of Research

SINTEF Industry is a large research institute (536 employees per 31.12.2022) with many generic scientific disciplines that are covered by six departments. SINTEF Industry is offering high levels of expertise in the fields of materials technology, advanced, materials, and nanotechnology, applied chemistry and biotechnology, applied geoscience, circular economy and industrial economics and optimisation. SINTEF Industry works closely with national and global companies within oil and gas, green/renewable energy, process industry, biotechnology, and nanomedicine.

SINTEF Industry usually works in a multidisciplinary context with broad interaction between disciplines inside the institute, together with other institutes in SINTEF, and with its research partners. Its strong position makes it heavily engaged in strategy and policy work on both national and European levels.

SINTEF Industry's overall ambition is to *develop the basis for a sustainable and competitive industry*. This fits with SINTEF's vision “Technology for a better society”, which contributes to realisation of the UN Sustainable Development Goals through the development of sustainable solutions and increased competitiveness for SINTEF's customers and society.

Also, SINTEF Industry’s vision aligns well to Norway’s Long-term Plan for Research and Higher Education with regards to two overall objectives, namely “Enhancing competitiveness and innovation capacity” and “Environmental, social and economic sustainability”. This is very positive. Moreover, two out of six thematic priorities of Norway’s Long-term Plan for Research and Higher Education are covered by SINTEF Industry. These are “Climate, the environment and energy” and “Enabling and industrial technologies”.

During the interview with SINTEF Industry, the strategy and organisation of its research activities was discussed regarding cohesiveness and adequacy. The administrative unit is organised around 17 Prioritised Research Areas (PRA), which are presented in Section 1.1 below, and which define the strategy towards further development of research infrastructures, projects and logically the expertise is embedded in the 23 research groups under evaluation out of 30 research groups in total.

On the other hand, coming markets, presented in Section 1.1, are addressed by the research groups projects with industry and universities, in particular NTNU, and further specialisation of researchers of SINTEF Industry into technologies and research questions related to these new markets. As such, the organisation and strategy of the research activities by SINTEF Industry cover a combination of top-down, where the PRAs are the top, and bottom-up approaches, where coming markets represent the bottom. This seems a cohesive and adequate modus operandi to stay ahead of competitors in the R&D sector.

1.1 Research Strategy

SINTEF Industry has a clear strategy, which is to develop the basis for a future-oriented industry by contributing to sustainable production and value-creation. This strategy has three dimensions based on the unit's strengths:

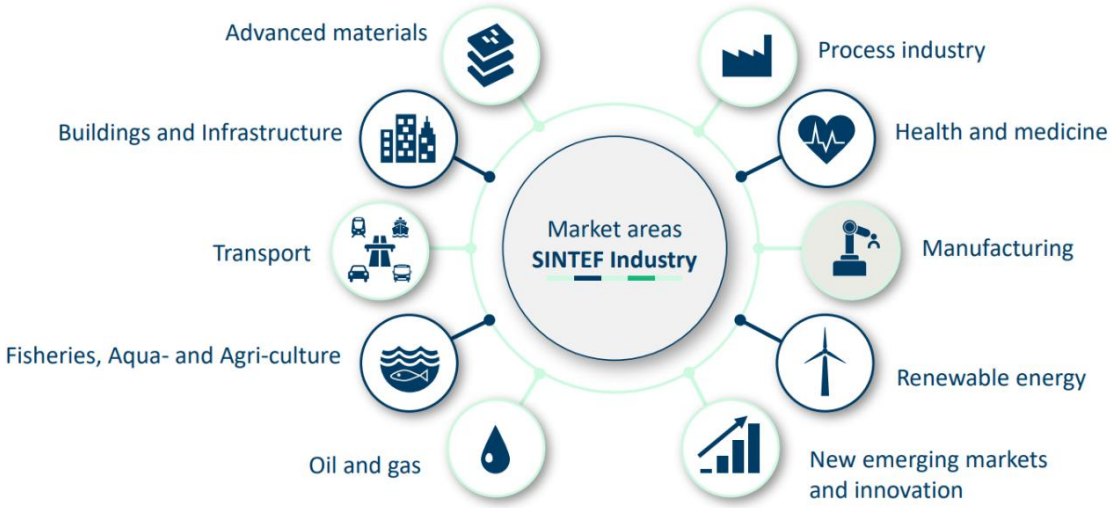
- SINTEF Industry develops generic competence, enabling technologies and multidisciplinary solutions for a wide range of market areas, in close collaboration with the rest of SINTEF, its customers and partners. This is relevant for society and economy.
- The unit develops and operates advanced laboratories, e-infrastructures and digital tools that are an integral part of its research, which is relevant for the administrative unit itself.
- It maintains scientific quality at a high international level.

With such a large group of researchers as employed by SINTEF Industry, it is logical that the strategy is formulated in a broad way, but it is also hard to determine a clear strategic direction that links them all together.

For its strategic objectives, the unit is in close contact with industry to evaluate, understand and operate based on the central market and technology trends while enquiring, being proactive, and always seeking new scientific and marked-based opportunities, see Figure 1 below. This fits the overall SINTEF Strategy and its strategic objectives which are summarised below:

- Deliver technology for a better society as an independent, world-leading research institute
- Contribute to societal solutions and competitive strength by realising the UN Sustainable Development Goals
- Co-create with customers and link their needs to the research front
- Develop SINTEF as an attractive, innovative and efficient organisation
- Build trust and economic solidity by good operations

Figure 1 SINTEF Industry's market areas in 2021



To support the vision “SINTEF Industry develops the basis for a sustainable and competitive industry”, the following 17 PRAs have been identified:

- Materials: Materials utilisation and characterisation, metal production, advanced materials and nano-technology, and plastics and composites
- Processes: Nanomedicine, metal processing, process technology, and circular economy
- Technologies: Biotechnology, hydrogen, batteries, solar, wind, carbon capture, utilisation and storage (CCUS), drilling and well, and geoscience
- Models (decision tools): Industrial economics and optimisation contribute to the realisation of the UN Sustainable Development Goals by developing sustainable solutions and increasing competitiveness for its customers and society

It is hard to assess how these PRAs are actually operationalised within the research groups and how they relate to the organisation of research in the departments and research groups of SINTEF Industry.

It is also not clear to the evaluation committee from the self-assessment report or interview how and when these PRAs will be updated. The process through which PRAs are revised, terminated or initiated, nor how the admin unit assess their relevance to wider societal pressures or trends. The evaluation committee considers these areas to be appropriate and relevant, but also expects that new areas will emerge in the coming years whilst others are deprioritised. The administrative unit should make sure that the process of identifying and prioritising these areas is sufficiently robust to ensure the overall activities of their departments and research groups continue to reflect the current and potential future needs of industry.

The unit works closely with its customers to (i) contribute to competitiveness and societal solutions through its prioritised research areas, (ii) develop strategic co-creation with important customers, (iii) leverage presence in industrial clusters and parks to create new opportunities for the institute and SINTEF, (iv) develop new businesses through the commercialisation and management of its IP and (v) develop better cooperation with the SME market.

The strategy regarding science is to develop new knowledge and competence through strategic use of the unit's basic grant and to develop multidisciplinary growth-areas through relevant corporate initiatives.

The strategy of SINTEF Industry regarding people is to develop employees by having several of the institute's researchers working with the customer (placement), to stimulate good performance and to improve the unit's scientific profile by following up on personal development plans and strategic recruitment.

A further purpose is to develop SINTEF's research infrastructure, digitise its own business and to seek alliances to increase its competitiveness. SINTEF Industry usually works in a multidisciplinary context with broad interaction between disciplines inside the institute, together with other SINTEF institutes, and with its research partners. Its strong position makes it heavily engaged in strategy and policy work at both national and European levels (e.g. Joint Undertakings, Private Public Partnerships, Position Papers, etc).

Recommendations to the administrative unit.

- It is recommended that the unit's strategy is better communicated regarding the prioritised research areas to explain why these areas are considered relevant in 2021 and how they may change in the future? What new prioritised research areas will be developed beyond 2024, and which ones will disappear? How are they related to the organisation of research in the departments and research groups of SINTEF Industry?
- Ensure the rationale for the selection of the prioritised research areas is clearly communicated and there is a robust process for reviewing them that reflects changing priorities and market needs
- Make clearer the connections between the PRAs and the activities of the departments and research groups within the admin unit to ensure clear alignment of research activities with strategic objectives
- It is recommended that the unit's strategy is better communicated regarding the prioritised research areas to explain why these areas are considered relevant in 2021

and how they may change in the future? What new prioritised research areas will be developed beyond 2024, and which ones will disappear? How are they related to the organisation of research in the departments and research groups of SINTEF Industry?

- In addition is would be beneficial if the above-mentioned strategies could be quantified by targets for the next five years, for instance, to make them more tangible and to enable an assessment of the effectiveness of these strategies on the long run.

1.2 Organisation of Research

The unit (with 536 employees as of 31.12.2022) is led by an Executive Vice President, who is member of SINTEF's corporate management team. The unit is one out of six research institutes in corporate SINTEF and is organised into six research departments, with around 50-110 employees in each department.

Each department is led by a Research Director who is also a member of the unit's management team, which has the responsibility of the overall performance of the unit. This team has also the responsibility for definition and coordination of common ambitions and objectives across departments. The responsibility for research and innovation rests mainly within the departments, which to some extent are "domain" oriented and coupled with the PRAs mentioned in Section 1.1 of this report, though it is not exactly clear how this coupling process is embedded in the organisation of the departments and research groups. Nevertheless, in this sense the organisation of SINTEF Industry complies with and contributes to the overall strategy and objectives of SINTEF.

Departments are sub-divided into research groups. The total unit covers 30 research groups, out of which 23 research groups participate in EVALMIT. Each group is led by a Research Manager. Each department's management team is constituted by its Research Director and its Research Managers. Departments are independent financial units with annual budgets and targets that have to be met.

The self-assessment report omits information about the topics of these six departments and the exact numbers of employees in these six departments and/or the underlying research groups, so it is challenging for the evaluation committee to have a good sense of how the research activities of the unit are organised. During the interview, the admin unit mentioned that these data are available in the SINTEF Industry digital system, which indicates that the overall management of the unit should have some oversight over the activities of each of the departments and research groups. The evaluation committee still considers however, given the large size of the research departments, that it may be useful to split them in smaller departments which are easier oversee and more manageable.

SINTEF Industry annually performs a thorough evaluation of 'competence-criticality' and identifies key researchers who would be particularly hard to replace, both from a scientific and market perspective. What is not clear from the self-assessment report is how the admin unit works to *retain* these key researchers. This will be especially important in essential R&D areas which align with the unit's own objectives but are also likely to be increasingly in-demand elsewhere, such as in sustainable technologies.

SINTEF Industry seems very well organised with regards recruitment and career development as procedures are developed and executed at a SINTEF corporate and unit level, however the actual strategy towards recruitment and the opportunities for career development are often not clear from the self-assessment report.

The unit's Research Director together with the department's Research Managers have the responsibility for recruitment and career development of its staff. Moreover, they also supervise that all activities are aligned with SINTEF corporate strategy, the unit's strategy, and are executed according to the corporate SINTEF management system. The SINTEF management system is well certified in an extensive manner in accordance with ISO 9001 "Quality Management Systems", ISO 14001 "Environmental Management Systems" and ISO 45001 "Occupational Health and Safety Management Systems".

The responsibility for general researcher training (incl. Project Work, Research Methods and Academic Writing, Project Management, Line Management, HSE, Ethics, Security, Export control, QA, Communication, etc.) is at corporate SINTEF and administrative unit level.

The administrative staff groups (HR, HSE, quality, communication, finance, legal) support the line management and researchers in their daily research work. They also cooperate with corporate staff when needed.

More than 20 employees of SINTEF Industry hold a part-time position with a university and are obliged to give lectures, supervise MSc and PhD students and develop collaborative projects between SINTEF and universities. These part-time positions form an important part of the unit's recruitment strategy, though the overall number of students is low relative to the size of the admin unit and could be increased.

The self-assessment report lacks information about mobility opportunities and internationalisation. Therefore, it was not possible for the evaluation committee to evaluate these topics.

Recommendations to the administrative unit.

- Better articulate and communicate the relationships between research groups and the prioritised research areas for the admin unit
- Split larger departments into smaller groups to make them more manageable
- Improve recruitment and career development strategies to decrease the gender imbalance in this unit, in particular in the management and at senior research positions. Better communicate recruitment and career development strategies, procedures and opportunities that are in place
- Develop a plan on how to retain key researchers in essential R&D directions, in particular given the transition of this administrative unit from oil industry led projects to sustainable technology projects
- Provide information to SINTEF Industry's employees and future evaluation committees about SINTEF Industry's policy and financial means to facilitate mobility opportunities and internationalisation

1.3 Research Funding

SINTEF Industry is very successful with project acquisition as is evidenced by its large research budget of 888 million NOK. This funding is distributed over four categories:

1. National grants: 405 million NOK (45.6% of total R&D budget of 888 million NOK)
2. National contract research: 303 million NOK (34.1% idem)
3. International grants: 189 million NOK (21.2% idem)
4. Basic funding and national funding 128 million NOK (14.4% idem)

In total, 370 million NOK (41.6%) is provided by industry, mainly by national contract research (292 million NOK). The evaluation committee finds this to be very good and should be continued. The evaluation committee also notes that for an organisation like SINTEF Industry that collaborates with industry on a daily basis, the unit should consider how the contribution of industry to the R&D budget could be enhanced from 41.6% to be around 60%, which would be more in line with other research institutes in Europe.

EU funding reached 110 million NOK, which is 12.5% of the overall R&D budget (excl. basic grants). This is a good rate but given the low success rates of proposals submitted for EU funding the evaluation committee recommends not to further expand this share in order to reduce R&D budget planning risks in the future.

The large amount of funding reflects a good to excellent level of research quality across the span of SINTEF Industry, however the self-assessment report lacks information on how the individual research groups of SINTEF Industry succeed in obtaining national and/or international grants over the five years 2018-2022. Therefore, the success rates of project acquisition by individuals, research groups or separate departments operating in different segments of SINTEF Industry's R&D portfolio is not clear to the evaluation committee. To ensure there is a good balanced contribution to the overall success of the unit, SINTEF Industry should review how specific groups and departments within SINTEF Industry contribute to acquisition of R&D budgets to improve performance.

The self-assessment report lacks information on how SINTEF Industry supports or facilitates researchers and research groups in applying for external funding and on how the research groups cooperate. This could be strengthened and may go some ways towards increasing the success rate of proposals for EU funding.

The RCN supports SINTEF Industry's basic budget with 75 million NOK, and it provides 371 million NOK of the national grants budget, totalling 446 million NOK (50.2% of the total R&D budget).

The SWOT analysis in the self-assessment report mentions the low level of basic funding (8%) as a weakness of SINTEF Industry. This low level of funding limits their capacity to build competence in new areas, develop and spin-out IP and start-ups, and to upskill and recruit to move into new markets. The evaluation committee means that although 8% is a small proportion of their overall budget, this represents 75 million NOK from the RCN; the evaluation committee considers this sum to be substantial. Additionally, the evaluation committee notes that 53 million NOK is available through Retur-EU (national funding scheme for increased participation in EU-projects), which also contributes to the amount of funding that the unit can call upon. The evaluation committee recognises that this basic grant might neither be sufficient for blue sky projects nor for the development of completely new inhouse infrastructures. However it is difficult to understand why this prevents the development of IP, the creation of spin-offs (resulting from own IP) through the Technology Transfer Office (TTO), the readjustment of skills of employees and the ability to attract scientific personnel outside the core-competences of SINTEF Industry. These aspects usually require less funding, while blue sky projects and new research infrastructures can be considered to be capital intensive activities.

Recommendations to the administrative unit.

- Develop a plan for efficient and effective spending of basic grants for training of employees regarding new skill sets and proposal writing, as well as for the recruitment of employees with new necessary skills for SINTEF Industry

- Review how specific groups and departments within SINTEF Industry contribute to acquisition of R&D budgets to improve performance
- Consider how the contribution of industry to the R&D budget could be enhanced from 41.6% to a more common share (for other research institutes in Europe) of 60%
- Look for new forms of funding, eventually through spin-offs, in order to support the transition towards sustainable technologies with less dependence on oil and gas

1.4 Research Infrastructures

According to SINTEF Industry's strategy, the development of advanced laboratory infrastructure and e-infrastructures and digital tools are an integral part of its research.

SINTEF Industry is very successful in the development of and participation in research infrastructures, as evidenced by the following:

- SINTEF Industry yearly invests ca 5 million NOK from its basic grant in Digitalisation of its infrastructure and competence base (databases, software, high-performance computing, etc.).
- The unit collaborates extensively with other research organisations, in particular NTNU and University of Oslo (UiO) on investments, running and exploitation of research infrastructures, for example around Tribology, Metallurgy and Batteries. The unit has participated in a large portfolio of 18 National Research Infrastructures, many of which are collaborations with NTNU, UiO and with other SINTEF units. The self-assessment report provides plenty of examples of shared research infrastructures in national and international collaborations.
- The self-assessment report covers an extensive overview of SINTEF Industry's participation in national research infrastructures. The unit takes part in all facilities for Bioresource research, Biotechnology, ICT, Materials and Energy research; in addition, 11 new national initiatives are mentioned.
- The self-assessment report mentions six international research infrastructures in which SINTEF Industry plays a role, ranging from CERN and European Organisation for Nuclear Research to the International Agency for Research on Cancer (IARC) and the European Space Agency (ESA) and ECCSEL (ERIC).
- A part of the unit's strategy is its presence at major industrial hubs which can be considered practical research infrastructures. The unit has one research group located at Herøya Industrial Park, has presence at Verdal Industrial Park, and has close cooperation with Mo Industrial Park, Helgeland and Raufoss Industrial Park/SINTEF Manufacturing.

Overall, the evaluation committee finds this to be impressive and sufficient to realise their objectives. This should be continued.

Recommendations to the administrative unit.

The evaluation committee has no recommendations.

1.5 National and international collaboration

The evaluation committee is impressed by SINTEF Industry's statements on collaboration in its self-assessment report. Its role as an independent, applied contract research institute results in a collaborative mode of working. The focus on the "grand challenges" as reflected in SINTEF's Corporate strategy and Sustainability report, mean stronger focus on cross-

sectorial and interdisciplinary collaborations. SINTEF's high representation in large Centres-of-Expertise (SFI, FME) and in the internal Strategic Corporate Initiatives, expresses a high degree of success in being collaborative and innovation oriented at both a national and international level.

The unit clearly has a breadth of strong industry collaborators both nationally and internationally, as evidenced by their levels of funding secured for contract research (detailed above). The collaboration profile of SINTEF Industry hence meets the aspirations and visions of the unit. Due to its natural tendency to execute R&D with and for industry (typically industry can be identified as non-academic partners), the collaborative attitude of SINTEF Industry has great added value to the research quality of the unit. It would be beneficial however for the unit to share a list of the companies which they have cooperated with to increase the credibility and reliability of the unit as an excellent collaboration partner.

Recommendations to administrative unit.

Develop a framework which enhances the transparency of the administrative unit regarding collaborations with universities and research institutes as well as the public visibility of collaborations. For example:

- Consider mechanisms for clustering collaboration so that it becomes more articulated within the embedding of broader strategic scope of the unit.
- Make public a list of companies that have cooperated with SINTEF Industry to increase the credibility and reliability of the unit as an excellent collaboration partner.

1.6 Research staff

SINTEF has an international work force from 80 different countries and has a career development plan that is represented by SINTEF's People Strategy. Internal training and mentoring are offered to all employees. Moreover, there exist clear guidelines for the promotion of employees in a system that consist of four levels.

Referring to Table 1, it can be concluded that the number of research staff appointed by SINTEF Industry has stagnated in the period of 2021 to 2022 while there was a growth of 23 staff members per year in the period of 2017 to 2021.

The average in terms of gender balance is 29% women, whereas among the institutes in this evaluation the sector's average is 46%.[1] The proportion of women in research positions within SINTEF Industry has dropped over a period of eight years: SINTEF Industry had 32% in 2017, and a 31% share of female researchers in 2022. This is contradictory to the statements made in the self-assessment report that "*This is a positive trend, and a more balanced gender distribution is expected in the coming years, which is also according to SINTEF's Gender Equality Plan.*" The evaluation committee disagrees and instead considers that SINTEF Industry is not doing well on this point and should develop a policy that leads to actual enhancement of the share of women in research positions. The unit has an uneven distribution of men in higher positions and women in lower positions: "*women represent 74% of masters, 32% of scientists, 25% of senior scientists…and 33.3% of Research Managers… and 16.6% of Research Directors were women"*. The unit has stated that "*in the coming years the percentage of women in research levels scientist and higher will increase*",

[1] Statistics Norway (2024), Statistics for use in the evaluation of mathematics, informatics and technology Analysis of research personnel in 2013, 2017 and 2021

however it is not clear to the evaluation committee how career development is organised in this unit in order to achieve this objective.

It is good to learn that a high share of the scientific staff holds a PhD (79%, but it is concerning that this share has decreased as compared to 2021 when it was 80%. The 69% share of females that hold a PhD, compared to 85% of males does not represent equality.

As of 2022, 11 of the unit's research staff held part-time positions at HEIs, both nationally and abroad (of which only one was a woman), though elsewhere in the self-assessment report it is mentioned that 20 colleagues hold part-time positions at universities, which is confusing.

Table 1: Personnel statistics for SINTEF Industry in 2013, 2017 and 2021. Source: Statistics Norway

Indicators	**2013**	**2017**	**2021**
Total researchers	294	278	395
Female researchers	87	90	126
Male researchers	207	188	269
Share of female researchers	30	32	32
Share of researchers with phd-degree	73	77	80
Share of female researchers with phd-degree	66	69	69
Share of male researchers with phd-degree	77	81	85
Share of researchers with foreign phd-degree	21	22	25
Average age, all researchers	43	45	45
Average age, female researchers	40	42	41
Average age, male researchers	45	46	46
Share of researchers 62 years or older	5	8	9

Recommendations to the administrative unit

- Improve SINTEF Industry's recruitment and career development strategies to decrease the gender imbalance in the unit at all levels, in particular in the management and senior research positions.

1.7 Open Science

SINTEF Industry has procedures for open science, such as:

- Accepted, peer-reviewed versions of its employees' scientific publications can be deposited in SINTEF's institutional repository, SINTEF Open (unit.no)
- SINTEF has established an infrastructure platform to ensure that research data is FAIR - data.sintef.no (DSN). DSN is a data catalogue that makes it easier for internal SINTEF researchers to store, search and find data, connect different data sets, analyse and make data available for re-use
- SINTEF Software is made available through GitHub
- SINTEF's Research Data Management Policy states how to work with research data, incl. the FAIR principles. Each project must have a Data Management Plan (DMP)

Despite these procedures and regulations, it is inevitable that confidentiality is required in collaborations with industrial partners that preferably work with NDAs. This can affect open science.

DSN is only available for SINTEF researchers, therefore the evaluation committee does not consider this to be in line with supporting "open science" according to the original definition.

Industry collaborations under NDAs and lacking open access through DSN can also affect the amount of open access publications. The share of open access publications by SINTEF Industry is 57.4%, with gold open access for 19.7% of publications. This is high compared to the national average for open access publications, which is 41.5%; however low compared to the national average for gold open access publications, which is 35.3%. These shares should be compared to all publications by SINTEF Industry in 2022 which amount 289. With 536 employees this results in 0.54 publication per employee per year and hence 0.31 open access publication per employee per year. These are relatively low numbers that can be improved in the future.

Recommendations on how to promote open science

- Explore how DSN can be operated to true open science standards
- Develop a policy to increase the number of (open access) publications per employee: currently, this research output is weak and does not reflect the advertised aimed excellence of this unit.

2. Research production, quality and integrity

The size and complexity of the unit in terms of the number of research groups makes it very challenging to reach an overarching assessment of the unit. The absence of consistent information about numbers of various types of personnel, diversity, details about research topics covered by the groups, budget allocation and publications per researcher means that the evaluation committee has found it highly challenging to get an overall impression of the strengths and weaknesses within the unit. This raises the question about how the management of the unit maintains an overarching strategic view of its constituent departments and research groups and how they monitor activities and progress.

For this evaluation the evaluation committee members tried to capture which research groups and departments were involved in the self-assessment, see below:

- Sustainable Energy Technology is involved in this evaluation with all its research groups. The groups Electrochemical Energy Conversion and System Solutions, and Batteries and Hydrogen Technologies, were formed after splitting the formerly New Energy Solutions research group.
- Materials and Nanotechnology is involved in this evaluation with all its research groups.
- Metal Production and Processing is involved in this evaluation with all its research groups.
- Applied Geoscience is involved in this evaluation with all its research groups. The Applied Geoscience group (originally Dept. of Exploration and Reservoir Technology) was formed in 2013, by merging the old Dept. of Basin Modelling with the Dept. of Geophysics and Reservoir Technology (at that time all part of SINTEF Petroleum AS).
- Process Technology, is involved in this evaluation except the research groups Kinetics and Catalysis and SINTEF Tel-Tek, and there may be a new research group in this department named Industrial Process Design which summary is available in the long list at the end of this section.

SINTEF's Industry's publication policy is that of the overall corporate SINTEF. SINTEF wants its knowledge to contribute towards a better society, and to ensure that its research results

are made visible and easily accessible. At the same time, its results must be handled within the constraints imposed by its duties of confidentiality and non-disclosure. SINTEF wishes to take advantage of the opportunities provided by open access for the publication and dissemination of new knowledge. As a general rule, SINTEF's scientific results shall be published in open access media, provided this is possible given strict NDAs with industrial partners, see Section 1.7.

SINTEF Industry with 536 employees has the following publication record in 2022. Number of publications: 289. Modified author shares: 163.5. Percentage of author shares: 3.5%. This results in 0.54 publications per employee. This publication output is at the lower end.

The NIFU report on the bibliometric performance of each of the EVALMIT administrative units shows that SINTEF Industry has 7.1% of their publications in the top 10% most cited publications and the mean normalised citation score is 90. These values are at the lower end with an average national score for ICT of 129, for Energy Research 116, for Marine Technology 102 and for Other Technology and Engineering 113.

The national average collaboration share for national co-publishing in 24.3% and for international co-publishing 56.9%. SINTEF Industry is in this range with respectively 28.7% and 43.9%.

Collaboration with top-ranked institutions on the basis of bibliometric statistics shows that SINTEF Industry co-published 27 publications in 2022, with a 9.4% author share. As a reference the highest scores 351 / 27.5% and the lowest scores 0 / 0% are shared. On the basis of these numbers, it can be concluded that SINTEF Industry has potential to improve the collaboration with top-ranked institutions.

The relative interdisciplinarity score for SINTEF Industry is 108. As a reference the highest score 286 and lowest score 75 are shared. This indicates that SINTEF Industry can improve at interdisciplinary publishing.

2.1 Research quality and integrity

Based on the evaluation of the research groups conducted by the expert panels, the evaluation committee summarises emerging conclusions on the performance of the groups according to their departments (as presented in the Description of the Administrative Unit).

Overall, the evaluation committee has identified three key challenges for the unit in the management:

- The large amount of research groups within SINTEF Industry complicates keeping an overview and control over research quality and research integrity.
- The diversity of quality among research groups with each department requires different management approaches. It will be a challenge to uniformly collaborate among groups that are at the weaker end, in the middle and at the top of the performance spectrum.

In general SINTEF Industry seems to consist of a multitude of individually operating research groups instead of one organisation. This can be significantly improved and should SINTEF Industry manage to do this, it will result in a more efficient and cost-effective operation of this administrative unit.

Summaries of the assessment of the research groups are presented in the appendix.

Strengths

A large variety of research topics covered by many research groups can be matched with a broad range of interesting projects and collaborators that potentially can yield a high quality of research if well managed by the departments' management.

- Sustainable Energy Technology: the research groups cover both material science and system research. Two groups have an excellent performance and are visible in the international research community. The two groups that are relatively young have already defined a clear strategy for their research and operate accordingly.
- Materials and Nanotechnology: half of the research groups have an excellent international reputation, are able to self-fund themselves and have a great publication record.
- Metal Production and Processing: from a traditional perspective R&D in this department is well developed, and each research group can manage itself with regards to funding and output.
- Applied Geoscience: two research groups are performing at an outstanding level and have a strong international reputation. In particular the research group on formation physics produces world-leading research and consultancy services on geomechanics and petrophysics. All groups in this department have access to excellent research facilities.
- Process Technology: the diverse image as sketched above for the other departments also applies to Process Technology. A unique strength is its strong partnerships with industry.

Weaknesses

The broad stretch in research topics covered as well as TRL levels (from 2 to 8, even 9) may lead to lack of focus of research conducted by SINTEF Industry.

- Sustainable Energy Technology: at least two (if not more) of the research groups underperform with regards to research quality and publication output. There is little evidence of collaboration between research groups in this department while this would be very beneficial in an energy landscape with hybrid energy systems. In general, the intake of MSc and PhD students in the research groups is low and can be significantly improved.
- Materials and Nanotechnology: half of the research groups have a weak reputation and underperform with regards to funding and publications. Training on the job required to execute R&D in mechanical engineering at SINTEF is a complication.
- Metal Production and Processing: part of the research groups lag behind in the required greening of the metal production sector which is concerning given the fact that R&D offered by SINTEF should be at the forefront.
- Applied Geoscience: half of this department is performing at a satisfactorily level, however the quality is not outstanding nor internationally visible or recognised.
- Process Technology: the diverse image as sketched above for the other departments also applies to Process Technology.

3. Diversity and equality

SINTEF Industry operates according to many ethical rules and norms that have been formulated in guidelines at the corporate level, such as SINTEF's People Strategy 2021, SINTEF's Ethics Compass/Guidelines, Whistleblowing procedure at SINTEF 2021, SINTEF's HSE Policy 2022, and SINTEF's Gender Equality plan 2022.

Equality and a healthy working environment are key to SINTEF's social responsibility. Equality stands for the vision that no employee shall be subjected to unwarranted discrimination on account of their gender, pregnancy, taking parental leave or leave linked to adoption, role as carer, ethnicity, religion, life stance, functional disability, gender orientation or identity, or age.

Despite this vision, the unit has a weak gender balance (see Section 1.6 of this report). The unit also has a reasonable share of foreign colleagues; 35% of its employees are from abroad, and from 50 different nations. The self-assessment report does not provide statistics about the inclusion of migrants or international recruitment. However, from the interview with SINTEF Industry, the evaluation committee can conclude that international recruitment is highly relevant.

4. Relevance to institutional and sectorial purposes

SINTEF Industry actively contributes to the sector-specific objectives and its research innovation and commercialisation activities.

Innovation happens in close cooperation with industry through a broad portfolio of innovation-projects for businesses, demo-projects and centres for research-based innovation, which is evidenced by a list of successful innovation and commercialisation results in the self-assessment report.

This is supported by various institute policies for commercialisation of results, IP policy, Industry policy and use of basic grants and the Industry Commercialisation Accelerator.

SINTEF's mission "to be a world leading applied research institute", and the vision "Technology for a better society", imply to embed policy development, sustainable development, and societal and industrial transformations as a part of its working culture. The unit holds competence/research groups with a focus on circular economy and techno-economic and life-cycle analyses. This makes it capable, together with other research groups in SINTEF, to assess also the societal impact (ripple-effects etc) and sustainability impact of projects.

Its portfolio is indexed and measured in terms of sustainability impact (ref. Sustainability Report 2023). Sustainability is at the core of SINTEF's activities. In 2019, SINTEF's Board of Directors decided that its activities would be based on the UN Sustainable Development Goals (SDGs) and that the SDGs would be used as performance indicators in relation to competitiveness and the common good. In 2022 SINTEF had significant activities related to the following SDGs, listed by the proportion of its turnover. The highest ranked SDG is SDG 9) Industry, Innovation and Infrastructure, next SDG 7) Affordable and Clean Energy, subsequently SDG 13) Climate Action, SDG 12) Responsible Consumption and Production, SDG 11) Sustainable Cities and Communities, SDG 14) Life Below Water, SDG 3) Good Health and Wellbeing and also SDG 15) Life on Land. The remaining SDGs are not significantly covered by SINTEF's activities.

The unit also has strong and skilled communication staff being used extensively in policy debates and development, including business sector level, the public support system, and on a governmental level. Most of the unit's management team members hold strategic positions within their respective areas of responsibility (various industry sectors), as members of national strategy processes and large-scale research centre projects (SFI, FME, etc). The unit is actively involved in 12 of the 14 Strategic Corporate Initiatives (Konsernsatsinger) in SINTEF, addressing the major challenges of society.

5. Relevance to society

SINTEF Industry's activities are relevant to society and are in alignment with the Norwegian Long-Term Plan for Research and Higher Education. The unit has actively contributed to the development of this plan and follows the strategic objectives around strengthened competitiveness and innovativeness, to face major societal challenges, and to develop professional environments of outstanding quality. Of the long-term priorities mentioned in the Long-Term Plan, SINTEF Industry has concentrated its contribution particularly towards climate, environment and environmentally friendly technologies, as well as industrial and enabling technologies.

From the interview with SINTEF Industry, it can be concluded that it struggles with a transition from collaborations with the oil and gas industry to companies working with sustainable energy technologies. In this context, the evaluation committee advises the unit to look for new forms of funding, eventually through spin-offs, in order to contribute fully to a sustainable industry and society.

By advising policy makers about the developments regarding new technologies SINTEF Industry is relevant to societal challenges more widely, especially because this can impact the support of more climate-friendly solutions by regulations and law to be created by policy makers. Furthermore, SINTEF Industry actively participates in arenas where politics, public and private sector, NGOs and other actors come together to share and discuss new knowledge and needs for the development of new policies, for instance the circular economy, batteries and hydrogen.

In the self-assessment report, it is stated that SINTEF's research projects make specific contributions to the following UN SDGs: Decent work and economic growth; Industry, innovation and infrastructure; Affordable and clean energy; Climate action; Responsible consumption and production; Sustainable cities and communities; Good health and well-being; Life below water and Life on land.

The impact cases provide sufficient information regarding sustainability efforts in the energy sector and manufacturing, collaboration with companies and focus on environmental impact regarding emission reductions and health to confirm the statements made in the self-assessment report about the relevance of SINTEF Industry to society.

5.1 Impact cases

Comments to impact case 1: Solvit project for CCS

Short description of the impact case: The Solvit project (2008-2023) involving Aker Solutions, SINTEF and NTNU was one of the largest research projects at SINTEF. It is focused on the development of solvent-based CO_2 capture processes and has had a major impact in the field of Carbon Capture technology, positioning Aker as one of the world's leading

technology providers. The selection, testing, validation and benchmarking of solvents and next development for industrial application have been the core approaches in this case, with an overall aim to reduce the costs of CO_2 capture post combustion. It was also the basis for the construction of SINTEF's CO_2 Lab pilot, which has been used in benchmarking and development of technologies for a wide range of international companies. The project also established a close relationship between SINTEF, NTNU within CCS, with the education of many students that have been recruited both by Industry and SINTEF.

Relevance: This case is relevant from both an environmental and collaborative perspective. Namely CO_2 post combustion capture to reduce GHG missions is a means to green many existing industrial processes that don't have other opportunities for emission reductions. The case has also established long term collaborations between industry, SINTEF and academics, guaranteeing continued R&D budget and employment of researchers and recently graduated students over more than a decade.

Importance: It is one of the largest research projects of SINTEF, covering all levels of technology development from fundamental science to demonstration in a pilot plant and commercialisation by industry.

Strengths of the impact case: As an output of the project several new solvents were developed which created also new IP, and a new CO_2 Lab pilot for testing has been established at SINTEF which attracts many international companies to new collaborations with SINTEF Industry. Moreover, Aker Solutions has applied the results of this case in its cement production.

Comments to impact case 2: Multiphase research

Short description of the impact case: Research within the field of Multiphase flow (2011-2022) has been an important enabler for Norway’s oil and gas exploration, with the Multiphase Flow Lab hosted by SINTEF being identified as one of Norway’s most important innovations. Understanding of multiphase mixtures and their transport are relevant for the production facilities of the oil and gas sector in ocean reservoirs. In this case the flow of multiphase mixtures containing oil and gas in pipelines is simulated and tested in reality in the Multiphase Flow Lab.

Relevance: The oil and gas sector is of major importance to Norway's economy for which reason this case is of utter relevance. Also, it is related to research contributing to reducing emissions, including transport and storage of CO_2.

Importance: This case has resulted in development of the SINTEF Multiphase Flow Laboratory (which one of the world's largest multiphase test facilities) and long-term collaborations with various companies, such as Kongsberg Digital, Total and ConocoPhillips.

Strengths of the impact case: Strengths are SINTEF and Kongsberg Digital’s co-development of the Ledaflow simulator which is pioneering applications within CO_2 transport and storage. Furthermore this case has resulted in several patents and applications multiphase modelling findings in the commercialisation in CCS technology, and the development of new offshore oil and gas fields.

Comments to impact case 3: Shale as a barrier for plugging oil wells

Short description of the impact case: This case (2013-2021) is focused on developing new cost-efficient plugging solutions for decommissioned oil wells to avoid leakage of oil from these reservoirs in the environment. The solution that is investigated and further developed is applicable for to-be-abandoned oil and gas wells on the Norwegian Continental Shelf that typically contains a cap rock of shale. This shale can creep around the steel casing of a pipeline that leads to the oil or gas, resulting in an impermeable barrier that can replace the commonly applied cement plugs.

Relevance: Shale as a barrier concept has a large potential to cut cost of plugging of decommissioned oil wells and being a safe solution at the same time. A potential cost cut upwards to 50% can be possible. Further effective solutions for plugging oil and gas wells can also have an impact for CO_2 wells for CO_2 storage.

Importance: An estimated 7000 oil wells need to be plugged and abandoned on the Norwegian Continental Shelf within 2050. The oil and gas industry estimates the total plugging costs to be as high as 1 000 billion NOK. Finding new ways of plugging these oil wells that is safe but more cost efficient is therefore vital.

Strengths of the impact case: The new shale as a barrier concept will avoid the lengthy use of rigs for removing steel casing and inserting several large cement plugs. This will usually take 20 to 60 days and is therefore a very costly operation. Both costs and time will be saved. Secondly this case has resulted in close collaborations with the following oil companies: Total, Shell, Var Energi, Equinor, AkerBP, ConocoPhillips, BP, Lundin, and Petrobras, which are very pleased with the increased safety, environmental improvement and cost-effectiveness of this innovation. Thirdly, knowing that the total amount of wells to be plugged in the world is more than 4 million and that worldwide approximately 500 000 new wells are being drilled for the next 3-5 years, the international market for this new technology is enormous, provided that the core rock around the well is shale.

Comments to impact case 4: Hydrogen research in SINTEF Industry

Short description of the impact case: In this impact case (1990-2022) various projects related to hydrogen technologies are covered. These projects funded by the EU, RCN and industry are organised around the following five central themes:

- Low temperature fuel cells and electrolysers
- High temperature fuel cells and electrolysers, Pd membranes
- Hydrogen embrittlement
- Hydrogen as a fuel / reducing agent in metallurgical industry

SINTEF Industry is very active in various hydrogen networking activities, among others it is a member of the board of Hydrogen Europe Research and is a founder of EERA's hydrogen activities. SINTEF also has chaired the Norwegian Hydrogen Forum until 2023.

Relevance: According to the self-assessment report by this unit, hydrogen will be one of the major pieces in the energy storage puzzle, and as such, needs to be a vital part of Norway's national and international decarbonisation strategy.

Importance: In order to establish the energy transition, efficient and cost-effective hydrogen technologies must be developed.

Strengths of the impact case: This case has resulted in numerous publications, several patents, and projects executed over more than three decades. Also, strong collaborations originate from this impact case, such as with NTNU and hydrogen and steel companies.

Comments to impact case 5: Next-generation damage-based fatigue design of cable sheeting

Short description of the impact case: This impact case covers a collaboration between SINTEF Industry and Nexans Norway (2016-2019). Nexans Norway is an established manufacturer of subsea power cables. In the traditional design of subsea power cables, the protection against electrical failure is achieved by a watertight layer of lead. The REFACE project focused on the mechanical properties' evaluation of the lead layer, particularly with respect to its long-term fatigue and creep properties. The ambition was to challenge the over-conservativeness of the water barrier design practice.

Relevance: Lead is highly toxic for humans for which reason its use and potential for spreading in the environment should be minimised. This case contributes to this goal.

Importance: Within SINTEF Industry this case is covering a broad range of research topics from fundamental material science to modelling to experimental characterisation. The knowledge developed is considered to be important as well for other materials than lead.

Strengths of the impact case: This case resulted in updated subsea cable designs with up to 20% reduced use of lead. This amounts to approximately 1,500 Tn lead per year. In addition, the project explored a novel lead alloy which has been shown offer a potential for further reduction of lead by 30%. This novel alloy is under qualification by Nexans Norway.

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 at least 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's evaluation reports, 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 self-assessment report was insufficient to assess all evaluation criteria fully. However, the interview with the Administrative Unit filled gaps in the Committee's understanding, and the information was sufficient to complete the evaluation.

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
SINTEF	SINTEF Industry	Flow Technology (ST) Casting, forming and recycling (SFR) New Energy Solutions (NES) Material- and Structural Mechanics (MSM) Multiphase Flow (FFS) Drilling well (DW) Material Physics Trondheim (MPT) * Process Chemistry and Functional Materials (PCFM) * Solar Energy and Materials Thin Film and Membrane Technology (TFMT) Operations Research and Economics (IØO) Corrosion and Tribology (CT) Applied Geoscience (AG) Chemical and Environmental Process Engineering Electrolysis and High Temperature Materials (EHTM) * Process Metallurgy and Raw Materials * Polymer and composite materials (PKM) Batteries and Hydrogen Technologies (BHT) Materials Integrity and Welding (MIW) Industrial Process Design (IPD) Formation Physics (FF) Material Physics Oslo (MPO) * Material Modelling and Processing *

** Evaluated in the Evaluation of Natural Sciences (2022-2024), EVALNAT*

Summaries of assessments of each Research Group sorted by Department

Sustainable Energy Technology

Research group Batteries and Hydrogen Technologies (BHT) overall assessment

The research group has a focused program on battery and hydrogen technology where they utilise their strong competence in materials science, electrochemistry and modelling. Topically the group is well placed and is involved in several of the most important EU initiatives and projects. This gives them a good position for collaborating with leading international environments as well as industry. Thus, the group is clearly internationally recognised. However, based on the research output it is at the same time clear that they are not internationally excellent and there is room for development and an increase of ambition. One way to advance would be to increase the involvement of MSc and PhD students and prioritise among the projects and focus on scientifically excellent topics. With respect to societal contributions the group is well placed and there are examples of spin-offs, patents and policy papers, but involvement of partners in this work is not obvious (although implied).

Research group Thin Film and Membrane Technology (TFMT) overall assessment

The strength of the group is that it is well managed and somehow manage to combine a vast number of research fields and technology readiness levels in their research. The group has a well-functioning strategy revision, albeit lacking some detail, this is an important tool in refining the future direction of the group. To aid in this process, it is imperative that the group defines well-chosen measures as benchmarking goals and starts to use these in their strategic process. The group already produce high-quality research, which, perhaps, could be elevated further by downsizing the number of research areas, aiming at fewer research areas, but with higher quality. The research group is successful in its industrial interaction, both with large companies and in its ability to spin out companies based on inventions within the group. The group is performing on an excellent international level.

Research group Solar Energy and Materials overall assessment

SINTEF SE has a long experience on topics strongly related to the industrial production of silicon, so its work depends on the needs of this industry. Norway has long been considered as the best place in Europe where such industry, owing to its low energy costs. Asian competitors are now producing silicon at high volumes, low cost and high quality. The group’s work on innovation in silicon production is therefore becoming less relevant in Norway. Mainly with RCN support, the SINTEF SE group now spreads its research activities along the silicon value chain from materials to energy systems and PV end of life. This increases opportunities for partnerships with others research groups and contributing to education.

Research group Material Physics Oslo (MPO) overall assessment

The Materials Physics group has just moved out of the starting phase of the restructured constellation. It is developing very positively: the productivity has increased; the funding record is very good; the scientific output is of good quality that meets international standards but could be more substantial; the research themes chosen are timely and connections to partners outside academia both nationally and internationally are solid and productive. There is good potential for increasing the scientific output and attracting more PhD students. The group is matching the strategic goals concerning conducting research to international standards but could aim also for higher impact publications. Being in the starting phase has

presumably prevented the group from organising workshops or conferences, which is also among the strategic goals, but such activities should be possible soon.

Research group Operations Research and Economics (IØO) overall assessment

The Operations Research and Economics Research Group is a well-established research group. It conducts its research in a broad spectrum of projects and thereby plays an important role in many projects. They are in a good funding situation, well above critical mass and with a good gender balance. They have a clear interdisciplinary profile which is an advantage when generating research in many different interdisciplinary projects. In the day-to-day operations it seems that the group does not give enough attention to research dissemination. The activities are clearly weak when looking at the available resources. Even an internally modest goal of one peer-reviewed paper per year cannot be achieved. To be recognised internationally it is important to perform better on this part and keep it in mind when planning projects. Benchmarks are nicely formulated but difficult to measure and, therefore, follow up on.

Research group New Energy Solutions (NES) overall assessment

The group has successfully managed to formulate goals and objectives for its operation. It has also managed to, in a short time, establish itself as a group with a good influx of relevant projects. This enables the group to grow and continue to develop its software models. There is example of publications in well-established journals, but the papers have many authors. This is both an advantage and a disadvantage. It shows the strength of the group in collaborating with external, national and international, partners. But it may also be used to question how well the group in itself manages to set its research agenda. All in all, the group performs well over the different criteria assessed, with the user involvement standing out as especially high standard. The level of research is of high quality, sufficient to reach some international recognition.

Materials and Nanotechnology

Research group Material Physics Trondheim (MPT) overall assessment

The group focuses on batteries and metal research. The overall impression is that this is not a scientific group in the common sense of the term, but rather a service entity which works o n a project if someone approaches.The scientific quality is modest. For projects brought into the group by external partners, SINTEF Industry has a considerable role in the research pr ocess. It aims via research activities and has an active role in the preparation of the publicat ions. With a unique research agenda, the international visibility could be improved. Interesti ngly, the group is engaged with the Norwegian research ecosystem, especially in industrial collaborations, which has resulted in a considerable number of patents.

Research group Corrosion and Tribology (CT) overall assessment

The group appears to be agile and can work with a wide range of SMEs to help them solve practical problems in manufacture and use of their products. The group appears to function as a service group to industry and other research groups. There is little evidence of international collaboration and of impact at the international level. Also, the degree of close working with large metal-alloy manufacturers in Norway is limited; it may be that the larger companies have their own in-house capability. The publication rate in journals is moderate but is important in order to have national and international visibility. There is a need to promote this subject, and to make it attractive to recruit future employees in the face of

competition from other electro-chemical communities such as the recent battery community. The group should continue to work closely with NTNU, particularly on projects that involve the invention and synthesis of new alloys and coatings. They have state-of-the-art facilities, but it is unclear how unique they are from a global perspective; a challenge is to replace retiring professors; strategy is somewhat vague and could be more strategic.

Research group Polymer and composite materials (PKM) overall assessment

The basic funding from the host institution is very small. Hence, this group highly depends on the external funding but the efforts to secure the external funding, in particular, by numerous small projects or services with SMEs can compromise the quality of scientific research. Nevertheless, the quality of journal and the number of publications improved recently. The citation rates of papers are relatively low and should be improved further. In spite of several EU projects, the international collaboration activities are not clear (or not presented) whereas the collaboration with local players is active. The social impact dimension is very positive, and this group is very active in the contribution to the R of SMEs and the dissemination/communication to general public.

Research group Material- and Structural Mechanics (MSM) overall assessment

The Material and Structural Mechanics (MSM) group has matured into a sustainable research group that can attract and run its own projects. It has evolved in a natural way from the SIMLab activity at NTNU, with a sound strategy of becoming self-sustaining and with its own identity. Strengths: It is technically strong and works on a wide diverse range of problems both numerically and experimentally. The group recognises the importance of capability building projects in order for its expertise to be continually developed. It has broadened its efforts from automotive crash mitigation to a wider range of industries including green technologies. The group publishes in a wide variety of forms and is strong in the international context. Weaknesses: It is a challenge for the members of this group to resist being hired elsewhere as their skills are sought after by both universities and by industry. The current popularity of Machine Learning and Big Data poses a challenge as some new skill sets are needed, and this new field has not yet shaken down. Some engineering-oriented departments at NTNU and national universities seem to have a change in business model and enter traditional SINTEF areas like NRC supported innovation projects. This can lead to more competition in IPN projects in the future. Recently, the group has not grown. Also, the training period of new staff is substantial. These two factors make the group vulnerable. A strategy is needed, such as pushing into new areas of structural modelling, for example in energy materials (battery performance and degradation), in wind turbine failure, and in the handling of large datasets).

Research group Materials Integrity and Welding (MIW) overall assessment

The group is well established in the field of welding technology and of fracture mechanics. Historically, this activity has been of major industrial relevance and so the group has functioned well for many years. The group is competitive internationally and continues to work on a wide range of interesting projects. However, it needs to adapt to the green transition and to acquire some new skills to achieve this. Closer links with universities such as NTNU are needed to help the group maintain a profile in basic research and to help develop a multi-physics capability. Additionally, several retirements of key personnel within the next 5-10 years will be a challenge but may also lead to new opportunities. The benchmarks related to an academic level of performance (national or international) and the group’s contributions to other institutional or sectoral purposes are only described in general terms with little concrete (quantitative) reference to the group, therefore making them hard to

justify, and to determine how well they have achieved the benchmarks. The group publishes both in Scientific journals at a good rate in addition to popular Scientific journals.

Metal Production and Processing

Research group Process Metallurgy and Raw Materials overall assessment

This is a strong group with close collaboration with industry and university, capability to attract competitive funding and extensive experimental facilities. The field of research is highly important, non the least with the emphasis on carbon neutrality and resource efficiency, thus a field of high importance. Overall, the group activities match very well with the research goals. There has been success in critical funding especially one large grant is noted. Looking ahead for future securing continuous funding remains an open issue. Yet the focus on recycling and digitalization appears to be well chosen. Overall it is judged based on the documentation that it is a very strong organisational environment, research and publication quality and contribution is excellent and societal contribution is very considerable and societal partners have considerable involvement in the research process.

Research group Casting, Forming and Recycling (SFR) overall assessment

The research group has a very broad spectrum of competencies in terms of processes and materials, together with a strong industrial vocation, witnessed by a relevant number of high budget industrial projects. The latter are accomplished thanks to the robust technical background of the research staff and the availability of state-of-the-art equipment at SINTEF and also within national infrastructures. Two major weaknesses are evident: the first one is related to the lack of effective international collaborations, which, on one hand, prevents the research group's participation in international initiatives of research project submission, and, on the other hand, reduces the group's exposure to the international scientific community. The second major weakness is the limited number and impact of the research group's publications compared to similar groups, especially at the international level. Thus, the performance of the research groups is good when addressing technology transfer issues, but rather low in terms of scientific merit. The group has few researchers, even though the competencies and research activities to be carried out in the framework of funded projects are substantial. Overall, the performance of the research group is appropriate to its role.

Research group Electrolysis and High Temperature Materials (EHTM) overall assessment

Overall, the group is producing good quality research outputs in a relevant area which is clearly a strength, as is the external funding awarded. There are opportunities to develop this further in aligned fields. They also have good non-academic outputs, but there is a weakness in that the development of careers/career opportunities are not discussed. A further issue (weakness) is that there are no clear links to other SINTEF business areas discussed which would strengthen the outputs, e.g., with the modelling capability.

Research group Material Modelling and Processing overall assessment

The group has very good international links and an excellent track record of high-quality outputs and engagement with externally funded projects. The group's activities are aligned well with its research goals. The panel believed that the group is likely to continue to achieve its stated research goals. It was noted that the group is very successful in raising external funding which is noteworthy. It is also noted that career progression has not been considered

and there is no discussion of mentoring/recruitment processes. How the group defines societal impact is not clear from their self-assessment and the panel suggest that they could improve exploitation of their research results.

Applied Geoscience

Research group Applied Geoscience (AG) overall assessment

The AG group is well-supported by its organisation in terms of administration, HSE support, and facilities. In this regard, the provision of seed-corn funding to allow the development of new projects is particularly noteworthy. The structure of AG is adequate although the frequent reorganisations and changes in management are not ideal; the Expert Panel has concerns as to how these changes have impacted the performance of the group in recent years. AG has developed a reasonable and credible strategy that aims to transition to new (low carbon) energies, although this strategy does not provide specifics as to how it will be implemented (e.g. international recruitment) and how progress in the implementation will be monitored and evaluated. The AG group's publication output is below the SINTEF goal of one publication point per employee per year, with the current average being around 0.45 papers per person per year. While this would not be a problem per se, if these publications are internationally agenda setting and have a high impact. However, overall, the Expert Panel judges that only some of the publications are internationally leading and have subsequently been published in high profile journals; most of the publications presented in the self-assessment report are less original because they often focus too much on applying well-established techniques in petroleum industry to CO2 storage. The societal contribution made by the group is reasonable, with the management of a CO2 test-site and the frequent contribution to post-graduate training being particularly noteworthy, but these are understated in the self-assessment. The AG group has good involvement with industry and has developed software tools for industry, but some of these tools have not been updated for years and the self-assessment report does not provide metrics regarding how broadly the tools are used outside the industry partnership. Overall, the level the Expert Panel judges the level of research of the AG group as good but not outstanding compared to similar national and international environments.

Research group Formation Physics (FF) overall assessment

The Expert Panel find that FF is a well-organised research group with goals that they are already achieving because of a sensible strategy. The self-assessment form provides evidence that the group has satisfactory support from their administration unit in terms of the provision of administrative, HSE, facilities, seed-corn funding etc. FF is mainly funded through the RCN and industry but also receives support from the EU and basic funding from SINTEF. The group has a wide range of national and international collaborations with other research institutes, universities and industry. FF produces world-leading research and consultancy services on geomechanics and petrophysics particularly in shale-related research. The Expert Panel found that FF has few weaknesses although there are some areas that could be further improved as outlined in the recommendations.

Research group Drilling Well (DW) overall assessment

The DW group is very well-organised with a clear and sensible strategy, as well as robust and relevant benchmarks that enables the group to conduct very high-quality research that is highly relevant to a wide range of stakeholders beyond its immediate user-group. The group has the expertise and infrastructure to conduct a wide range of research projects related to

drilling and well technology across a range of subsurface energy applications, from traditional oil and gas to CCS and geothermal. This approach has enabled the group to attract funding from a wide range of sources including industry and research council. Internal strategic funding is available as well and allows the group to kick-start new activities. The group manages national facilities (i.e. NorPALabs) and has several other unique experimental facilities focused on DW research. The group has established a wide range of collaborations both nationally and internationally. The group educates a significant number of PhD and MSc students who work on specific research projects. A key strength of DW is its societal contribution particularly in the field of P but also in student education. A slight weakness is that the DW does not often publish in general readership science journals (e.g. Nature, Proceedings of the Royal Society of London, Science, etc) and therefore does not reach a broader international audience. Overall, the DW groups scores well to very on all evaluation criteria and the contribution from the group is very high. The Expert Panel considers the DW group to a leading research group on both a national and international context.

Process Technology

Research group Flow Technology (ST) overall assessment

SINTEF is one of Europe´s largest independent research institutes. The Flow Technology Group is part of the Department of Process Technology in the Institute SINTEF industry which is a part of the SINTEF corporation. Nearly three out of four employees are researchers.

- 71% research scientists (5% of research scientists have a PhD)
- 13% managers and administrative personnel
- 9% engineers
- 7% technical personnel

The research group works on sustainable flow and process solutions for industry and society. The strategy is founded on possessing competence which is applicable to many challenges and not focused on a specific market. The competence can be categorised as a combination of CFD, digitalisation, and multiphase reactor technology applied to flow phenomena and industrial processes. The group consists of 10 research scientists, 5 senior scientists, 2 chief scientists, one research manager, and an administrative consultant. Research and Development (R)funding has been about 5 MNOK (430.000 euros) /year 2018-2022. Gender balance in 19/2 (m/f) with just one female scientist. The research group is strong in research, practical applications as well as in an international context. The organisation supports the group adequately. Overall, all the aspect of the group are well-balanced and strong. The research group’s organisation and composition are very suitable to conduct its research activities. Moreover, the research group has a very cohesive and adequate strategy for its research activities, recruitment, internationalisation. The education of master students, training and mentoring of PhD candidates and post-docs, and mobility opportunities are active, in particular, taking into account that such activities are not formally part of the mandate of the group. However, 2 students a year seems low given the size of the group. The research group’s national and international collaborations (interdisciplinary, national, international, and non-academic) produce high-quality research. The research group's contribution to the institutional strategies and objectives is active, as can be seen in R funding.

Research group Multiphase Flow (FFS) overall assessment

FFS is an exceptionally well-equipped research group which operates internationally leading facilities. The majority of FFS's funding (3 MNOK in 2022) comes either from industry or from the Research Council of Norway. FFS's activities play a significant role in the testing and qualification of new industrial processes and equipment leading to significant societal impact. Despite these advantages and the associated level of contribution, the quality of the published research is below world standard. The Expert Panel assumes this is due to a major focus on industrial and technical reporting rather than publishing to the broader scientific community. FFS's broader societal engagement and impact is also limited, and the Expert Panel feels an opportunity is being missed to celebrate key research infrastructure and consequently to enthuse the next generation of research engineers.

Research group Chemical and Environmental Process Engineering overall assessment

CEPE operates a world leading research environment centred around the Tiller pilot plant. Consequently, they are a world leading group in post-combustion CO2 absorption. The works closely with industry and has had a central role in the development of both the Aker Carbon Capture Technology and the CESAR1 solvent technology. Despite these advantages and the associated level of contribution, the Expert Panel find the quality of the published research is lower than would be expected from a world leading group. The Panel recommends that the group publish more broadly in general science journals to promote their important work on thermal power station control and CO2 capture. The group has close links with NTNU and the self-assessment document states that it is involved in the informal supervision of PhD students. The Expert Panel is concerned that quantitative data is not presented in the self-assessment. The Expert Panel finds that CEPE plays a very considerable role in the research process and has created very considerable economic impact given what is expected from groups in the same research field. Furthermore, industry has a very considerable involvement in the research process,

Research group Process Chemistry and Functional Materials (PCFM) overall assessment

The group has a good number of staff and appears to be quite stable. They are developing activity in six areas that are complementary but may not have critical mass in each of these. They are collaborating internationally, but do not appear to have a strategy in place to increase their engagement with internationally funded programmes. It is also less clear what the overlap is between the process chemistry and functional materials aspects of the group. The overall outputs are fewer than would be expected for a group of this size and it is curious that they elected to only include a small number of outputs in their self-assessment.

Research group Industrial Process Design (IPD) overall assessment

The group, as visible in their external funding success, is a leading group in its specialised field. It is well connected nationally and internationally, both as a research group and as a quasi-academic group publishing and teaching. Its teaching contribution comes in the form of a part-time professorship of one of its members. Their focus area is important in many industries, especially when considering the attempt of a full recycling of all materials. Here, powders and their sorting will become central as an interim step. The group does not want to grow, but that raises the question of its long-term stability, as small groups can easily become under critical. It is difficult to determine the focus and boundaries of the group from the report. The main activity appears to be powder flow: this has a wide range of potential applications, ranging from avalanches to explosives, powder metallurgy, and additive manufacturing. The group appears to take the approach of a chemical engineering group

with powder characterisation methods. The group defines itself as world-class, but the international profile is limited. The modelling activity tends to use existing commercial codes as Barracuda, so it is difficult to determine any unique and fundamental methodologies that the group is developing.

Terms of Reference (ToR) for the administrative unit

The Executive Vice President of SINTEF Industry mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess SINTEF Industry based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by SINTEF Industry and its research groups 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 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 8 aspects in your assessment of both SINTEF Industry and its research groups:

1. Research groups with a clear, well-defined and complementary core scientific competence, adequate in order to serve its markets on the short and long term
2. Adequate and relevant collaboration with universities and other research institutes, particularly through participation in various centres of excellence and innovation (e.g. SFIs, FMEs, and National Research Infrastructures) as well as EU-projects
3. Adequate and relevant cross disciplinary collaboration with other parts of the SINTEF organisation
4. Adequate and relevant collaboration with industry
5. Access to necessary experimental and/or theoretical infrastructure including excellent technical staff
6. A project portfolio with a well-balanced mix of competence building projects and industrial innovation projects, and an adequate peer reviewed and popular scientific dissemination
7. Well-developed scientific network and expert contributions to the national and international scientific community
8. Appropriate organization in terms of size of research groups, human and economic resources, adequate mixture of leading expertise and broad competence, to fully exploit the organizational opportunities for the institute

In its assessment we ask the evaluation committee to also consider the following:

SINTEF Industry has a low share of basic funding (7-10% of total revenues) compared to the average 40 % for European RTOs, and the ~70 % for Norwegian universities. Low basic funding has an important impact on the institute's distinctive character and organisational culture. The low basic funding makes SINTEF Industry more dependent on competitive

financial instruments, and thus more vulnerable for rapid changes in national and international programmes and schemes (in particular The Norwegian Research Council and The European Commission)

SINTEF is a part of a relatively large RTO sector offering research capacity for Norwegian industry (including a large SME sector) and public sector. Through co-creating with customers, linking their needs to the research front, the institute is an important RTD partner for industry.

A growing amount of Norway's Research and Innovation budget is distributed through international financial instruments, in particular the EU framework programme. The EU represents 85% of the Norwegian export market and is therefore an important agenda setter for Norwegian industries. The EU framework programmes represent an increasing amount of the total annual revenues of SINTEF Industry (from 7% in 2015 to 17% in 2022).

SINTEF Industry is primarily organized in groups with distinct scientific competences that often collaborate cross-disciplinarily in domain/market-based project teams to address the needs for innovation in various markets, and which allows us to develop additional business expert competence. This is also reflected in our career system that covers specialists in both science, project management, and business development.

SINTEF Industry has cultivated a "bottom-up" organisation with a flat organisational structure and highly dynamic, self-navigating and market-adjustable research groups. This makes the organisation robust and well prepared for change of pace and rapid shifts in the RTD-system

Strategy processes and organizational development in *SINTEF Industry* are characterized by bottom-up delivery and a high degree of involvement from the entire organisation. The governance of the institute is directional and supportive.

In addition, we would like your report to provide a qualitative assessment of Technology Division 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
- relevant strategy documents
- organisational charts
- relevant statistics and analytics

Interviews with representatives from the evaluated units

Interviews with *SINTEF Industry* 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 Technology Division 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 relevant secretariat. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to *SINTEF Industry* and RCN by [date]. *SINTEF Industry* should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the relevant secretariat no later than two weeks after receipt of the draft report. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the Executive Vice President of *SINTEF Industry* and the RCN no later than two weeks after all feedback on inaccuracies has been received from *SINTEF Industry*.

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)

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