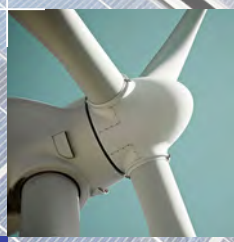
The Research Council of Norway

Evaluation of Norwegian Technical Industrial Research Institutes

Principal report

Evaluation
Division for Science



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Principal report

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Division for Science

The Research Council of Norway
P.O.Box 564
NO-1327 Lysaker

Telephone: +47 22 03 70 00
Telefax: +47 22 03 70 01
post@rcn.no
www.rcn.no/english

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Contents

Summary of Recommendations

This report contains the assessments and recommendations of a panel appointed by the Research Council of Norway (RCN) to evaluate the technical industrial institutes (TI institutes). Its key recommendations, responding to the main questions in the Terms of Reference, are addressed to three target groups: the Government, the RCN and the institutes respectively.

The TI institutes contribute to current value creation in Norway. Existing industrial customers provide a high fraction of TI revenues and generally express satisfaction with the services they receive. Nonetheless, and especially since Norway is entering an industrial transition period, the TI institutes need to strengthen their innovation capabilities and accelerate their adaptation to changing markets in order to better assist Norwegian industry in the face of increasing international competition.

The principal recommendations to deliver an improved Norwegian TI sector are:

1. The Government must continue to develop and disseminate clear guidelines and targets for national industrial and innovation strategies and engage the TI institutes closely in this process.

2. RCN needs to allocate resources to TI innovation via specific incentivisation measures linking a significant fraction of base funding to an assessment of ongoing innovation contributions.

3. RCN should also allocate additional funds to TI institutes who can demonstrate how these can be used to deliver support for accelerating industrial transition.

4. TI institute managements must regularly review their strategies' and targets' alignment with the national strategies and needs, and these efforts must be supported and reviewed by their boards.

5. TI institutes that are below critical size for their research activities need to be encouraged by Government and RCN to take steps to address this. Fewer and stronger regional and national units are required with fit-for-purpose ownership structures and better collaboration between different TI institutes and with universities.

6. Government and RCN policies and funding mechanisms should encourage the different but complementary roles and responsibilities of TI institutes and universities to maximise the contribution from both.

7. TI institutes need to have strategies in place to maintain a global level of science and technology competence in their selected spearhead areas.

8. All TI institutes must plan for international activities, taking into account their size and regional/national characteristics and their scope to facilitate wider Norwegian participation in global networks.

9. Continued Government and RCN support for international collaboration is required, in particular STIM EU for the EU Framework Programmes.

10. To ensure sustainable finances for their activities and to allow for internally-funded transformation, the TI institutes should aim for a minimum long-term average of 4% operating margin.

Recommendations to the individual institutes are given in Section 3.4.

Norsk sammendrag av anbefalingene

Denne rapporten inneholder vurderingene og anbefalingene fra et utvalg oppnevnt av Norges forskningsråd for å evaluere de teknisk-industrielle instituttene (TI-instituttene). De sentrale anbefalingene, som svarer på hovedspørsmålene i mandatet, rettes mot tre målgrupper: Regjeringen, Forskningsrådet og instituttene selv.

TI-instituttene bidrar til verdiskapningen i Norge. Eksisterende kunder fra næringsliv/industri står for en høy andel av TI-instituttenes inntekter, og gir uttrykk for at de generelt er tilfredse med tjenestene de mottar. Det er likevel å anbefale at TI-instituttene styrker sine innovasjonsevner og tilpasningsdyktighet til endrede markeder slik at de kan yte bedre hjelp til et norsk næringsliv som møter stigende internasjonal konkurranse. Dette er spesielt viktig ettersom Norge er på vei inn i en periode med omstillinger i næringslivet.

Hovedanbefalingene for å styrke den norske TI-sektoren er:

1. Regjeringen må fortsette arbeidet med å utvikle og formidle klare retningslinjer og mål for nasjonale industri- og innovasjonsstrategier. TI-instituttene må engasjeres tettere i denne prosessen.

2. Forskningsrådet må allokere ressurser til innovasjon gjennom spesifikke insentiver som knytter en vesentlig andel av basisbevilgningen til en vurdering av TI-instituttenes bidrag til innovasjon.

3. Forskningsrådet bør i tillegg tildele midler til TI-institutter som kan dokumentere hvordan midlene kan brukes for å støtte raskere omstilling i industrien/næringslivet.

4. Ledelsen ved TI-instituttene må regelmessig vurdere sine strategier og mål opp mot nasjonale strategier og behov. Disse tiltakene må støttes og godkjennes av instituttenes styrer.

5. Regjeringen og Forskningsrådet bør oppmuntre TI-institutter som har forskningsaktivitet under kritisk størrelse til å ta grep om situasjonen. Det er behov for færre og sterkere regionale og nasjonale enheter med eierskapsstrukturer som er tilpasset oppdraget og for bedre samarbeid mellom TI institutter og med universiteter.

6. Utformingen av policy og finansieringsverktøy fra regjeringens og Forskningsrådets side bør ta sikte på å oppmuntre de ulike, men komplementære rollene og ansvarene som ligger hos instituttene og universitetene slik at bidragene fra begge sektorer kan utnyttes i størst mulig grad.

7. TI-instituttene må ha på plass strategier for å opprettholde vitenskapelig og teknologisk kompetanse på globalt nivå innenfor deres utvalgte spisskompetanseområder.

8. For å legge til rette for større norsk deltakelse i globale nettverk, må alle TI-instituttene ha en plan for sine internasjonale aktiviteter. Planene må ta hensyn til instituttets størrelse, regionale/nasjonale særpreg,samt virksomhetsområde.

9. Det må fortsatt gis støtte fra regjeringen og Forskningsrådet til internasjonalt samarbeid, spesielt STIM-EU for EUs rammeprogrammer.

10. TI-instituttene bør sette et gjennomsnittlig driftsresultat på 4 prosent som et minimumsmål for å sikre seg en bærekraftig økonomi med rom for å kunne finansiere omstillinger med egne midler.

Anbefalingene til de individuelle instituttene finnes i seksjon 3.4.

1 Introduction

This chapter provides a short background to this evaluation as well as a description of the composition and working mode of the evaluation panel. It also highlights some important departure points for the evaluation.

1.1 The background and basis of the evaluation

Objectives and Terms of Reference

This evaluation attempts to bring new understanding to the areas of strength and the areas for improvement in the Norwegian technical-industrial (TI) research institutes, individually, as groups and as parts of a broader system. It provides recommendations to the government, the Research Council of Norway (RCN) and the individual institutes respectively. The Norwegian technical-industrial research institutes constitute an essential part of the Norwegian R&D and innovation system. Following up its strategic responsibility for the research institute sector, the RCN has decided to organise evaluations of all the research institutes, belonging to different sectors, in the period 2014 to 2018. This evaluation is part of this strategy, covering the technical-industrial institutes (TI institutes).

The Terms of Reference for the evaluation asks for a report that is useful for the institutes' own strategic development efforts, that strengthens the knowledge base for the Research Council and the ministries in developing an effective, targeted research institute policy, and that provides a basis for assessing the funding instruments of the RCN. Hence, the report has three target groups: the Norwegian government, the RCN and the TI institutes. The report is structured to provide recommendations to all these groups.

In the Terms of Reference four main topics are identified for the evaluation (the full ToR are given in Appendix 1):

1. ***Commissioned research, customer relations and role in innovation:*** Assess how the technical-industrial institutes fulfil their national responsibility of supplying applied research as commissioned by trade and industry and the public administration (role as research contractor).
2. ***Role in the Norwegian research system:*** Assess how the technical-industrial institutes maintain and fulfil their role in the Norwegian research system. This involves examining how cooperation, task distribution and competition function between the technical-industrial institutes, between the institutes and universities and university colleges (higher education sector), and between the institutes and other research environments.
3. ***International collaborative activities:*** Assess the international collaborative activities of the technical-industrial institutes.
4. ***Financial sustainability and basics:*** Assess the financial situation, infrastructure and basic conditions for the technical-industrial institutes.

The technical-industrial sector contains 14 research institutes covered by the evaluation. The institutes vary significantly in size and so, to allow the two largest units (the SINTEF Foundation and IFE) to be examined at a comparable level of detail to the others, the ToR specified that these were to be assessed as smaller units, making a total of 18 units for evaluation:

Table 1.1 Institutes and units covered by the evaluation

Institute	Unit	Part of
1	1. Christian Michelsen Research AS (CMR)	
2	Institute for Energy Technology (IFE)	
	2. IFE nuclear research activities	IFE
	3. IFE other research activities	IFE
3	4. International Research Institute of Stavanger AS (IRIS)*	
4	5. Norwegian Geotechnical Institute (NGI)	
5	6. NORSAR	
6	7. Norut Tromsø*	Northern Research Institute
7	8. Norut Narvik	Northern Research Institute
8	9. Norwegian Computing Center (NR)	
9	10. Norwegian Marine Technology Research Institute AS (MARINTEK)	SINTEF Group
10	11. SINTEF Energy Research AS	SINTEF Group
11	12. SINTEF Petroleum Research AS	SINTEF Group
12	SINTEF Foundation	
	13. SINTEF Building and Infrastructure	SINTEF Foundation/SINTEF Group
	14. SINTEF ICT	SINTEF Foundation/SINTEF Group
	15. SINTEF Materials and Chemistry	SINTEF Foundation/SINTEF Group
	16. SINTEF Technology and Society*	SINTEF Foundation/SINTEF Group
13	17. Tel-Tek, Telemark Technological Research and Development Centre	
14	18. Uni Research AS: Including 2 of 6 units: Uni CIPR and Uni Computing	

*These units also comprises some social science research which is not covered by this evaluation.

The present report covers all 18 units and all main topics in the ToR. The four topics are discussed in consecutive order in Chapter 2.1 to 2.4. Within the main topics, the panel has put particular emphasis on issues found to be the most important for the future success of the TI institutes.

In addition to covering the 18 units, the SINTEF Group and IFE have been considered as overall units.

It should be added that much data is only available at institute level, and hence covers the 14 institutes, whereas the 18 units are mainly covered by information from the submitted self-evaluations and the meetings with the institutes and from the user survey and the bibliometric analysis undertaken by independent consultants.

The composition and work of the evaluation panel

The evaluation panel appointed by the RCN consisted of:

- Anne-Christine Ritschkoff (chair), Executive Vice President, Strategic Research, VTT, Finland
- Jan-Eric Sundgren, Senior Adviser to the CEO, Volvo Group, Sweden
- Axel Makurat, Team Leader Rock and Fluid Science, Shell, Netherlands
- Freek Heidekamp, Senior Adviser Corporate Staff Department Strategy, TNO, Netherlands (until July 2015)
- Jon Gibbins, Professor, University of Edinburgh, UK
- Bjarne Foss, Professor, NTNU, Norway
- Anne Jorun Aas, Managing partner, Sigla AS, Norway

Liv Langfeldt, Deputy Head of Research NIFU, served as the scientific secretary for the panel. Starting on 11 February 2015 the panel had 4 one day meetings plus an additional 4 days of interviews with the institutes. The meetings with the institutes, included 2-4 representatives from each institute/unit, and started with a short presentation of the institute before going through the topics in the ToR for the evaluation. All panel members participated and met representatives from all institutes. The programme for the interviews is attached in Appendix 2.

A reference group consisting of representatives from RCN, the Ministry of Education and Research, the Ministry of Trade, Industry and Fisheries, Innovation Norway, the Federation of Norwegian Industries ('Norsk Industri') and the Association of Norwegian Research Institutes (FFA), has met with the panel on two occasions and provided input and comments to the evaluation panel and commented on the draft report.

Documentation and background reports

RCN provided the evaluation panel with extensive background information for their work, including:

- A self-assessment report from each unit to be evaluated. These reports comprised information on research profile, innovation activities, markets, collaboration, competence development, funding etc., as well as the units' assessments of own strengths, weaknesses, opportunities and threats (see template in Appendix 4).
- Facts report (from RCN, published as separate report): Based on available data and statistics, RCN produced a report giving an overview of the TI institutes and their framework conditions, including human resources, revenues, funding and performance indicators.
- User survey (from Technopolis, published as separate report): commissioned by RCN the Technopolis Group conducted an analysis of the users' views on the TI institutes, comprising 518 survey responses and 79 telephone interview.
- Impact analysis (from Technopolis, published as separate report): commissioned by RCN the Technopolis Group conduced an analysis of the TI institutes' contribution to value creation in society.
- Bibliometric analysis (from NIFU, published as separate report): commissioned by RCN NIFU conducted an analysis of the TI institutes' scientific publication profiles, citation indicators, and co-authorship.

The self-assessments and the first version of the facts report were already available for the panel at its first meeting in February, whereas the user survey, bibliometric report and impact analysis were presented at the panel's second meeting in May.

1.2 Historical backdrop and previous evaluations

The establishment and growth of the TI institutes coincide with the development of Norway as a modern knowledge-based economy. The systematic establishment of research institutes as a national infrastructure is first and foremost a post-war phenomenon. During the first decades after World War II, Norway saw the emergence of a number of applied industry oriented research institutes. The major 'founding father' in this process was the Royal Norwegian Council for Scientific and Industrial Research (NTNF), who saw the systematic establishment of technical industrial research institutes as a national knowledge infrastructure for revitalising Norwegian industry. Several of today's major institutes (or their predecessors) were founded during the first decade after World War II, e.g. SINTEF, NGI and the Norwegian Computing Center.

The institutes have been more resilient and played a more pronounced role in the Norwegian system than in many other countries. This is partly due to the rather decentralised and sector-oriented research policy system in Norway, where establishing dedicated sector-oriented research institutes has been part of R&D strategies for both ministries and sector-oriented research councils (the latter was the case until the research council merger in 1992-93). Another major factor is the relatively large share of SMEs in non R&D-intensive industries in Norway. In the absence of large R&D-intensive companies, the TI institutes have played the role of providing R&D-based knowledge and solutions to companies which have not been in the position to perform these tasks themselves.

Furthermore, the discovery and extraction of Norwegian oil and gas resources from the 1970s introduced a prosperous period for many TI institutes. The combination of technological challenges, strong demand from large international companies and favourable financial conditions created a prosperous knowledge market for many applied research institutes. Hence, the late 1970s and 1980s constitute a 'golden age' for many research institutes. Partly due to this growth period, the institute sector was the largest R&D-sector in Norway up until 1983.

The last series of evaluations specifically targeting TI institutes was conducted in the second half of the 1990s (1995-2000). During this period, the Research Council of Norway engaged 10

committees which carried out 10 evaluations covering 26 different TI institutes and research groups. A synthesis report issued in 2002 concluded that the TI institutes generally performed well (Norges forskningsråd 2002). However, the evaluations pointed to differences between the institutes, both in terms of research quality, relevance and robustness. The evaluations also addressed a few systemic challenges, including a weak tradition for collaboration between TI institutes and the university sector.

Is the institute sector a bridge or a barrier for university–industry collaboration? Prior to this synthesis report, the evaluation of the Research Council of Norway in 2001 questioned the role of the institute sector in the Norwegian system (Arnold et al 2001). The question raised was if the institute sector could form a barrier to contact between universities and industry. In a number of subsequent analyses and policy reports, e.g. in the Government White Paper on research in 2005, the institute sector in general, and the TI institutes in particular, were seen as a strength of the Norwegian R&D system. In many ways, this positive image of the TI institutes as a national strength has prevailed until today. However, the structural background for the questions raised in 2001 are still valid, namely that Norway has a relatively low R&D intensity in the industry sector and a rather weak tradition for direct industry orientation in (parts of) the higher education sector. Currently, the question of whether the institutes constitute a bridge or a barrier for such university–industry collaboration is a concern of the Government appointed Productivity Commission[1].

Norwegian engineering science performs well. Another point of departure for our evaluation is the recent evaluation of Norwegian engineering science. In 2014-15, three international panels evaluated research groups within engineering science both at higher education institutions (42 groups/units) and at research institutes (22 groups/units). The report from the principal evaluation committee concluded that Norwegian engineering science performs slightly above the average (international standard) for scientific quality and clearly above the average with respect to impact and relevance of research (RCN 2015, p.4). The institutes were (on average) rated slightly better than the universities on relevance and impact. Moreover, the committee concluded that the national cooperation between research organisations and industry is excellent and supports 'the Norwegian commitment towards a technology driven society'. Still, there is 'little visible environment for technology innovation such as guided support for spinoff companies, clear rules regarding commercialisation of intellectual property, the rights for university staff and incentives for inventors and risk based financing' (RCN 2015, p.5).

1.3 Recent changes affecting the situation for the institutes

The following elements provide an important backdrop for the conclusions in chapter 2 and recommendations in chapter 3:

Norway is currently in an industrial transition period: There is a clear need for Norway to reduce its dependence on exports of fossil fuels and to increase efforts in new areas and awareness, e.g. of the role of digitalisation and resource efficiency in economic growth and job creation. The sudden decrease and fluctuations in the oil price have created a higher awareness and sense of urgency of the need for Norway to reconsider its future economic backbones. Alongside of the oil industry, other industrial and economic sectors should be taken into consideration. New businesses and means to create value are needed and innovation is a prerequisite for the successful transition to these. While there are a large range of sector specific strategies (such as Bygg 21, Energi 21, Skog 22 etc) and ongoing efforts to develop overarching strategies for which areas Norway should focus on in a low carbon society (e.g. 'Ekspertutvalget for Grønn konkurransekraft'), they currently have limited guidance on the expected direction and content of the transition.

Key customers for many of the TI institutes are facing cutbacks and staff reduction: Whereas the oil and gas industry has for decades been a key costumer for many of the TI institutes, this industry is today facing cutbacks and staff reductions, a situation that requires the institutes either to scale down or reorient their activities. Notably, the TI institutes have already broadened their portfolio

[1] http://produktivitetskommisjonen.no/

to include areas such as renewable energy, ICT, health, etc. Furthermore, some have increased their international activities, especially related to the EU RTD framework programmes. In a sense, one can say that the TI institutes have thus added a new perspective to their original missions, namely the role of connecting Norwegian R&D and industry to international partners.

New role of universities gives a more challenging situation for the TI institutes. The role of the institutes has become more difficult as a) the universities are encouraged to be in more direct contact with business/industry, including conducting more applied R&D, and b) several consultancies (including start-ups) have highly-educated staff and deliver related services. There is also a challenging balance between scientific innovation (as proven by publishing) and the need to earn revenues from commissioned research. Customers use institutes because they have high scientific competence and a proven record of problem solving capacity. However, as universities are getting into their 'turf' with more direct contact with industry – and have better conditions for publishing (with larger basic grants), it is difficult for the institutes to compete in the space where innovative solutions are required.

Closer collaboration and possible mergers between the institutes and the higher education institutions is on the political agenda. The current Norwegian R&D policy agenda includes discussions of structural reforms to consolidate resources in the higher education sector. In this situation, the role of the independent research institutes in the Norwegian research landscape is also on the agenda. The recent White Paper on structural reforms in the higher education sector[2] includes a chapter on the relation between the higher education sector and the institute sector, stating that the Government is in favour of closer cooperation and mergers, as far as it gives larger and more competitive units – both within the institute sector and between higher education institutions and research institutes.

[2] Meld. St. 18 (2014–2015). Konsentrasjon for kvalitet. Strukturreform i universitets- og høyskolesektoren.

2 Main Findings/Assessments

This chapter is organised according to the four main topics in the Terms of Reference and includes the main findings of the panel based on all the information the panel has had available (self-assessments, interviews, the fact report, external reports etc.). For each topic an overall conclusion is presented, with key points below, and then supporting evidence. The conclusions in this section are the basis for the recommendations provided in Chapter 3.

2.1 Commissioned research, customer relations and role in innovation

Overall conclusion

The TI institutes contribute to value creation in Norway and current customers generally express satisfaction with the services they receive from the TI institutes. This is reflected in the fraction of total revenues stemming from industrial customers. However, in the industrial transition period that Norway is facing and increasing international competition, TI institutes need to prepare for the future by strengthening their innovation capabilities and speeding up their adaptation to changing markets. To support these changes, incentives and metrics for innovation must be strengthened and properly directed.

Key points

- The TI institutes fill their role and contribute to value creation both qualitatively and quantitatively, as proven by the impact analysis and user survey.
- In the industrial transition period Norway is facing, many TI institutes have recognized the need to re-orient themselves to new markets, areas of application and new cooperation models. However, this pace needs to be increased, and TI institutes must ensure that they have the ability and willingness to initiate change to enter new markets and attract new customers. The Research Council plays an important role in this change process by setting the research agenda and by supporting institutes that are moving towards new areas where funding is available.
- The institutes need to promote innovation and currently have limited incentives for this from customers and the Research Council.

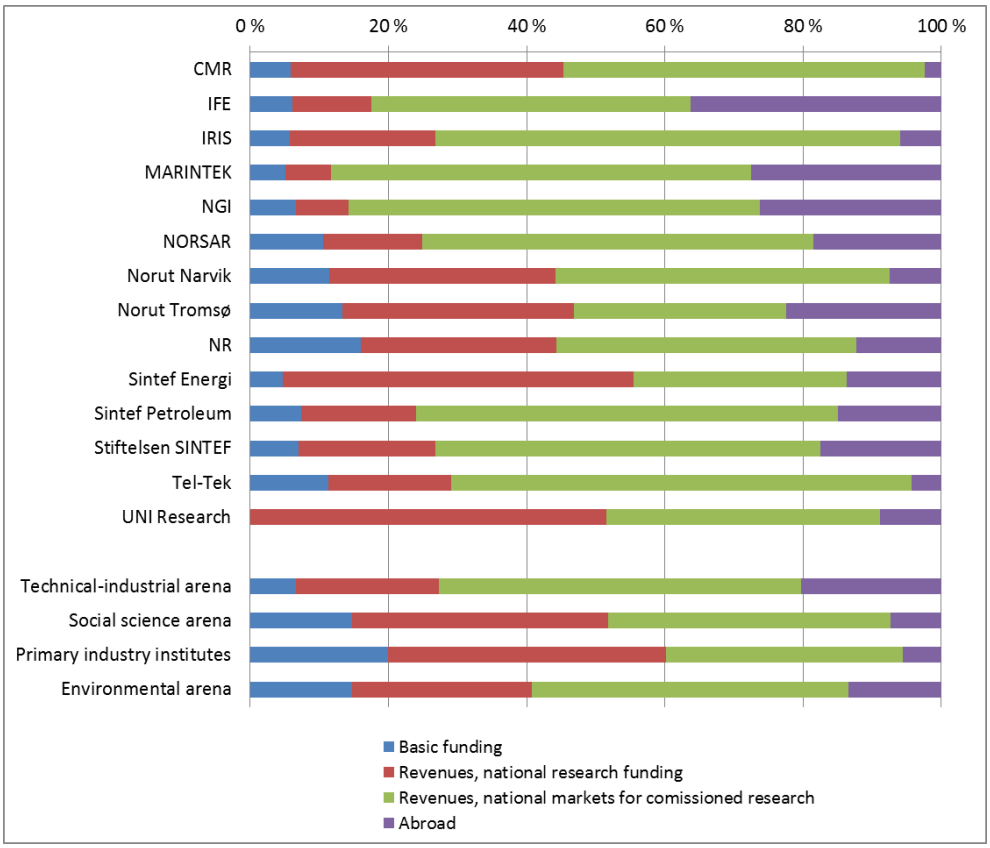
The TI institutes, as a group, are major contributors to value creation in Norway and play an important role in providing expertise, facilities and networks to the Norwegian industry: The impact study estimates that with the NOK 10 bn Norwegian public funding that the TI institutes have received in the period 1997 to 2013 they have generated the following economic impact (Åström et al. 2015):

- NOK 37 bn in direct economic value creation and indirect and induced economic impact in the period 1997 – 2013
- NOK 11 bn in economic value created through licensing, patenting and spin-off companies, mainly from turnover generated by 117 spin-off companies in the period 1997-2013
- NOK 800 bn of additional turnover generated by user companies, in part as a result of their collaboration with TI institutes in the period 2004 – 2013.

Furthermore, the institutes play an important role in providing expertise, facilities and networks to Norwegian industry. The impact analysis performed for the evaluation concludes that the TI institutes 'play a very important role in the Norwegian innovation system, and the direct and indirect economic impact that they generate is of great importance to Norway and to Norwegian companies and public organisations'. The analysis indicates that the institutes have contributed to a considerable expansion of industry turnover in the last decade (Åström et al. 2015, page 4).

A large part of the TI institutes' income stems from industry commissioned research. In the period 2009 to 2014, 52 per cent of their income was from national commissioned research (varying from 67 per cent for IRIS and Tel-Tek to 31 per cent for SINTEF Energy and NORUT Tromsø, see Figure 2.1). In addition a large fraction of their (in many cases limited) international income is from industries abroad.[3] In total about 64 per cent of the income came from commissions, whereas only 7 per cent from base funding (and the remaining part mainly from competitive research grants). It should be noted that a considerable part of the revenues from commissioned research for the industry originates from the Research Council through funding allocated to industrial companies. This typically occurs in innovation projects where a company is the project owner, and collaborates with or buys R&D services from a TI institute. Unfortunately, there are no exact figures available to state the proportion of the institutes' revenues from commissioned research coming indirectly from public funding in this way.

Figure 2.1 Operating revenue by source of funds. Technical-industrial institutes, 2010-2014



Source: RCN/NIFU, key R&D statistics for the institute sector. Only the technical industrial parts of the institutes are included in the figures (e.g. only two of the six Uni Research units, see note to Table 1.1).
Note: Figures are uncertain due to limited possibility to account for public funding ending up at the institutes via public funding to industry.

In general, the institutes seem to have good relations to their customers and user satisfaction is high. According to the user survey performed for the evaluation, a majority of the users are highly satisfied with the scientific and technical competence of the TI institutes, and the institutes receive high ratings on collaborative skills, flexibility and adaptability. Moreover, the users perceive the institutes as competitive compared to Norwegian universities and foreign research organisations. On the other hand, the user survey points to challenges when it comes to market intelligence and marketing. Here some users comment that the institutes would benefit from more employees with an industry background and more emphasis on dialogue and networking with stakeholders. On average, the users are reasonably satisfied with the institutes' project management, but some point out areas for improvement (Fridholm et al. 2015).

[3] In 2014, 57 per cent of their international income came from industry (source RCN 2015, Figure 4.9).

Many TI institutes are currently repositioning themselves as the demand from the oil industry is declining. However, there is a need to increase the pace of this transition. Not all TI institutes have a clear vision on where they need to be in the future and how to get there. Furthermore there are large differences between institutes in the degree to which their respective leaderships accept the need for change and exhibit an ability and willingness to initiate change in order to enter new markets and attract new customers.

The TI institutes can play a larger role with regard to innovation, but need clearer incentives to do so from funding sources such as customers and the Research Council. Limited tangible encouragement, e.g. guided support for spin-off companies, clear incentives or rules towards commercialization, appears to exist for technology innovation and commercialization activities. When choosing between publishing and patenting, publishing wins as it gives credits for funding. Furthermore, while patents tend to be expensive, publishing is sufficient to secure freedom of action and has proven to be an efficient marketing strategy towards customers that can benefit from TI institute innovation services. The low base funding of the institutes also limits their ability to conduct research directed towards future needs and independent of short-term industry focus. But this is an important starting point for technology innovation.

2.2 The technical industrial institutes in the Norwegian research and innovation system

2.2.1 The TI institute sector: Size, structure and interaction (fragmentation/collaboration/competition)

Overall conclusion

There is a need to restructure the TI institute sector to give fewer and stronger regional and national units. The complex ownership of the institutes may, however, present challenges, since owners' interests may not always be aligned with national needs.

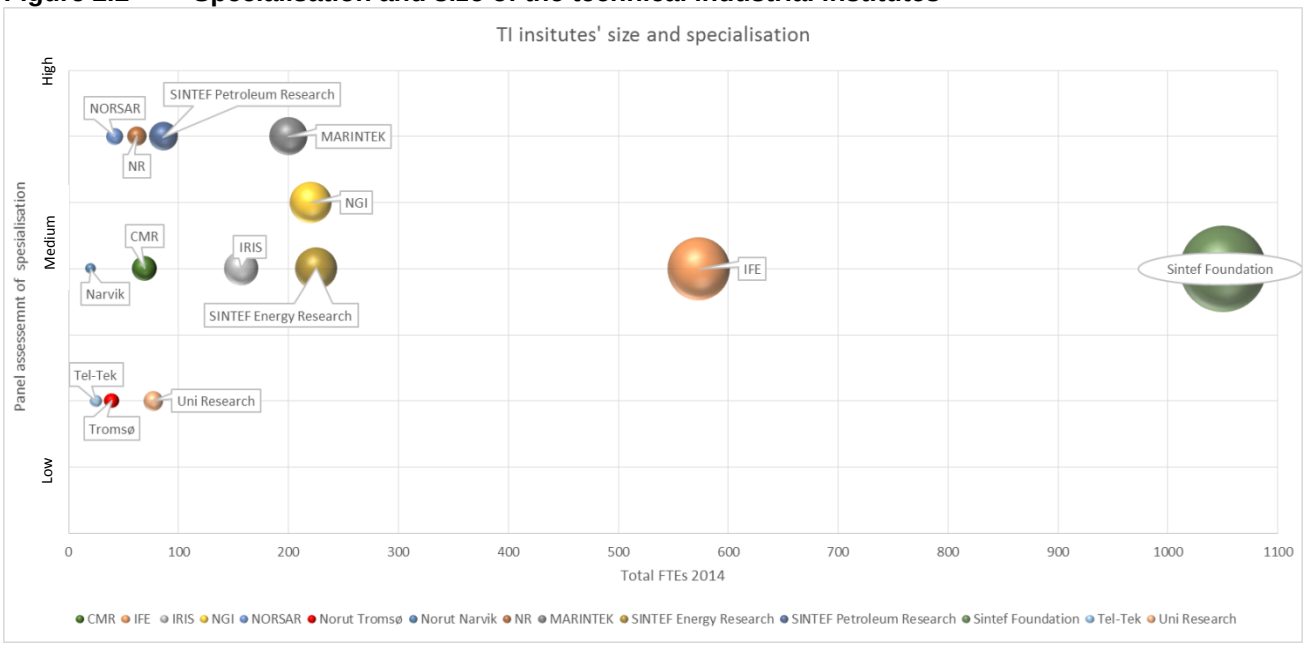
Key points

- The Norwegian TI institute sector appears to be fragmented compared to the situation in many other countries. The total number of institutes is large, reflecting in many cases how they have been established based on regional needs or to serve a specific national function. Apart from SINTEF in particular and a few other examples, the average size of the institutes is small by international standards. Furthermore, there is much competition and limited cooperation between the TI institutes.
- Adapting and focusing on new emerging areas can be very difficult for small institutes and it is not clear that a sufficient number of alternative industries exist in Norway (or in readily-accessible global markets) that could generate a similar level of economic return on R&D expenditure.
- While it appears that the general level of the TI institutes' activity in the prevailing economic and operational environment match the current end user industries to support, restructuring is hampered by the large number and generally small size of the institutes. Evidently there is a need for restructuring the TI institute sector either towards larger institutes with stronger and more clearly focused research capability portfolios (through mergers between institutes) or, where they fulfil a regional role in Norway, through reorganizing some of the institutes as a part of the research infrastructure in regional universities or university colleges.
- The complex ownership, often for historical reasons, of many institutes is a challenge for the development of the TI institute sector. The scope for change depends on the multiple owners sharing similar expectations. Where this is not the case direct interventions by the funders may be required to effect beneficial transformation.

The TI institute sector consists of a very heterogeneous set of units. The institutes have different kinds of ownership and history, and vary in size from 16 to 748 researcher full time equivalents (FTEs) (NORUT Narvik being the smallest measured in researcher FTEs, and SINTEF Foundation the largest, figures for 2014). Taking the SINTEF Group as one unit (including the SINTEF Foundation, MARINTEK, SINTEF Energy and SINTEF Petroleum), it accounts for 59 per cent of the TI institutes' researcher FTEs, 58 per cent of the total operating revenues and 62 per cent of the publication points.[4] Apart from the SINTEF Group there are three institutes with above 100 researcher FTEs, IFE (with 179[5]), NGI (with 190) and IRIS (with 105). Of the remaining institutes, four are quite small (NORUT Narvik, Tel-Tek, NORSAR and NORUT Tromsø with 16 to 34 researcher FTEs).

Figure 2.2 visualises the size differences along with an indication of the institutes' degree of research specialisation as assessed by the panel. Some of the smaller institutes have a lower degree of specialisation and their expertise may (more often) overlap with what is found at the other TI institutes.

Figure 2.2 Specialisation and size of the technical industrial institutes



Notes: Degree of specialisation in research as assessed by the evaluation panel. Size of institutes measured by total staff (FTEs) in 2014. Size of bobbles indicates operating revenues 2014. Only the technical industrial parts of the institutes are included in the figures (e.g. only two of the six Uni Research units, see note to Table 1.1).

Prior evaluations of the TI institutes have indicated that **there is much competition**, and not enough cooperation, between them. This is corroborated by the data available for the present evaluation. In their self-assessments the institutes were asked to indicate their research partners and most important competitors (national and international). The replies point to SINTEF as the dominant player. Whereas all units outside the SINTEF Group point to SINTEF as one of their most important competitors, most of the SINTEF units do not list any of the other TI institutes among their most important competitors (the exceptions are SINTEF Petroleum who lists three of them and SINTEF Technology and Society who lists one of them).[6]

Moreover, there is limited collaboration, in terms of co-authorship, between researchers at the various TI institutes. The bibliometric data indicate that, in total, 6 per cent of the institutes' scientific publications are co-authored with other TI institutes and that there are notable differences between the

[4] FTEs and revenues 2013 (source: RCN 2015) and publication points 2011-2013 (source: Aksnes 2015, page 20).
[5] IFE has a large amount of technical staff, and overall, not only counting researcher FTEs, IFE is much larger than NGI with 573 FTEs in 2014, whereas NGI had 220.
[6] Notably, there is asymmetry in the assessments of main competitors also among the other (non-SINTEF) institutes. Asymmetry in these assessments may be a result of differences in e.g. their key research areas or customer base.

institutes. Many of the SINTEF units have hardly any co-authorship with other TI institutes, while some of the units outside the SINTEF group seem to have substantial research collaboration with other TI institutes (Table 2.1). The main TI co-authorship links appearing from the analysis are between IRIS and Uni Research and between NGI and NORSAR. There is also notable co-authorship between SINTEF Materials and Chemistry and IFE. It may be noted that the dominant co-authorship link is between the SINTEF group and an actor beyond the TI institutes, namely NTNU.

Table 2.1 Co-authorship between Norwegian TI institutes (number of publications with co-authors from other TI institutes). Sorted by % TI co-authorship. 2011-2013.

Institute	Total number of publications[1]	# TI co-authorship[2]	% TI co-authorship	Main TI collaborator
NORSAR	86	17	19,8	NGI
IRIS (TI part)	122	22	18,0	UNI Research
Uni Research (TI part)	234	33	14,1	IRIS
NGI	230	28	12,2	NORSAR
SINTEF Petroleum Research	91	11	12,1	
IFE - nuclear	136	16	11,8	SINTEF
IFE - other	255	30	11,8	SINTEF
Tel-Tek	66	7	10,6	
CMR	51	4	7,8	
NR	159	7	4,4	
SINTEF Materials and Chemistry	689	28	4,1	IFE
SINTEF ICT	537	20	3,7	
Norut Narvik	34	1	2,9	
Norut Tromsø (TI part)	82	1	1,2	
SINTEF Technology and Society (TI part)	202	2	1,0	
SINTEF Energy Research	523	5	1,0	
MARINTEK	133	1	0,8	
SINTEF Building and Infrastructure	212	1	0,5	
Total	**3842**	**234**	**6,1**	

Sources: NIFU's Key figure database, CRIStin, Calculations: NIFU.
[1] Including publications with and without external collaboration.
[2] Collaboration between units within the SINTEF Group are not included in the table. For explanation of sample and methods, see Aksnes 2015.

Figures on collaboration in RCN projects corroborate the picture of limited collaboration. The TI institutes collaborate with each other in 13 per cent of their RCN projects, and a substantial part of this collaboration is between SINTEF units (Table 2.2).

Table 2.2 National collaboration in RCN projects by institute and sector 2009-13. Per cent.

Institute[5]	Per cent of projects with collaboration with					N (projects)
	Industry	Institute sector	Other TI institutes[1]	HEI[3]	Other org	
CMR	33.3	33.3	33.3	38.1	4.8	21
IFE	21.0	13.3	12.4	16.2	1.9	105
IRIS	28.9	24.4	16.7	32.2	6.7	90
NGI	9.3	14.8	7.4	9.3	9.3	54
NORSAR	12.5	25.0	18.8	25.0	0.0	16
NORUT Narvik	16.7	16.7	8.3	8.3	8.3	12
NORUT Tromsø	15.0	20.0	5.0	20.0	25.0	20
NR	15.2	10.9	6.5	10.9	8.7	46
SINTEF Group	32.1	17.6	[2]13.5	29.4	9.0	524
Tel-Tek	14.3	0.0	0.0	0.0	0.0	7
TEKNOVA[4]	71.4	42.9	42.9	14.3	0.0	7
Total	**27.5**	**17.8**	**13.4**	**25.3**	**7.9**	**902**

Source: RCN project database. Sample: All RCN projects to TI institutes (a TI institute is 'prosjektansvarlig') with funding at least one of the years 2009 to 2013.
[1] Subcategory of previous column. Uni Research, SINTEF Raufoss and MARINTEK Denmark are here included as TI institutes.
[2] Includes 90 collaborations in a total of 71 projects: 70 collaborations between SINTEF institutes, 1 with NGI, 4 with Uni Research, 5 with IRIS, and 10 with IFE. In addition, SINTEF is partner in 18 projects lead by other TI institutes (8 by IRIS, 4 by IFE, 4 by CMR and 2 by NGI).
[3] Higher education institutions, the large majority are universities (284 of 309 collaborations).
[4] Teknovoa was included as TI institute in the RCN project database in this period, whereas Uni Research was not.
[5] Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

2.2.2 Scientific and technological competence

Overall conclusion

Scientific and technological excellence of the TI institutes is an essential prerequisite for innovation capability and impact. On average, the scientific and technological competence of the institutes is high. The TI institutes need to ensure the global level of scientific and technological competence in their selected spearhead areas also in the future.

Key points

- The bibliometric analyses and the user survey performed for the panel indicate that the institutes exhibit adequate scientific quality:
  - Overall, the TI institutes score relatively high on academic output and their scientific publishing has grown the last years.
  - Several of the subfields with high citation rates are in areas in which the TI institutes are highly specialised, for example Petroleum engineering, Construction & building technology and Metallurgy & metallurgical engineering.
  - The users are in general very satisfied with the scientific and technical competences of the TI institutes. More than half of the users in the survey rate the institute in question as 'excellent' and more than a third as 'good'.
- However, the publication activity and scientific quality vary a lot depending on the institute. Companies, especially the global ones, make their buying decisions according to expected excellence and references. Global level scientific and technological competence is a critical competition factor for the TI institutes and therefore they have to ensure that they have adequate scientific references and competence.

In general, the TI institutes score relatively high on academic output and their scientific publishing has grown the last years. There are, however, large differences in their publication profiles, partly related to their different research and funding profiles. The bibliometric analysis performed for the evaluation show that annual publication points per FTE researcher vary from 0.2 (CMR) to 0.9 (SINTEF Energy), and the relative citation index (field standardised citations as per cent of the world average) vary from 49 (Norut Narvik) to 192 (SINTEF Building and Infrastructure, Table 2.3/Aksnes 2015). The general picture is that the institutes perform well according to standard bibliometric indicators, and account for a substantial part of the Norwegian scientific production in selected fields. Overall, the TI institutes' scientific publishing increased from 0.33 per FTE in 2009 to

0.44 in 2013 (as counted in publication points, Aksnes 2015, page 23). Moreover, their articles have been cited 20 per cent more frequently than the field-normalised world average (citation index of 120). This is marginally above the Norwegian average within engineering science (citation index of 117). In the fields of geological engineering, construction and building technology, and metallurgy/metallurgical engineering the TI institutes have contributed to 45-55 per cent of the total Norwegian publication output in the studied period (2009–2013), and they seem to play leading roles in the Norwegian R&D system in these fields.

Table 2.3 TI institutes' publication and citation profile.

Institute***	Average publ points per year 2009-13[1]	Publ points per FTE researcher 2011-13[1]	Level 2 publ. 2009-13[1]	Relative citation index (field normalised)[2]	% international co-authored[2]
CMR	7.1	0.19	24%	74	42 %
IFE - total	89.3	0.44	24%		
IFE – nuclear*	24.3		30%	88	79 %
IFE – other*	66.5		21%	88	54 %
IRIS TI	30.9	0.36	33%	162	39 %
MARINTEK	23.2	0.22	17%	140	28 %
NGI	43.6	0.26	21%	123	78 %
NORSAR	17.1	0.78	31%	74	81 %
Norut Narvik	5.3	0.28	13%	49	61 %
Norut Tromsø TI	17.5	0.57	24%	128	52 %
NR	36.1	0.66	18%	118	37 %
SINTEF Energy Research	120.3	0.89	23%	93	47 %
SINTEF Petroleum Research	20.5	0.24	29%	103	30 %
SINTEF Foundation (TI) total	318.9	0.45	21%		
SINTEF Building and Infrastructure*	41.1		20%	192	29 %
SINTEF ICT*	112.5		14%	130	44 %
SINTEF Materials and Chemistry*	137.8		30%	97	41 %
SINTEF Technology and Society TI*	38.2		10%	98	25 %
Tel-Tek	8.4	0.38	17%	71	12 %
Uni Research (CIPR and Computing)*	55.1	0.70	38%	164	55 %
Total**	**738.1**	**0.44**	**22%**	**120**	**49 %**

Sources: Aksnes 2015/NIFU's Key figure database/CRIStin[1], Thomson Reuters/National Citation Report[2]. Calculations: NIFU. See Aksnes 2015 for explanation of methods and indicators.

*) Publications points and level 2 figures not available for 2009 and 2010. Average based on 2011-2013 publications.

**) Excluding Uni Research.

***) Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

In general, the users rate the scientific and technical competences of the TI institutes quite high. On a scale from 1 (very poor) to 5 (excellent) all the institutes receive average rates[7] close to or above 4. Splitting users into partners and clients, the average score from clients is slightly higher than from partners (4.5 vs 4.3 in total for all TI institutes). Notably, the institutes receive higher scores on scientific and technical competences, than on other competences such as market intelligence and ability to identify and share ideas (Figure 2.3).

[7] In the user survey, there is a limited number of respondents for some of the institutes, and the differences in scores between the institutes are not statistically significant.

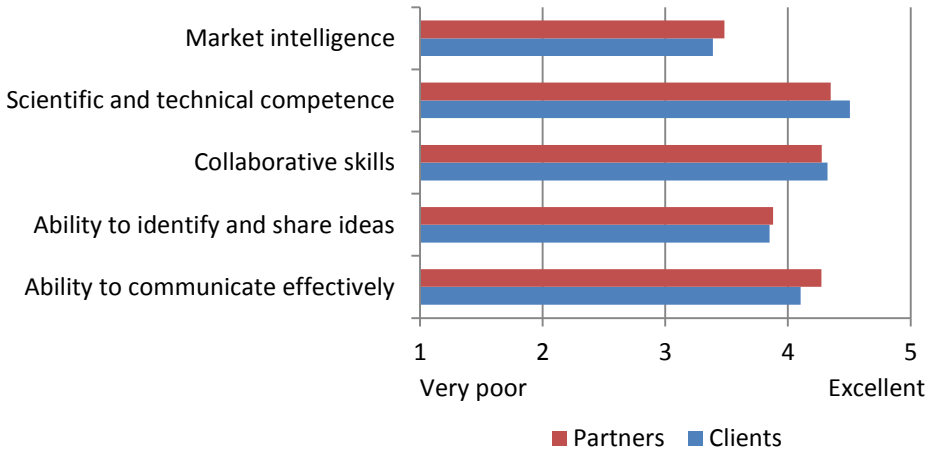


Figure 2.3 **User assessments of institutes' competences. (**Source: Fridholm et al. 2015, Figure 1)

2.2.3 Strategic partnerships and networks with universities

Overall conclusion
There is a need for nurturing and further developing the partnerships between the TI institutes and the universities, and to encourage complementarity and strong competence centres.

Key points

- Norwegian TI institutes have traditionally, often through ownership, had very close connections to the university sector. This is something which should be kept and further nurtured. Strong complementary partnerships and joint initiatives between TI institutes and universities are highly beneficial for Norway and should be encouraged.
- At the same time, competition from the Norwegian university sector is growing as universities increasingly take on roles traditionally in the province of the TI institutes, and many of the institutes find their present university relations challenging.
- While the TI institutes largely continue as a bridge between university-based fundamental research and industry, this role pattern has become more diffuse with universities addressing industry directly and specialized TI institutes conducting fundamental research. There is room for optimizing the innovation process through more strategic university – TI institute partnerships.

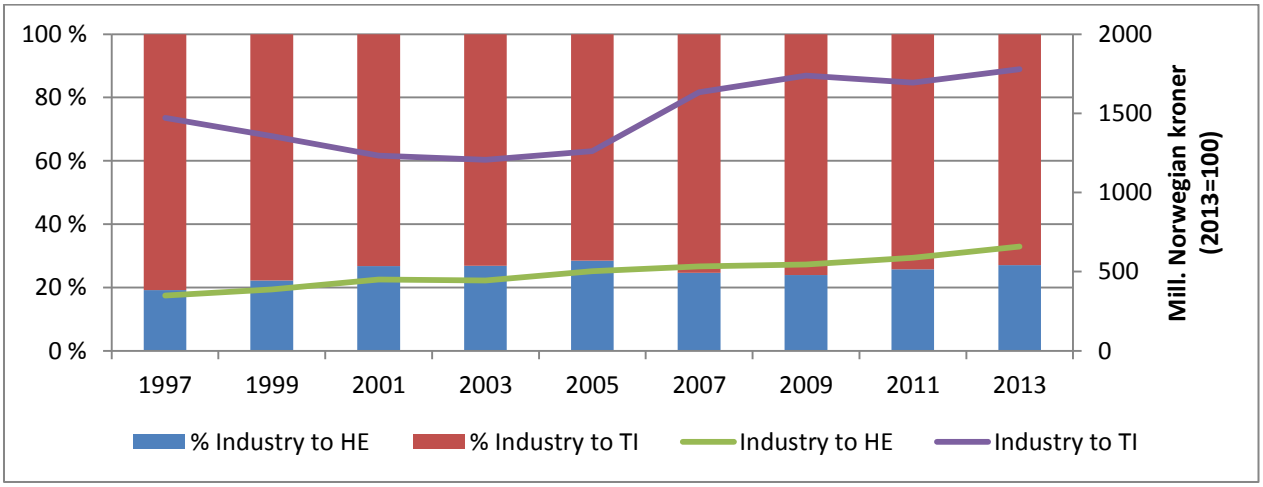
Formals links[8] with universities seem important for the extent of collaborative research activities. A large part of the TI institutes' co-authorship is with 'their' higher education institution: SINTEF with NTNU, IRIS with UiS, Uni Reserch and CMR with UiB and Tel-Tek with the Telemark University College. Moreover, SINTEF, CMR and IRIS have substantially higher proportions of RCN projects with university collaboration than the institutes without formal links to higher education institutions (Table 2.2, data missing for Uni Research). Links in terms of mutual staff (part-time positions) seem limited for all the TI institutes but, not surprisingly, appear somewhat more frequent for some of the institutes directly linked to universities. For example, a higher proportion of researchers at IRIS, Uni Research and NORSAR have a part-time position in the higher education sector, and Tel-Tek, NORUT Tromsø and NORUT Narvik employ staff from the higher education sector in part-time positions (RCN 2015, Chapter 3.3).

[8] Ownership structures or collaboration agreements.

The institute-university collaboration provides mutual benefits. The institutes clearly benefit from collaborating with higher education institutions – especially in terms of competence building and recruitment/PhDs – and are concerned to have good relationships with the best academic research groups in their field. Replies from the higher education institutions (to the survey performed for the evaluation) indicate that they are reasonable satisfied with how they benefit from collaborating with the institutes. In general, they seem most satisfied with results in terms of scientific publications, improved working practises for R&D, improved scientific or technical skills and strategic relations with the institute. On the other hand, they less frequently report that the collaboration has resulted in improved opportunities to recruit trained researchers or to expand their networks with companies (see Åström 2015, page 20, and Figure A2 in Appendix 3 here).

Competition has become more pronounced and the institutes find the university relations challenging. Several of the institutes mention that the competition from higher education institutions can be challenging due to different terms and costs for research projects, and that the universities are increasingly engaged in contract research and building relations with industry. The statistics indicate that the higher education institutions have steadily increased their R&D income from industry over the last 15 years, but the balance in between the TI institutes and the higher education institutions has been close to constant since 2001 (Figure 2.4).

Figure 2.4 **Total expenditure on R&D that origins from the industry sector (lines) directed to the HE sector and the TI institutes in the period 1997-2013, and percentage wise distribution between these two sectors (columns). Amounts are in NOK adjusted to 2013-kroner.**



Source: RCN Fact report Figure 5.5/NIFU, key R&D statistics for the institute sector.

2.3 International cooperative activities

Overall conclusion

International operations for the benefit of Norway demand strong TI institute–university partnerships. Better co-utilization and co-exploitation of unique facilities, competences and location are needed for stronger international positioning and competitiveness.

Key points

- International collaboration with R&D providers and with industry is important for a small country. Companies go global and so the R&D&I providers should do too. Benefits come to Norway via competence building, taking Norwegian companies (especially SMEs) to international value chains and networks, and attracting foreign companies to invest in Norway.
- In many cases, Norwegian TI institutes serve global customers because the Norwegian oil business is global. Global customers demand global level competence as there are

competitors outside of Norway. These customers select always the best R&D&I providers (competence, price, speed etc.).

- Norway has a limited number of strong and successful institutes that can compete at an international level. This is of great benefit to the Norwegian society and economy, in the face of growing overseas competition, including in the emerging economies. All support to maintain and expand their international role needs to be strengthened.
- Many of the TI institutes have a very weak international strategy and for many of the small ones international activities are not even realistic. Individual TI institutes need to identify their capacities for international activities and elaborate the strategies and implementation plans accordingly.
- The TI institutes play an important role for the Norwegian participation in EU research projects. However, there are large differences between the institutes' abilities and ambitions to fulfil their national mandate in terms of acquiring EU funding and helping Norwegian industry into international research cooperation.
- Norway has clear targets for the revenues from Horizon 2020 and other EU instruments. TI institutes have a crucial role in domiciliation of EU funds to Norway. The TI institutes are also great channels for Norwegian industries to EU networks. However, EU is challenging for the TI institutes as the needed matching fund for projects is difficult to obtain. Hence, the STIM-EU instrument is crucial for the institutes.

The TI institutes play an important role for the Norwegian participation in EU research projects. With SINTEF as the largest Norwegian participant in FP7 (among all Norwegian institutions), the TI institute sector ranks quite high compared to other parts of the Norwegian R&D sector when it comes to involvement in EU research. Table 2.4 gives some key figures on the individual institutes, showing that the SINTEF Foundation accounted for 63 per cent of the TI institutes' FP7 participation, whereas some of the other institutes had no, or a very limited amount of, FP7 participation. Still, one of the smaller organisations, NORUT Tromsø, excels, with the highest participation compared to their number of FTE researchers. The data also indicate that the institutes have, to varying degrees, mobilised Norwegian industry into participation in EU projects. Some of the institutes often collaborated with Norwegian companies in their FP7 projects, others with few or none. Participation from Norwegian public administration was generally very limited or non-existent (Table 2.4). In contrast, the results from the partner survey indicate that in terms of expanded networks with non-Norwegian R&D providers, project collaboration with the TI institutes may be more important for the public sector than for industry (Åström et al. 2015, Figure 8 and 9).

Table 2.4 TI institutes in FP7. Participations, granted amounts, and Norwegian partners.

Institute	Number of participations (projects)	Granted amount (mill. Euro)	Participations per researchers FTEs	% projects with at least one Norwegian partner**	# Norwegian industry partners	# Norwegian public adm partners
SINTEF Foundation	204	117.1	0.28	52.0	92	16
SINTEF Energy	30	17.5	0.18	56.7	11	3
Uni Research Total*	24			45.8	2	
MARINTEK	19	7.8	0.16	73.7	13	2
IFE	14	5.0	0.07	35.7	2	
NGI	12	4.7	0.06	16.7		
NR	10	4.1	0.17	60.0	5	
NORUT Tromsø	10	3.2	0.32	20.0	1	
SINTEF Petroleum	5	1.3	0.06	80.0	6	
NORSAR	4	0.9	0.17	25.0	1	
IRIS	3	0.5	0.03	100.0	2	2
CMR	1	0.1	0.02	100.0	1	
Norut Narvik	0	0				
Tel-Tek	0	0				
Total	**336**	**162.2**		**51.2**	**136**	**23**

Sources: RCN 2015/Ecorda.
* Figures includes all Uni Research departments.
**This column shows the percentage of the projects which has at least one Norwegian partner, that is, one partner in addition to the TI institute in column one.

There are notable differences in the institutes' level of international co-authorship. Whereas NORSAR, IFE Nuclear and NGI co-author about 80 per cent of their scientific articles, three of the institutes have international co-authorship on less than 30 per cent of their articles (Tel-Tek, SINTEF Technology and Society and MARINTEK). Overall, international cooperation is present in about half of the TI institutes' scientific articles (see Table 2.3).

Some of the institutes have extensive international collaboration within their RCN projects. To some extent, RCN provides funding for international research collaboration. In total, there was international collaboration (registered non-Norwegian partners) in 18 per cent of the TI institutes' RCN projects in the period 2009-2013. Most frequently, this includes European collaboration. There were international industry partners in 9 per cent of the projects, and collaboration with research organisations abroad in 12 per cent of the projects (see Table 2.5).

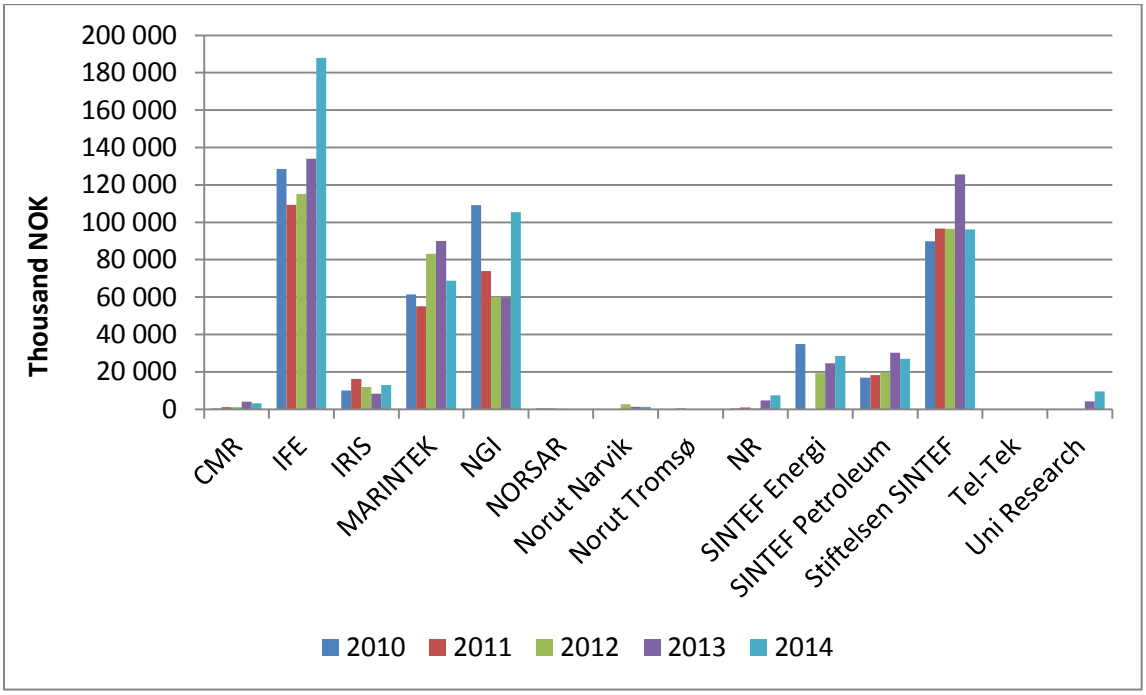
Table 2.5 International collaboration in RCN projects by institute and sector 2009-13. Per cent.

	Per cent of projects with collaboration				
Institute	Total abroad	Research organisations abroad	Industry abroad	Other/unknown abroad	N
CMR	28.6	14.3	14.3	0.0	21
IFE	12.4	5.7	8.6	4.8	105
IRIS	28.9	23.3	5.6	3.3	90
NGI	13.0	9.3	7.4	5.6	54
NORSAR	18.8	18.8	6.3	6.3	16
NORUT Narvik	16.7	16.7	0	0	12
NORUT Tromsø	15.0	15.0	5.0	5.0	20
NR	6.5	6.5	2.2	2.2	46
SINTEF Foundation*	14.8	8.3	8.3	3.6	385
MARINTEK	16.1	16.1	9.7	0	31
SINTEF Energy	29.0	18.3	16.1	9.7	93
SINTEF Petroleum	46.7	33.3	20.0	6.7	15
SINTEF Group	**18.3**	**11.3**	**10.1**	**4.6**	**524**
TELTEK	14.3	0.0	14.3	14.3	7
TEKNOVA	57.1	57.1	14.3	14.3	7
Total	**18.2**	**12.1**	**8.8**	**4.4**	**902**

Source: RCN project database. Sample: All RCN projects to TI institutes (a TI institute is 'prosjektansvarlig') with funding at least one of the years 2009 to 2013. Teknovoa was included as TI institute in the RCN project database in this period, whereas Uni Research was not.
*Data include all projects registered as coordinated by SINTEF/TI institute sector in the RCN database, except for those specified as MARNTEK, SINTEF Energy or SINTEF Petroleum, and may include projects coordinated by other parts of the SINTEF Group than the SINTEF Foundation.

There are large differences in the institutes' ability to acquire funding from industry abroad. Of the evaluated institutes, four (IFE, MARINTEK, NGI and the SINTEF Foundation) have high revenues from industry abroad, while some of the smaller units have hardly any revenues from industry abroad Figure 2.5).

Figure 2.5 Revenues from abroad industry. Technical-industrial institutes, 2010-2014. Thousand NOK.



Source: RCN/NIFU, key R&D statistics for the institute sector. Note: Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

2.4 Financial sustainability and basic conditions

2.4.1 Funding and financial sustainability

Overall conclusion

The base funding level of the Norwegian TI institutes is low compared to that for many other similar organisations in EU, and this has not been compensated for by reasonable operating margins. A minimum long-term average level of 4-5% of operating margins is needed to allow institutions to function and to undertake vital internal transformations. In addition, the institutes in general do not appear to have a strategy either to move to a situation where sustained operating margins are achievable nor to use surplus funds for strategic objectives.

Key points

- The TI institutes' base funding that can be directed to renewal of the competences and emerging technologies is relatively low by international standards. However, while this is a striking feature in the funding for the Norwegian TI institutes, international comparisons need to consider other differences in national funding structures. Any future increases in base funding should be linked to measures and criteria to encourage its application for strategic transformation and to prevent its being used for filling gaps and for conducting business as usual.
- The operating margin has varied significantly for most institutes over the last 6 years with only a few having had a net surplus all years since 2009.
- Operating margins needs to be in the range of at least 4-5% in order to ensure long-term financial stability. For most institutes this is not the case.

- The ratio between turnover from research grants from national research funding agencies and commissioned research varies over a large range, e.g. with NGI having a ratio of roughly 0.07 and Norut Narvik a ratio of approx. 2.6 respectively, reflecting the different nature of the institutes. In order to obtain a healthy operating margin commissioned research is crucial. On the other hand, research grants from funding agencies are necessary to keep competence and ensure a strong depth in the fields of activity. A balance between publicly funded and 100% commissioned research is therefore needed to ensure competence development and hence the ability to provide adequate R&D&I services for the customers. It is not, however, obvious that all institutes have this as a strategic objective.
- Growth has, in most institutes, been rather limited over the time period studied. Most institutes do not have a clear growth strategy. A growth strategy is not, of course, a complete necessity for success, but it does help to ensure long term financial sustainability.
- The current market situation with a low oil and gas price influences not only the institutes working in the field, but also the whole Norwegian economy. This implies, for the institutes working in the oil and gas sector, that alliances and cooperation are essential. For Norway as a whole a continued focus on expanding the industrial base to other areas is also crucial and here the institutes can play an important role that will in turn result in strong benefits for the institutes themselves. A transitional increase in the national R&D budget is probably necessary to achieve this.
- Taken into account the strong position of Norway as a whole in several areas, an expanded international role is possible both when it comes to research grants, e.g. from the EU, and from commissioned research.

Financial sustainability varies among the TI institutes. The operating profit varies between both institutes and years. Some of the institutes (IRIS, MARINTEK, NR, SINTEF Energy and the SINTEF Foundation) have had a positive result for all years in the period (2010-2014), while others have had a negative result in one or more years. As might be expected, 2013 was particularly problematic with a low or negative result for most institutes (see Table 2.6 below). Figure A1 in Appendix 3 shows operating profit as a share of operating revenue.

Table 2.6 Operating profit for technical-industrial institutes and other institute groups. Mill. NOK. 2009-2014

	2009	2010	2011	2012	2013	2014	2009-2014
CMR	-4,2	6,0	-4,2	-6,7	0,7	-11,7	
IFE	7,6	17,9	21,5	15,7	-45,3	6,9	
IRIS	7,1	7,1	12,8	22,9	18,1	9,4	
MARINTEK	18,4	12,3	11,1	11,7	13,8	22,6	
NGI	7,4	12,2	-5,5	-4,0	-1,3	4,9	
NORSAR	2,8	6,6	-3,1	1,0	-0,4	0,6	
Norut Narvik	0,0	0,4	1,1	0,0	-1,7	0,1	
Norut Tromsø	0,7	1,0	-2,9	-0,6	-1,5	-0,2	
NR	1,9	2,5	9,2	1,4	0,2	2,1	
Sintef Energi	20,3	40,7	30,2	22,0	24,4	17,2	
Sintef Petroleum	8,3	5,2	-5,3	0,1	-15,3	23,1	
Stiftelsen SINTEF	55,9	68,7	56,2	63,4	43,6	61,1	
Tel-Tek	1,7	1,1	-0,5	-0,2	-0,6	1,6	
UNI Research			-0,5	1,6	2,5	4,6	
Total Technical-industrial institutes	127,9	181,7	120,1	128,3	37,3	142,2	
Social science institutes	19,3	15,8	20,8	12,7	0,3	33,9	
Primary industry institutes	4,1	20,0	31,2	-27,5	6,9	16,8	
Environmental institutes	14,8	48,3	23,6	-7,5	-30,8	26,4	

Source: RCN 2015, Table 4.4/NIFU, key R&D statistics for the institute sector. Note: Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

In the past period the TI institutes' growth in operating revenues has been rather limited, but (as a group) still higher than for institutes in other areas. Some of the TI institutes (e.g. CMR and NORUT Tromsø) have seen notable growth in the past 6 year period, whereas many (e.g. Tel-Tek, SINTEF petroleum and Uni Research) have seen marginal or negative growth over this period (Table 2.7, per cent growth 2009-2014).

Table 2.7 Total operating revenue. Technical-industrial institutes and other institute groups. Mill. NOK (current prices). 2009-2014.

								Change 2009-2014	
	2009	2010	2011	2012	2013	2014		mill. NOK	percent
CMR	93,4	121,6	149,3	140,0	145,9	137,8		44,4	48 %
IFE	656,1	724,7	756,9	785,5	807,6	900,9		244,8	37 %
IRIS	203,7	186,1	204,9	255,4	255,7	265,8		62,1	30 %
MARINTEK	303,3	287,2	287,7	312,2	310,1	328,3		25,0	8 %
NGI	309,1	316,9	331,9	356,6	367,9	392,7		83,6	27 %
NORSAR	53,9	56,2	53,7	59,3	71,4	61,7		7,8	14 %
Norut Narvik	21,4	27,7	33,1	31,6	27,9	22,7		1,3	6 %
Norut Tromsø	29,7	33,0	32,7	41,5	41,2	47,1		17,4	59 %
NR	71,6	74,6	83,7	81,7	80,5	80,4		8,8	12 %
Sintef Energi	375,8	401,3	404,2	400,9	399,0	399,3		23,5	6 %
Sintef Petroleum	183,5	207,0	179,2	199,0	171,6	187,8		4,3	2 %
Stiftelsen SINTEF	1 593,5	1 626,2	1 619,8	1 724,6	1 726,4	1 708,2		114,7	7 %
Tel-Tek	31,9	33,8	47,0	36,7	32,0	31,5		-0,4	-1 %
UNI Research			96,5	99,9	89,4	86,5		-10,0	-10 %
Total Technical-industrial ir	3 927	4 096	4 281	4 525	4 526	4 651		723,8	18 %
Social science institutes	1 299	1 291	1 320	1 342	1 337	1 296		-3,0	0 %
Primary industry institutes	1 641	1 659	1 729	1 734	1 769	1 761		120,0	7 %
Environmental institutes	1 041	1 076	1 113	1 125	1 114	1 203		162,0	16 %
*Total Institute sector	7 908	8 122	8 443	8 725	8 745	8 911		1 003,0	13 %

Source: NIFU, key R&D statistics for the institute sector, *Only institutes in the base funding scheme are included. Only the technical industrial parts of the institutes are included in the figures for the individual institutes (see note to Table 1.1).

The base funding and the revenues from national research funding are substantially lower for the TI institutes than for other Norwegian institutes. On the other hand, the revenues from commissioned research and from abroad are substantially higher. Hence, the TI institutes are more dependent both on national and international markets. Table 2.8 shows 2014 figures for all the TI institutes, and comparable data for institutes in other areas.

Table 2.8 Economic data for technical-industrial institutes and other institute groups, 2014. Mill. NOK.

Institute*	Operating revenue	Operating profit	Base funding	Revenues from national research funding	Revenues from national markets for commissioned research	Abroad
CMR	137.8	-11.7	6.8	46.7	60.4	3.9
IFE	900.9	6.9	81.6	86.5	360.6	324.2
IRIS	265.8	9.4	13.8	65.2	168	14
MARINTEK	328.3	22.6	16.6	34.5	194.7	82.3
NGI	392.7	4.9	23.3	20.6	235.6	111
NORSAR	61.7	0.6	6.2	10.1	32	12.3
Norut Narvik	22.7	0.1	3.1	11.7	5.9	1.9
Norut Tromsø	47.1	-0.2	4.9	21.6	5.5	14.4
NR	80.4	2.1	11.8	19	37	11.7
Sintef Energi	399.3	17.2	22.2	246.1	74.9	56.1
Sintef Petroleum	187.8	23.1	13.8	47	92.7	27.6
Stiftelsen SINTEF	1 708.2	61.1	111.9	290	919.7	277.4
Tel-Tek	31.5	1.6	3.8	13.7	10.9	3.1
UNI Research (CIPR and Computing)	86.5	4.6		30.2	46.1	9.8
Total TI institutes	**4 650.4**	**142.3**	**319.8**	**943**	**2 244.0**	**949.7**
(%)		*(3.1)*	*(6.9)*	*(20.3)*	*(48.3)*	*(20.4)*
Social science institutes	1 295.8	33.9	170.0	535.4	442.0	94.0
(%)		*(2.6)*	*(13.1)*	*(41.3)*	*(34.1)*	*(7.3)*
Primary industry institutes	1 761.5	16.8	265.0	576.8	439	86.5
(%)		*(1.0)*	*(15.0)*	*(32.7)*	*(24.9)*	*(4.9)*
Environmental institutes	1 203.1	26.5	169.8	416.2	427	137.1
(%)		*(2.2)*	*(14.1)*	*(34.6)*	*(35.5)*	*(11.4)*
Total Institute sector	**8 910.7**	**219.5**	**924.6**	**2 471.4**	**3 552.2**	**1 267.3**
(%)		*(2.5)*	*(10.4)*	*(27.7)*	*(39.9)*	*(14.2)*

Source: RCN/NIFU. key R&D statistics for the institute sector.
*Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

2.4.2 Infrastructures and national facilities

Overall conclusion

Many institutes operate large infrastructures and rely upon having state of the art research, test and demonstration facilities. In addition to resources for the initial investments, adequate resources for running costs and up-grading are needed, in turn requiring TI institutes to have positive operating margins and sufficiently strong balance sheets.

Key Points

- It is crucial that the large infrastructures are operated as efficiently as possible and utilized by the institutions active in the field. Shared use of research facilities should continue to be encouraged wherever possible.
- The RCN Funding Initiative for Research Infrastructures is a well-functioning instrument within RCN with a large number of applications received. In the last strategy RCN also points to the fact that they would like to see more activities in the business sector and a stronger cooperation with the public sector to drive innovation. TI institutes thus not only need infrastructures for research but also for test and demonstration. While several of the institutes already have such test and demonstration facilities very little attention is given to this area in the RCN infrastructure strategy.
- The RCN strategy and road map do not properly point to the future demands but seem rather to be bottom-up driven description. While of course bottom-up processes are crucial, a true road map also needs to include the future demands from industry and society in general.

For any organisation involved in research and development, access to adequate and state of the art infrastructures is a necessity. Most of the TI institutes depend, for a part of their activities, on standard research infrastructures such as laboratories and test facilities. Several TI institutes also have unique infrastructures and report these to be important assets. Also when taking research results to the marketplace, test and demonstration facilities help to not only validate the results, but in many cases also to speed up market adaptation. For the TI institutes to serve their customers well, there is not only a need for investing in new infrastructures, but also a constant need to upgrade existing infrastructures.

The RCN has, for several years, operated a scheme to fund research infrastructures through their *National Funding Initiative for Research Infrastructures* and to date grants have been allocated in many different fields including databases, advanced scientific equipment and high performance computing and storage. Also support for, and thus access to, international infrastructures is given by the initiative. The funds for infrastructures are not only intended to support one institution but are aimed at providing infrastructures that can be used by several institutions in Norway. However, normally one or a few institutions are responsible for each project. The overall objective for the initiative is to ensure that the Norwegian research community and trade and industry have access to relevant up-to date infrastructures that facilitate high-calibre research, which in turn helps to solve major knowledge challenges facing society. The strategy for the initiative was updated by RCN in 2012 and this current version strategy is valid through 2017.

TI institutes take part in nearly half of the research infrastructure investments granted in the national initiative. Tables 2.9 and A1 - A4 in Appendix 3 show the participation of the technical-industrial institutes in applications from the National Financing Initiative for Research Infrastructure in the period from 2009 up to the present day. There have been four calls (2009, 2010, 2012 and 2014) in this period receiving a total of 547 applications. Of these, 100 were given a grant. Almost one in five of these had a TI institute in lead, representing 15 per cent of the granted amounts. In addition 27 per cent of the granted projects, representing 32 per cent of the amounts, had one or more TI institutes as partners (but not in lead). Thus, TI institutes took part in nearly 50 per cent of the research infrastructure investments granted in 2009 to 2014.

Table 2.9 The technical-industrial institutes in the National Financing Initiative for research infrastructure calls 2009-2014.

	Applications		Grants	
	# applications	NOK	# grants	NOK
Total 2009 - 2014	547	17 097 499 000	100	3 084 300 017
TI as responsible applicant	114	3 646 075 000	19	470 458 176
% of applications/grants	21	21	19	15
TI only as partner	NA	NA	27	974 376 334
% of grants			27	32

Source: The Research Council of Norway.

TI institutes collaborates extensively with other institutions in research infrastructure applications. In the applications from 2012 and 2014 more than half of the applications which had a TI institute in lead, had an institution in the higher education sector is a partner. Around one third of the applications had another TI institute as partner, and less than one of five had a partner from industry or public sector. Note than some applications had partners from several sectors. In applications where TI institutes are partners (and not the lead), all except five had an institution in the higher education sector as the lead applicant and all except one included cooperation with another institution in the higher education sector. Almost one third included collaboration with other TI institutes (meaning that two or more TI institutes are partners), a slightly lower proportion than for research institutes in other sectors. Collaboration with industry or public sector was also less frequent than collaboration with the higher education sector (Table A4). Note that while this means that only a moderate number of institutions in the industry or public sectors were partners in the applications there are obviously many more users of the infrastructure from these sectors.

All TI institutes have at least one application for research infrastructure to the National Financing Initiative for Research Infrastructure in the period 2009-2014, with eleven of them being granted support. The SINTEF foundation has been granted six projects where they are the lead, and IFE four. In the case where other types of institutions are the lead and TI institutes are partners, ten of the TI institutes are represented among the granted projects. The SINTEF foundation is involved in 12 such partnerships, while SINTEF Energy, CMR and Uni Research are the three others that participate in most granted projects.

As seen above **many of the large infrastructures are operated as collaborations between different research organisations.** Centre collaborations (SFIs and FMEs) are reported to be good instruments for expanding and exploiting shared infrastructures. However, a minority of the self-assessment reports mention challenges in national access and collaboration or state a need for better mechanisms for providing access to national research infrastructures. It is also important to point out that any type of infrastructure not only needs resources for the initial investment but also for operation and maintenance. The demands thus placed on the long-term financial stability of the 'owners' of the infrastructures will in turn require adequate operating margins and sufficiently strong balance sheets.

The RCN scheme for funding research infrastructure seems to be working well and the TI institutes are active in applying for grants in cooperation with partners. The strategy by RCN in this area seems to be almost entirely a bottom-up strategy and their road map does not adequately recognise future demands from industry or society in general. While of course bottom-up processes are crucial, a true road map also needs to include a clear view of future and planned needs.

The TI institutes are particularly suited to facilitate cooperation with the business and public sectors to drive innovation. In the last strategy RCN also points to the fact that they would like to see more activities in the business sector and stronger cooperation with the public sector in order to accelerate innovation. The TI institutes are particularly suited to facilitate this. However, it is also important to point out that to drive innovation in increasingly more complex markets for products, services and solutions to societal challenges it is crucial that the TI institutes provide infrastructures not only for research but also for test and demonstration and even for standardization. While several of the institutes already have such test and demonstration facilities very little is mentioned in the RCN documents about these types of infrastructures.

3 Recommendations

As requested in the ToR, this report provides recommendations to the Norwegian Government (Section 3.1), the Research Council of Norway (Section 3.2) as well as to the institutes themselves, both in general (Section 3.3) and specific comments and recommendations to the individual institutes (Section 3.4).

The main issues are much the same across these sections, but they are framed and emphasised according to the different roles and responsibilities of the addressees.

3.1 Recommendations to the Government

1. **The Government must continue to develop and disseminate clear guidelines and targets for national industrial and innovation strategies and engage the TI institutes closely in this process.**
   - It is difficult for the TI institutes to take actions to support the transition without guidance on the expected direction and content of the transition.
   - The TI institutes have important expertise and should be involved in formulating a Norwegian industrial strategy.
2. **There is a need further to strengthen collaboration between TI institutes and universities in order to utilise the full potential of the research and innovation system.**
   - The TI institutes have historically been the link between university and industry. Whilst it is important that both universities and institutes have relationships and understanding of industrial needs, government should encourage the different but complementary roles and responsibilities of TI institutes and universities to maximise the contribution from both.
3. **The government needs to ensure that the TI institutes have strong incentives to contribute to innovation.**
   - As institutes are to play an important role in Norway's transition they need clearer incentives to contribute to innovation.
   - These incentives need to be integrated into the TI institutes' overall funding structure (the RCN funding schemes and/or the base funding).
   - In parallel, the expectations for TI institutes in this process need to be articulated, and the consequences for failing to adjust to the new challenges also have to be clear.
4. **TI institutes that are below critical size for their research activities need to be encouraged by Government (and RCN) to take steps to address this.**
   - Currently the TI institutes are too numerous and fragmented. In general, the institutes have a weak financial situation and overlapping portfolios, and several are below critical mass (exceptions mainly include those serving niche markets or very specific regions). Moreover, there is too much dependency on certain customers, in particular within the oil and gas sector.
   - Fewer and stronger regional and national units are required with fit-for-purpose ownership structures, also more formal collaboration agreements established between different TI institutes and with universities.
5. **The government must continue to encourage international collaboration and maintain high ambitions for return from the EU Framework Programmes.**
   - The TI institutes play a central in role the internationalization of Norwegian research and this role must be further enhanced.

3.2 Recommendations to the RCN

1. **RCN needs to allocate resources to TI innovation via specific incentives linking a significant fraction of base funding to an assessment of ongoing innovation contributions.**
   - Innovation must be incentivized more clearly. The criteria for allocation of base funding provide an important signal and need to include specific measures that are linked to innovation. We propose that a significant fraction of base funding becomes dependent on a panel assessment of a narrative account of innovation contributions that is able to include the wide range of relevant TI activities (this process should be developed by RCN in conjunction with the TI institutes).
   - Moreover, a broad set of instruments and mechanisms for facilitating innovation needs to be considered, such as user committees for RCN programmes to promote the implementation of research results.
2. **RCN should also allocate additional funds to TI institutes who can demonstrate how these can be used to deliver support for accelerated industrial transition.**
   - RCN are recommended to develop a scheme to allocate funds for a limited period and on a competitive basis to TI institutes that can demonstrate how these will deliver transformation/innovation outcomes linked to clear performance indicators.
3. **RCN funding mechanisms should encourage the complementary roles and responsibilities for TI institutes and universities.**
   - Funding schemes and allocations need to be designed to facilitate cooperation between universities/university colleges and research institutes.
   - RCN calls should promote collaborative TI institute-university proposals.
4. **Infrastructures**
   - Access to research infrastructures is crucial and the RCN initiative should be continued, with an expanded budget when the financial situation allows. A road map is required that clearly identifies future needs, taking into account the requirements of Norwegian society as well as strategic infrastructures planning by individual TI institutes and other stakeholders, including the business community.
   - In order to drive innovation not only research infrastructures should be supported, but also infrastructures for test and demonstration. Standardization procedures and accompanying test facilities are also an important part of driving innovation. The possibilities for the TI institutes to engage in this area should be further explored.
5. **STIM EU is extremely important and needs to be continued.**
   - The TI institutes play an important role for the Norwegian participation in EU research projects. In the present situation with increased competition and reduced success rates in EU calls for proposals, it is especially important that the RCN keeps up its activities in facilitating Norwegian participation.

3.3 Recommendations to the institutes

1. **The TI institutes should play an important role in the transition.**
   - TI institutes are strong national assets and their role in Norway's transition period is crucial. In the best case they act as innovation catalysts. The TI institutes form knowledge platforms which provide tools for the Norwegian government to help define and identify industrial and innovation strategies.
     1. The TI institutes need to renew their strategies and targets according to the national needs.
     2. TI institute strategies need to give a greater emphasis to the need to speed up the transition.
2. **Leadership is required in the transition.**
   - Pro-active leadership is essential in times with big changes. A substantial variation in leadership quality was observed for the different institutes. It is recommended that the TI institutes invest in leadership training and/or recruitment at all management levels.

- Focus on leadership must be a high priority for the executive boards of TI institutes. The role of executive boards with respect to governance and repositioning appeared unclear or invisible in assessments. The executive boards need to take stronger actions in the TI institutes' strategy and renewal process together with the institutes' leadership.
- A more streamlined ownership model of the TI institutes is recommended to ensure the successful transition of the institutes. The present model with many owners with diverse interests has the potential to hinder the change process of the TI institutes and in the worst case cement the status quo.

3. **TI institute managements must regularly review their strategies and targets fit to the national strategies and needs, and these efforts must be supported by their boards.**
   - To overcome the current and coming challenges the TI institutes need clear and ambitious short-, mid- and long-term strategies. These strategies need to be developed in alignment with the national industrial and innovation goals. A balance between the existing and emerging R&D&I activities needs to be ensured so that the TI institutes can fulfil their responsibilities to current stakeholders and customers, but at the same time are able to pave the way for new innovations.
   - Interdisciplinary skills of human resources are very important for TI institutes, especially in the times of transition. In addition to good scientific and technical skills there is a need for people with competence in business development, sales, marketing and customer relations. Establishing new customer relations, especially global ones, is demanding and specific skills and experience are needed.
   - The TI institutes need to take ownership for initiating and executing the necessary change process. This must include pro-actively engaging with all stakeholders, instead of waiting for encouragement and incentives.
4. **Financial situation and growth strategy**
   - The TI institutes play a vital role in the industrial transition period. However, the TI institutes do not appear financially or strategically prepared and equipped to fill this role.
   - The TI institutes need clear and well defined growth strategies to overcome the unwanted side effects of the transition. The growth strategies can pinpoint regional, national or global needs and activities that determine the optimum size and role of the TI institute. In this context growth can also be achieved through mergers.
   - Healthy operating margins (4-5%) are needed to secure a sustainable financial situation. In addition research grants from funding agencies are necessary to keep and build competences and ensure a strong depth in the fields of activity. A balance is needed, but it is not obvious that the institutes include this in their strategies.
5. **Collaboration with university**
   - Norwegian TI institutes have traditionally, often through ownership, had very close connections to the university sector. This is something which should be retained and further developed. Strong complementary partnerships and joint initiatives with clearly defined roles and responsibilities between institutes and universities are good for Norway and should be encouraged and intensified. Adoption and tuning of best practices is recommended. A start could be learning from the ongoing SINTEF-NTNU project 'Better together'.
6. **Internationalization**
   - Internationalization is a must: TI institutes need to have access to knowledge (not everything is created in Norway) and access to customer value chains which are in many cases global. In return TI institutes together with universities and companies provide good platforms for foreign investments. Companies seek for the best knowledge and international visibility is crucial. However, many of the TI institutes have a weak international strategy and for many of the smaller institutes international activities are not even realistic. The TI institutes are encouraged to identify clear targets and implementation plans for their international activities taking into account the size and regional/national characteristics of each TI institute.
   - Role in EU: Norway has clear targets for the revenues from H2020 and other EU instruments. The TI institutes have a crucial role in domiciliation of EU funds to Norway. STIM-EU offers a crucial mechanism for the TI institutes to overcome potential obstacles regarding EU funding. In addition to the institutes' own EU activities, they should proactively facilitate the inclusion of other Norwegian actors into EU networks. The TI institutes role towards SMEs as networkers is valuable. TI institutes should pave the way for Norwegian industries to join EU networks.

3.4 Recommendations for the individual institutes

3.4.1 Christian Michelsen Research AS (CMR)

CMR – Overview/Key figures

Established	**1992**	**Research areas/ departments**	Process Monitoring Visualization and condition monitoring Measurement Services Renewable Energy Measurement Platforms & Decision Support
Ownership	UiB (50%) UNI Research (35%) Statoil Techn Invest Ltd. (5%) Sparebanken Vest (5%) Seabed Geosolutions R&D (5%)	**Centres**	Hosts 2 FMEs (NORCOWE and SUCCESS) and hosted 1 SFI (Michelsen Centre 2007-14)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	140.0	145.9	137.8
Core funding %	4.9	4.5	4.9
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	33.7	35.2	33.9
Other Norw. contrib. income %	0.0	0.0	0.0
Norwegian comm. research:			
Trade and industry %	44.2	39.0	39.6
Public administration %	2.4	3.2	4.3
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	0.0	0.0	0.3
Other int. sources %	0.9	3.1	2.5
Other operating revenues %	13.9	15.0	14.5
Operating profit MNOK	**-6.7**	**0.7**	**-11.7**
Equity MNOK	**122.0**	**133.0**	**126.3**

Personnel			
Total full-time equivalents(FTEs)	67	67	69
Researcher FTEs	51	54	61
of this women	8	14	17
Per cent researcher FTEs	76%	80%	88%
PhDs per researcher FTE[3]	0.53	0.49	0.41
Resignations per researcher FTE	0.10	0.04	0.03

Specific concerns/other information:
Mergers in the Bergen region are presently considered.
History dating back to 'Chr. Michelsens Institutt for Videnskap og Åndsfrihet' (est. 1930, no formal relation to the present CMI).

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	2	0	1
Revenues from licencing (MNOK)	0.5	0.8	1.0
Number of new spin-off companies	0	1	0
Publication / reporting			
Publ. points per researchers FTE	0.29	0.17	0.11
Reports to commissioners (#)	40	32	37
Researcher education			
Number of dr. candidates/students	4	1	1
Number of awarded dr. degrees	0	0	0
of this women	0	0	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	75
Field normalised	74

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	94%
International	42%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	33%
with other TI institutes	33%
with international partners	29%
	FP7
# Norwegian industry partners in EU projects [2]	1

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] CMR participated in 1 FP7 project, hence there was Norwegian industry collaboration in all their FP projects (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by CMR ('prosjektansvarlig').

Major strengths

CMRs vision is 'Research for industrial development', and its position is applied research and prototyping close to industrial research, with a focus on innovation and disruptive research. CMR has good commercial and innovation capabilities as demonstrated amongst others by bringing forward several companies. It has also been good at mobilizing users and customers into research cooperations as shown by being the host for two FMEs (NORCOWE and SUCCESS).

Major weaknesses

CMR is in a vulnerable financial position. It has amongst the lowest core funding of the technical-industrial institutes (4.5% in 2013). The majority of their customers are in the oil and gas industry, with a changing operational and economic environment. Finally, the end of the first FME period and upcoming decisions on which FMEs to continue/start, may lead to changes that can influence CMR. For these reasons it is important that CMR has a solid 'plan B' for how to manage with increasing competition and fewer projects going forward.

While CMR clearly has demonstrated their commercial abilities, it is highly questionable whether Prototech and Gexcon, which are 100% owned by the CMR group, are provided with the best opportunities to develop under this ownership structure.

CMR has low engagement towards the international market, and a very small proportion of revenues coming from abroad.

Important focus points for the coming years

1. CMR needs a solid ‘plan B’ for how to manage with fewer projects and increasing competition for projects within oil and gas.
2. Develop a clear holding strategy for existing and future companies. It is questionable whether the institute is the best owner of companies which are as mature as Gexcon and Protoech and CMR should ensure they are transferred to owners that can develop them optimally going forward.
3. While CRM has indirect international presence since many customers are Norwegian offices of international companies, they should use the industry network more to get access to EU projects and increase their international presence.
4. CMR should continue the consolidation discussions.

3.4.2 Institute for Energy Technology (IFE)

IFE – Overview/Key figures			
Established	**1948**	**Research areas/ Departments**	Nuclear Technology and Physics sector Isotope Laboratories sector Nuclear Safety and Reliability sector Sector Safety – MTO Energy and Environmental Technology sector Petroleum Technology sector
Ownership	Independent foundation (from 1953)	**Centres**	Hosts one FME (Solarunited) and hosted 1 SFI (FACE 2007-14)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	785.5	807.6	900.9
Core funding %	4.2	4.1	9.1[5]
Management tasks %	11.1	12.8	4.9
RCN (contribution income) %	10.2	9.9	9.4
Other Norw. contrib. income %	0.0	0.6	0.2
Norwegian comm. research:			
Trade and industry %	33.3	29.2	35.8
Public administration %	10.0	8.2	2.7
Other comm. research %	1.6	1.4	1.5
International revenues:			
EU research funding %	1.2	1.3	1.2
Other int. sources %	28.0	31.8	34.8
Other operating revenues %	0.3	0.7	0.4
Operating profit MNOK	**15.7**	**-45.3**	**6.9**
Equity MNOK	**265.2**	**-87.5**	**20.3**

Personnel			
Total full-time equivalents(FTEs)	579	600	573
Researcher FTEs	226	214	179
of this women	56	50	58
Per cent researcher FTEs	39%	36%	31%
PhDs per researcher FTE[3]	0.45	0.35	0.44
Resignations per researcher FTE	0.08	0.14	0.30

Specific concerns/other information:
Started up as part of FFI in 1946.
Hosts the Halden Reactor Project since 1958.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	17	2	12
Revenues from licencing (MNOK)	1.8	2.9	6.3
Number of new spin-off companies	0	0	2
Publication / reporting			
Publ. points per researchers FTE	0.43	0.37	0.44
Reports to commissioners (#)	223	133	88
Researcher education			
Number of dr. candidates/students	28	10	24
Number of awarded dr. degrees	3	3	0
of this women	0	0	0

Citation indicators		
NCR publications. % of world average[1]		**2009-12**
Journal normalised	84^{N}	86^{O}
Field normalised	88^{N}	88^{O}

Collaboration (% of publications/projects with collaboration)		
Co-authorship		**2011-13**
Norwegian public research organisations	38^{N}	49^{O}
International	79^{N}	54^{O}
Collaboration in RCN projects[4]		**2009-13**
with Norwegian industry		21%
with other TI institutes		12%
with international partners		12%
		FP7
# Norwegian industry partners in EU projects [2]		2

^{N}= IFE nuclear; ^{O}=IFE other

[1] As explained in Aksnes 2015/the separate report on the publication analysis.

[2] IFE participated in 14 FP7 projects, and had a at least Norwegian partner in 5 of them (source, RCN/Fact report).

[3] Number of employees with a PhD divided by researcher FTEs.

[4] Includes only projects coordinated by IFE ('prosjektansvarlig').

[5] From 2014, 45.15 mill. MNOK which was previously ear-marked for nuclear research at Kjeller, is included in the base-funding.

Major strengths

The nuclear activities, centred around the two research reactors, are unique in the Norwegian research landscape and (fairly) unique on the international arena as well. The Halden reactor has been a platform for a strong international research activity through the Halden Reactor Project (HRP). Further, there is a strong portfolio of research projects, in particular related to basic research in physics, and isotope research within pharmaceuticals, at Kjeller.

Notably, IFE's location close to Oslo is important since its strong political exposure through nuclear activities requires a tight coupling to Norway's political power base.

IFE specializes in nuclear and energy research, thus IFE has arguably a healthy ratio between their number of researchers and research breadth, i.e. IFE has a reasonable focus in the portfolio. The institute has been able to move research activities from the nuclear area into other domains, for instance using the comprehensive human machine interface (HMI) laboratory facilities at Halden in the oil&gas sector. IFE has diversified within energy, in particular towards the petroleum sector and solar energy. This seems like a sustainable strategy. Further, there is now a drive towards closer cooperation between the MTO (Safety Man-Technology-Organization), Petroleum Technology, and Energy and Environmental Technology departments. This is an effort that will strengthen these departments.

Major weaknesses

Activities in different parts of IFE seem to be rather disconnected even though they launched a 'one IFE' project in 2013 in response to severe financial challenges in the aftermath of the Fukushima accident. There seems to have been a culture in which silos have been dominating for an exceeding number of years.

The reactor related activities have a strong political dimension, which makes IFE particularly vulnerable to changing political priorities. This complicates strategic planning. In order to mitigate this there is a need to isolate the obligations related to operations and future decommissioning of the reactors. The nuclear activity also depends on the acceptance of nuclear power production on the international arena. Nuclear power is controversial in many regions and IFE is vulnerable to future incidents/accidents. It is difficult to devise a strategy to mitigate this factor significantly.

There is no clear vision on how and where to position IFE in Norway's future research landscape, Even though at interview potential candidate institutions were named for a closer and binding cooperation IFE has not committed to any close, strategic cooperation with other actors within the Norwegian research landscape. This may partly be due to the obligations related to the nuclear infrastructure. IFE seems to apply a case-by-case approach in terms of cooperation with other domestic research players.

Petroleum research in Norway is performed at many research institutes. Thus, critical mass and internal domestic competition is an issue. Moreover, IFE's financial situation is on the weak side with an average operating result of about 2% of their operating income.

Important focus points for the coming years

1. The nuclear reactors complicate long term planning severely, in particular IFE's ability to form close alliances with other research players. Thus, there is a definite advantage in isolating the exposure and risk of the nuclear reactor facilities. If these were ring-fenced, it would help in alliance building within the Norwegian research institute sector in general and for IFE in particular.
2. IFE should focus on leadership due to its complex structure with nuclear research activities in combination with more traditional research activities, and due to its exposure to political priorities. The 'one IFE' initiative is definitely positive. It should be continued and driven with even more focus and with higher speed.
3. IFE should further capitalize even more on their nuclear-related research by encouraging new initiatives based on this research in other sectors.
4. The petroleum research would benefit from a closer collaboration with other national actors, in particular due to the recent, significant changes within the oil and gas sector, which probably necessitates a consolidation of oil related research in Norway.
5. IFE should intensity its activity towards EU research since energy is an important part of the Horizon2020 program.

3.4.3 International Research Institute of Stavanger AS (IRIS)

IRIS (TI part) – Overview/Key figures			
Established	**2006** (Rogalandforskning 1973)	**Research areas/ departments**	Automated drilling Improved Oil Recovery Environmental Assessment Monitoring Microbiology and Biotechnology
Ownership	UiS (50%); Rogalandforskning (50%)	**Centres**	Hosts one SFI (DrillWell)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	255.4	255.7	265.8
Core funding %	5.0	5.1	5.2
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	18.0	21.0	22.5
Other Norw. contrib. income %	1.0	1.2	2.0
Norwegian comm. research:			
Trade and industry %	66.9	64.1	61.1
Public administration %	3.0	1.8	0.6
Other comm. research %	0.0	1.1	1.4
International revenues:			
EU research funding %	0.3	0.2	0.2
Other int. sources %	5.7	3.3	5.1
Other operating revenues %	1.0	2.2	1.8
Operating profit MNOK	**22.9**	**18.1**	**9.4**
Equity MNOK	**101.1**	**120.9**	**134.3**

Personnel			
Total full-time equivalents(FTEs)	145	146	157
Researcher FTEs	100	93	105
of this women	30	27	29
Per cent researcher FTEs	69	64	67
PhDs per researcher FTE[3]	0.65	0.69	0.67
Resignations per researcher FTE	0.13	0.10	0.07

Specific concerns/other information:
IRIS has a formal collaboration agreement with UiS.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	4	0	2
Revenues from licencing (MNOK)	0.07	0.00	0.40
Number of new spin-off companies	1	0	0
Publication / reporting			
Publ. points per researchers FTE	0.36	0.35	0.22
Reports to commissioners (#)	106	93	142
Researcher education			
Number of dr. candidates/students	11	6	9
Number of awarded dr. degrees	1	5	1
of this women	1	2	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	130
Field normalised	162

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	68%
International	39%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	29%
with other TI institutes	17%
with international partners	29%
	FP7
# Norwegian industry partners in EU projects [2]	2
# Norwegian public adm. partners in EU projects	2

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] IRIS participated in 3 FP7 projects, and had at least one Norwegian partner in all of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by IRIS ('prosjektansvarlig').

Major strengths

IRIS has a leading position in drilling automation with high industry relevance in drilling, well modelling and IOR/EOR, and a high citation index. The institute has stable revenues from national markets, sound operating results and has been able to increase its operating revenues in later years.

So far IRIS has been very successful within traditional areas as inherited from Rogalandsforskning, and has been a hallmark in the Norwegian Oil research. IRIS provides national and international testing services, including the Ullrigg test rig which is part of the national road map for research infrastructure. In strong competition with the Bergen, Oslo and Trondheim cluster, IRIS managed to attract the national centre for IOR/EOR to Stavanger. In the international arena, IRIS cooperates and provides services in EOR and automated drilling – in collaboration with US, Russia and Brazil, and IRIS has a strong position in the highly competitive US marked. To improve its portfolio spread IRIS has identified funding from the public sector social sciences as an opportunity, and has currently no problem finding customers in the oil and gas sector. IRIS has gained substantial revenues from divesting IRIS initiated start-ups.

The UiS ownership of IRIS works very well, as UiS sees IRIS as a tool for collaboration and deployment. IRIS has a good cooperation with UiS, with a loosely defined division between fundamental research (UiS) and more applied research (IRIS). IRIS has already started to seriously consider tighter cooperation and also mergers with carefully selected partners.

Major weaknesses

IRIS has low revenues from industries abroad, very low revenues from EU funded research, no patent applications granted in 2012-13 period, low numbers of licenses and revenues from licenses, a low risk profile with respect to commercialization. Moreover, a rather narrowly focused portfolio makes IRIS vulnerable to market variations. IRIS has too long survived on the benefits of a strong (now declining) Norwegian oil and gas industry.

IRIS is in the process of downsizing, and may have to cut up to 10% of staff, to have some surplus to invest, and is planning to be just in balance in 2015. While downsizing may be the correct strategy in a declining market situation, it can also be seen as a defensive and too late reaction with respect to changing markets. Moreover, the institute lacks a clear strategy for how to utilize and expand the benefits of having a unique capability such as Ullrigg on the European/international level. Notably, the cost of operating infrastructure (e.g. Ullrigg) is high and smaller companies have problems paying for it.

In summary, it appears as if IRIS has not really managed to capitalize its (previously) dominant role on the Norwegian sector and develop into a fully international role, with associated sound financial results.

Important focus points for the coming years

1. Fully assess the potential benefits of various merger opportunities: While IRIS has started to look into various options, it appears as if the institute has so far taken a somewhat defensive approach. Maintaining IRIS in its current format is not a goal in itself. If IRIS can be better off by finding different partners for its three units, such as merging social sciences with a university, then this should be done.
2. The industry is more than willing to pay for the services at Ullrigg. Current waiting time for operations indicate a considerable potential to increase revenues from this unique infrastructure.

3.4.4 Norwegian Geotechnical Institute (NGI)

NGI – Overview/Key figures			
Established	**1953** (by NTNF)	**Research areas/ departments**	Offshore Energy; Building. construction and transportation; Natural Hazards; Environmental Engineering
Ownership	Independent foundation	**Centres**	Hosted one SFF (ICG 2003-12)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	316.9	367.9	392.7
Core funding %	6.9	6.0	5.9
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	7.0	3.2	3.3
Other Norw. contrib. income %	1.5	1.6	2.0
Norwegian comm. research:			
Trade and industry %	58.0	51.9	45.3
Public administration %	18.2	16.0	14.5
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	0.4	4.8	0.0
Other int. sources %	19.2	16.2	28.2
Other operating revenues %	0.3	0.3	0.5
Operating profit MNOK	**-4.0**	**-1.3**	**4.9**
Equity MNOK	**121.1**	**120.8**	**196.5**

Personnel			
Total full-time equivalents(FTEs)	212	216	220
Researcher FTEs	181	186	190
of this women	41	44	40
Per cent researcher FTEs	85	86	86
PhDs per researcher FTE[3]	0.36	0.36	0.32
Resignations per researcher FTE	0.06	0.08	0.06

Specific concerns/other information:
Daughter companies in Houston and Perth.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0.0	15.3	16.0
Number of new spin-off companies	0	1	2
Publication / reporting			
Publ. points per researchers FTE	0.26	0.26	0.39
Reports to commissioners (#)	487	495	770
Researcher education			
Number of dr. candidates/students	16	6	5
Number of awarded dr. degrees	4	0	1
of this women	1	0	1

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	121
Field normalised	123

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	46%
International	78%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	9%
with other TI institutes	7%
with international partners	13%
	FP7
# Norwegian industry partners in EU projects [2]	0

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] NGI participated in 12 FP7 projects, and had at least one Norwegian partner in 2 them – in total 4 Norwegian partners, all from research organisations (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by NGI ('prosjektansvarlig'). For NGI a substantial part of these projects (33 per cent) are project establishment support for EU projects (PES), not including registered partners.

Major strengths

The Norwegian Geotechnical Institute (NGI) has built up a strong position in the sectors i) Offshore energy, ii) Building, construction and transportation, iii) Natural hazards and iv) Environmental engineering. Specialization within areas and exploitation of strong synergies between disciplines have been key factors in achieving this position. NGI has strong customer relationships in a diverse market; the private sector is well-embedded in research and innovation projects. The international position of NGI is strong and acknowledged. International turnover has been high since the start and has significantly increased over the years. The contribution of daughter companies in Houston (Texas, USA) and, more recently, Perth (Australia) to the international profile is important and growing. Scientists from abroad like to work at NGI, as is shown by the high percentage (35%) of international staff.

The financial situation of NGI is healthy, despite negative end results in recent years. The institute has good solubility, with strong positions in equity and assets. The leadership of the institute is strong, with a clear vision for the future position of NGI and a strategy for how this will be achieved.

Major weaknesses

NGI has a big project portfolio, with a high percentage of relatively small (consultancy) projects (< 0.1 million NOK) mainly for national customers. On the other hand, the volume and revenue of (large) RCN-funded and EU-funded projects is low. These (large) projects are important for knowledge development and strengthening of NGI's international reputation. Therefore, it is important to increase

the contribution of RCN-funded and EU-funded projects in NGI's project portfolio.

NGI is active in diverse markets and wants to become active in new expansion areas such as future energy-mix, climate and environmental related research, the transportation sector and railway in Norway. However, the strategy for business development and value creation in these new areas is not clear.

Important focus points for the coming years

1. Develop a more aggressive growth strategy and implementation plan in areas where NGI has a strong national and international track record and leading reputation.
2. Increase the level of participation, together with Norwegian industrial partners, in H2020 proposals in prioritised research topics.
3. Develop a valorisation strategy and implementation plan for NGIs activities in new expansion areas and markets.
4. Increase efforts to commercialise NGI products and methods.

3.4.5 NORSAR

NORSAR – Overview/Key figures			
Established	**1970** (as section of NTNF)	**Research areas/**	Seismic Modelling
Ownership	Independent foundation (from 1999)	**Departments**	Seismology and Test Ban Monitoring
			Earthquake and the Environment
		Centres	

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	59.3	71.4	61.7
Core funding %	10.5	8.4	10.0
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	16.5	12.2	13.3
Other Norw. contrib. income %	0.5	1.7	3.1
Norwegian comm. research:			
Trade and industry %	29.5	26.9	28.7
Public administration %	32.2	26.6	23.3
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	2.9	3.1	2.9
Other int. sources %	6.7	20.6	17.0
Other operating revenues %	1.0	0.4	1.6
Operating profit MNOK	**1.1**	**-0.4**	**0.6**
Equity MNOK	**49.7**	**50.0**	**51.0**

Personnel			
Total full-time equivalents(FTEs)	41	38	42
Researcher FTEs	26	24	27
of this women	5	4	6
Per cent researcher FTEs	64	63	64
PhDs per researcher FTE[3]	0.69	0.67	0.67
Resignations per researcher FTE	0.08	0.17	0.07

Specific concerns/other information:
Runs and maintains seismic arrays. Located at Kjeller, field installations in Hedmark, Finnmark, Spitsbergen and Jan Mayen.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	4	0
Revenues from licencing (MNOK)	0.3	0.0	0.0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.97	0.66	0.51
Reports to commissioners (#)	6	19	15
Researcher education			
Number of dr. candidates/students	1	0	2
Number of awarded dr. degrees	0	0	1
of this women	0	0	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	84
Field normalised	74

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	37%
International	81%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	13%
with other TI institutes	19%
with international partners	19%
	FP7
# Norwegian industry partners in EU projects [2]	1

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] NORSAR participated in 4 FP7 projects, and had one Norwegian partner in one of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by NORSAR ('prosjektansvarlig').

Major strengths

NORSAR has built up a very strong international reputation within its field and can attract leading researchers. Their business has excelled in a market niche, building on their statutory international role in seismic monitoring. The resulting software products are widely marketed and reach international users through multinational companies with links to Norway. The management has a clear strategy for growth through transposing existing skills into the area of disaster management as well as maintaining their core monitoring role.

Major weaknesses

Despite its reputation with others working in their specialised field NORSAR appears to be overlooked for collaboration in some cases. It is also a small organisation which does not seem ready to increase its scientific mass through mergers. Unlike many other Norwegian research institutes it does not have university ownership and links with the university sector are weak, with few PhD students.

Important focus points for the coming years

1. Formal agreements with key academic institutions should be used to develop stronger partnerships.
2. The disaster management field is a key area for diversification and NORSAR management's strategic approach here is supported.
3. The size of the organisation may make it vulnerable to staff changes. NORSAR seems to be a very strong, if specialised, institute, but it is still small by most standards.

3.4.6 Norut Tromsø

NORUT Tromsø (TI part) – Overview/Key figures			
Established	**2007**	**Research areas/**	Earth observation
Ownership	UiT (majority)	**Departments**	ICT
			Biotechnology
		Centres	

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	41.5	41.2	47.1
Core funding %	12.0	11.8	10.4
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	25.1	30.6	23.3
Other Norw. contrib. income %	0.0	5.1	22.5
Norwegian comm. research:			
Trade and industry %	9.4	6.1	10.0
Public administration %	31.3	20.4	1.7
Other comm. research %	1.0	0.5	0.0
International revenues:			
EU research funding %	8.4	13.6	17.2
Other int. sources %	7.7	10.2	13.4
Other operating revenues %	5.1	1.9	1.3
Operating profit MNOK	**-0.6**	**-1.5**	**-0.2**
Equity MNOK	**48.6**	**42.0**	**43.1**

Personnel			
Total full-time equivalents(FTEs)	35	37	39
Researcher FTEs	30	31	34
of this women	4	3	5
Per cent researcher FTEs	86	84	87
PhDs per researcher FTE[3]	0.70	0.61	0.68
Resignations per researcher FTE	0.1	0.0	0.06

Specific concerns/other information:
Norut Tromsø is one of five companies in the Norut Group. Merged with Norut Alta August 2015 (now named Norut). Norut Tromsø was a merger of Norut Information Technology. Norut Social Science Research and the Norut Group.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.74	0.33	0.35
Reports to commissioners (#)	13	8	5
Researcher education			
Number of dr. candidates/students	3	4	0
Number of awarded dr. degrees	0	0	1
of this women	0	0	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	134
Field normalised	128

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	65%
International	52%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	15%
with other TI institutes	5%
with international partners	15%
	FP7
# Norwegian industry partners in EU projects [2]	1

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] Norut Tromsø participated in 10 FP7 projects, and had had a Norwegian partner in two of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by Norut Tromsø ('prosjektansvarlig').

Major strengths

With its vision 'Sustainable growth in the North', Norut Tromsø supports sustainable growth in the north and supplies the industry with R&D. Their location, including facilities at Svalbard is a key strength and this is an area that has huge political support. They have a multi-disciplinary approach, including disciplines outside this evaluation (social science), and there is much activity between the different groups. They have good relation to the University of Tromsø, which is the main shareholder, both at higher and lower levels, and see themselves as the more applied side of UiT. They have some clear niches such as applied remote sensing, which has high international standing and potential to increase.

Major weaknesses

Norut Tromsø has a broad portfolio of activities which likely is due to the facility having a strong regional role that is also combined with a national role in certain areas. While the entire Norut Group has around 130 employees, Norut Tromsø is currently below critical mass even after the merger with Norut Alta. It is largely focusing on domestic industry and has amongst the lowest industrial funding of the TI institutes with purely industrial customers providing less than 10% funding. It is questionable to the panel whether Norut Tromsø is really building on its strengths and utilizing the political support for northern areas growth.

Important focus points for the coming years

1. It is important to ensure that the NORUT group act and is perceived as one unit and that they focus and build on their unique strength as the experts on the northern areas.
2. There is a need for solid international strategy and implementation plan.
3. NORUT Tromsø should further consolidate with the rest of the NORUT Group and possibly others to ensure critical mass. Resolving the current complex ownership structure would be of assistance.

3.4.7 Norut Narvik

NORUT Narvik – Overview/Key figures

Established	**1991**	**Research areas/**	Infrastructure materials and structures
Ownership	NORUT Tromsø (50%) Narvik University College/ForteNarvik (50%)	**Departments** **Centres**	Cold Climate Technology Process and environmental technology

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	31.6	27.9	22.7
Core funding %	10.1	11.0	13.7
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	16.8	20.1	21.6
Other Norw. contrib. income %	0.0	37.6	30.0
Norwegian comm. research:			
Trade and industry %	21.8	13.3	16.7
Public administration %	36.7	9.3	9.3
Other comm. research %	0.3	0.0	0.0
International revenues:			
EU research funding %	0.0	2.5	3.1
Other int. sources %	13.6	4.7	5.3
Other operating revenues %	0.6	1.4	0.4
Operating profit MNOK	**0.0**	**-1.7**	**0.1**
Equity MNOK	**10.9**	**9.3**	**12.4**

Personnel			
Total full-time equivalents(FTEs)	33	29	20
Researcher FTEs	28	24	16
of this women	7	6	4
Per cent researcher FTEs	85	83	80
PhDs per researcher FTE[3]	0.46	0.46	0.44
Resignations per researcher FTE	0.21	0.17	0.44

Specific concerns/other information:
NORUT Narvik has a formal collaboration agreement with Narvik University Collage (HiN). HiN is presently in a merger process with UiT and Harstad University Collage.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	1	0	0
Publication / reporting			
Publ. points per researchers FTE	0.15	0.54	0.65
Reports to commissioners (#)	17	0	6
Researcher education			
Number of dr. candidates/students	5	4	5
Number of awarded dr. degrees	1	0	0
of this women	0	0	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	61
Field normalised	49

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	29%
International	61%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	17%
with other TI institutes	8%
with international partners	17%
# Norwegian industry partners in EU projects [2]	**FP7** 0

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] Norut Narvik participated in no FP7 projects (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by Norut Narvik ('prosjektansvarlig').

Major strengths

Norut Narvik has built on its long-term expertise in cold climate infrastructure to cope with difficult conditions in the local industrial market and a downturn in Norwegian solar PV activity. This has allowed it to maintain financial viability; the number of staff, although currently reduced, is expected to grow again. The institute has access to good equipment for its tasks and can make effective use of field studies. Despite the challenge of distance, the members of the Norut Group recognise the importance of working together.

Major weaknesses

The local industrial base for Norut Narvik may be weakening, with a consequent inability to pay for R&D and perhaps also a lack of need for it. But increasing reliance on RCN funding is not an option either; it is not supposed to be a substitute for market money. Complex institute ownership and possible differences in owner priorities may hamper future changes and mergers.

Important focus points for the coming years

1. The region of Norway that Norut operates in may not be able to support large institutes, so the members of the Norut Group must act together effectively to reach critical mass in areas where they have an inherent advantage through their specialisation in 'Northern Research'.
2. Norut Narvik needs to focus on a long-term and sustainable growth strategy based on delivering services to the market in areas where it has unique expertise, locally and also nationally and internationally. The main theme could well be national with a strategic role; infrastructures are obviously extremely important to make Norway function in the winter.
3. Strategic relationships should be developed with other institutes in Norway to give access to wider capabilities where needed; the existing cooperation with local universities and with NTNU for PhD candidates must also be maintained and adapted to new conditions.

3.4.8 Norwegian Computing Center (NR)

NR – Overview/Key figures

Established **Ownership**	1952 Independent foundation (from 1985)	**Research areas/ Departments** **Centres**	Statistical Analysis. Pattern Recognition and Image Analysis Statistical Analysis of Natural Resource Data Applied Research in Information Technology Hosts/hosted 2 SFIs (Big Insight; (SFI)[2] 2007-14)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	81.7	80.5	80.4
Core funding %	14.9	14.6	14.7
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	32.4	20.1	16.5
Other Norw. contrib. income %	0.0	3.9	7.0
Norwegian comm. research:			
Trade and industry %	38.6	37.5	40.3
Public administration %	5.9	7.6	5.6
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	5.6	5.5	3.9
Other int. sources %	1.2	9.8	10.7
Other operating revenues %	1.3	1.1	1.2
Operating profit MNOK	**1.4**	**0.2**	**2.1**
Equity MNOK	**67.4**	**73.2**	**86.8**

Personnel			
Total full-time equivalents(FTEs)	67	67	62
Researcher FTEs	58	58	53
of this women	21	20	19
Per cent researcher FTEs	87	87	85
PhDs per researcher FTE[3]	0.64	0.60	0.66
Resignations per researcher FTE	0.05	0.12	0.15

Specific concerns/other information:
Under NTNF until 1985.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.60	0.65	0.53
Reports to commissioners (#)	55	56	32
Researcher education			
Number of dr. candidates/students	8	7	4
Number of awarded dr. degrees	2	2	2
of this women	1	0	2

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	121
Field normalised	118

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	45%
International	37%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	15%
with other TI institutes	7%
with international partners	7%
	FP7
# Norwegian industry partners in EU projects [2]	5

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] NR participated in 10 FP7 projects and had had a Norwegian partner in 6 of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by NR ('prosjektansvarlig'). For NR a substantial part of these projects (39 per cent) are project establishment support for EU projects (PES), not including registered partners.

Major strengths

NR has a stable financial situation and customer base and are clearly contributing to value creation in Norway. Their methodology is niche and they have limited competition in their areas. Their base funding is amongst the highest of the institutes in this assessment, and it has been quite stable in past years as they have good academic scores and at the same time serve their customers well. Their staff is very stable, and they currently have a high share of people at the peak of their career. Their sales process is very much driven bottom-up, with basically all researchers having a responsibility for

identifying and driving projects. In sum, this should give ample and exciting opportunities for young, ambitious researchers.

Major weaknesses

NR is mainly characterized by an overall good performance. However, while being stable in terms of research areas and staff has many clear advantages, there is a danger of becoming too conservative, too risk averse, too dependent on single individuals and not providing the younger personnel with incentives and opportunities to grow and develop. NR is currently doing well, and has limited incentives to grow further and develop. NR may have a dangerous demographic situation in 10 years if they start to loose people, and particularly a challenge in computing. On innovation, they are mainly focused on deliveries to large companies and do not have a policy, but rather decide on a case by case basis.

Important focus points for the coming years

1. NR needs a clearer vision and should define a growth strategy where new areas are opened up, in particular for younger people to take a leading role.
2. As part of the above, they should also define an innovation strategy to ensure incentives and predictability for employees related to commercialization.

3.4.9 SINTEF and institutes in the SINTEF Foundation

SINTEF Foundation– Overview/Key figures			
Established	**1950** (by NTH)	**Research areas/ Departments**	SINTEF Building and Infrastructure SINTEF ICT SINTEF Materials and Chemistry SINTEF Technology and Society
Ownership	Independent foundation	**Centres**	Hosts/hosted 3 SFIs (SFI Manufacturing; COIN and NORMAN 2007-14).

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	1724.6	1726.4	1708.2
Core funding %	6.2	6.2	6.6
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	17.3	16.1	14.5
Other Norw. contrib. income %	0.5	0.7	2.5
Norwegian comm. research:			
Trade and industry %	37.2	36.7	49.3
Public administration %	15.0	10.3	4.5
Other comm. research %	2.1	0.0	0.0
International revenues:			
EU research funding %	8.7	9.9	9.3
Other int. sources %	6.3	8.8	6.9
Other operating revenues %	9.5	11.5	6.4
Operating profit MNOK	**63.4**	**43.6**	**61.1**
Equity MNOK	**1987.2**	**2026.0**	**2106.5**

Personnel			
Total full-time equivalents(FTEs)	1020	1054	1050
Researcher FTEs	767	740	748
of this women	202	219	229
Per cent researcher FTEs	75	70	71
PhDs per researcher FTE[3]	0.56	0.60	0.59
Resignations per researcher FTE	0.12	0.08	0.07

Specific concerns/other information:
Part of the SINTEF Group and majority owner of MARINTEK. SINTEF Energy Research and Petroleum SINTEF Research.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	23	17	22
Revenues from licencing (MNOK)	1.0	0.0	0.5
Number of new spin-off companies	0	0	1
Publication / reporting			
Publ. points per researchers FTE	0.48	0.44	0.48
Reports to commissioners (#)	450	1039	1189
Researcher education			
Number of dr. candidates/students	55	34	40
Number of awarded dr. degrees	5	4	2
of this women	5	2	1

Citation indicators				
NCR publications. % of world average[1]				**2009-12**
Journal normalised	160[B]	141[I]	98[M]	114[T]
Field normalised	192[B]	130[I]	97[M]	98[T]

Collaboration (% of publications/projects with collaboration)				
Co-authorship				**2011-13**
Norw. public research org.	71[B]	55[I]	77[M]	67[T]
International	29[B]	44[I]	41[M]	25[T]

Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	29%
with other TI institutes	12%
with international partners	15%
	FP7
# Norwegian industry partners in EU projects [2]	92
# Norwegian public adm. partners in EU projects	16

[B]=SINTEF Building and Infrastructure; [I]=SINTEF ICT; [M]=SINTEF Materials and Chemistry; [T]=SINTEF Technology and Society.

[1] As explained in Aksnes 2015/the separate report on the publication analysis.

[2] The SINTEF Foundation participated in 204 FP7 projects, and had at least one Norwegian partner in 106 of them (source, RCN/Fact report).

[3] Number of employees with a PhD divided by researcher FTEs.

[4] Includes only projects coordinated by SINTEF ('prosjektansvarlig'). Data include all projects registered as coordinated by SINTEF/TI institute sector in the RCN database, except for those specified as MARNTEK. SINTEF Energy or SINTEF Petroleum, and may include projects coordinated by other parts of the SINTEF Group than the SINTEF Foundation.

In this section, the SINTEF Group and the four evaluated institutes in the SINTEF Foundation are addressed. The three limited SINTEF companies (all partly or fully owned by the SINTEF Foundation) are addressed in separate sections below.

The SINTEF Group

Major strengths

SINTEF is the largest technology and industrial oriented TI institute in Norway. In the changing operational and economic environment (oil and gas) SINTEF could and should pave the way for new growth areas (e.g. green technologies). The special strength of SINTEF is that it is well driven organization with a strong leadership and skilled personnel. SINTEF has a good track record in EU Framework Programmes, and has professional capability to win and bring EU money to Norway as well as to introduce Norwegian industry to EU networks. SINTEF has a strong customer-oriented approach and ability to generate new businesses via spin off companies. The close 'symbiosis' with NTNU provides access to basic research and science and thus, when working properly, enables the formation of innovation value chains from fundamental research to higher TRL levels.

Major weaknesses

SINTEF is a merger of a range of institutes which has led to overlapping of some of the activities and in house competition. The real competition is outside of SINTEF and thus one might ask whether the full potential of SINTEF is in use. SINTEF and NTNU have a very special and complicated relationship where the collaboration varies from excellent to poor. The current state of the cooperation does not provide best results from the Norwegian innovation capability point of view. The growth scenario of SINTEF is unclear as the growth will probably not happen through the current focus areas nor domestic commission and/or public research. The customer sales and marketing as well as the business development activities are not strong enough.

Important focus points for the coming years

1. New, productive and win-win ways to get the best out of the SINTEF – NTNU 'symbiosis' should be identified, implemented and enhanced (as is attempted in the ongoing SINTEF-NTNU project 'Better together').
2. The full potential of One SINTEF should be exploited, including the focus on complementarity and avoid overlaps of the SINTEF institutes and companies. The ambition level of R&D&I activities should be high. Hence, clear and bold visions are need.
3. There is a need for boosting and accelerating customer oriented research with expertized marketing, sales and business development personnel and activities.

SINTEF Building and Infrastructure

Major strengths

SINTEF Building and Infrastructure is a successful merge of two institutes. The current SINTEF B&I is strongly customer oriented, has very close connections to its customers, and knows the needs of the industrial sector well. SINTEF B&I has in generally a good relationship and division of activities with NTNU and other Norwegian universities. SINTEF B&I has good links to other SINTEF institutes and the competences are integrated and used. In particular, energy efficiency in built environment is a good example of cross-selling and exploitation of SINTEF competences.

Major weaknesses

The number of customers is very high and the industrial sector is not very research and innovation intensive, but focusing on incremental R&D activities. The project portfolio is heterogeneous and project management is sometimes an issue. SINTEF B&I is not, in the current mode, able to improve the R&D&I capability towards a more ambitious direction. Moreover, public procurement regulations seem a problem as the public sector in some cases turns directly to NTNU/universities rather than (taking the time and resources for) organising an open competition where SINTEF B&I can participate.

Important focus points for the coming years

1. There is a need for larger projects and more focus on key questions in the research portfolio. One strategy to obtain this may be fewer and bigger customers.
2. The level of scientific and technological ambition should be enhanced. There is a need for a solid growth strategy and more demanding projects.

SINTEF ICT

Major strengths

SINTEF ICT has strong focus areas and solid strategy accordingly, and good balance between basic research, applied research and commission work. Furthermore, there is good cooperation with NTNU and other universities with clear roles and win-win approach. The institute's innovation oriented approach has generated new business via spin off companies, and successful exits have generated significant revenues. Furthermore, the institute has a good track record on EU activities and also potential to gain more.

Major weaknesses

The major weakness is that the full potentiality of digitalization is not taken into account in the research strategy. Moreover, SINTEF ICT is focused on the domestic markets having mainly Norwegian customers. Due to the EU funding rules that have negative influence on the institutes' ability to apply more EU proposals the institute is not able to utilize its whole potential in EU calls.

Important focus points for the coming years

1. There is a need for a long-term strategy on digitalization in industry and society. ICT and digitalization is a game changer in societal and economic productivity.
2. SINTEF ICT should develop an ambitious plan for their international activities, and target growth via international sales.
3. There is a need for active and creative recruitment and IPR policies to balance inward and outward flows of people, competences and knowledge.

SINTEF Materials and Chemistry

Major strengths

SINTEF Materials and Chemistry has a strong and forward looking strategy. The main strength of the institute lies in scientific competence integrated with an innovation orientated approach. SINTEF M&C as a generic discipline develops markets with other SINTEF institutes in a wide range of application areas. SINTEF M&C is an experienced player in EU networks and has the ability to bring Norwegian companies in EU networks. Management is based on leadership, and personnel are encouraged to take initiatives towards innovation.

Major weaknesses

SINTEF M&C has a broad portfolio of activities which might lead to lack of necessary critical mass in resources. The excessive fragmentation should be avoided. The right balance between strategy-driven and bottom-up driven project portfolio management seems to be missing. Apart from EU projects, the international sales are small.

Important focus points for the coming years

1. There is a need for solid international strategy and implementation plan on the selected growth and emerging areas of activities.
2. The spin off activity and commercialisation should be increased. Tools and capabilities for international sales should be created. There is a need for clearer priorities, focusing on strong competence areas and better exploiting complementarities within the SINTEF group as well as in university collaboration.

SINTEF Technology and Society

Major strengths

SINTEF Technology and Society is a user-oriented institute with multidisciplinary staff and projects. The major strength lies on the focus on social sciences and foresight, integrated with strong technological competences. There is good task division and long-term collaboration with NTNU and UiO, though in some research areas competition with universities has forced SINTEF T&S to stand aside from certain commission research areas (e.g. logistics). The foresight activities combined with technology development provide an asset to SINTEF which should be used at the national level, for example in supporting political/governmental decision makers in their national strategy work.

Major weaknesses

SINTEF T&S is a small institute (10% of the SINTEF) which deals with many diverse topics. The research focus and portfolio is fragmented and small teams do not necessarily allow the formation of critical mass. The fragmented structure also hinders elaboration of the overall market and research strategy for the whole institute. It may be difficult for SINTEF T&S to reach the growth targets without mergers with other institutes or restructuring within SINTEF.

Important focus points for the coming years

1. Social sciences and foresight integrated with strong technological know-how is a hidden asset for SINTEF which should be fully exploited throughout the organization.
2. There is a need to develop a clear growth and implementation strategy with clear focus areas and critical mass. Furthermore, SINTEF T&S should differentiate itself from consultants and other R&D actors in the field either by acting in SINTEF corporate level or by having specialized activity areas. There is need for specialized sales, marketing and business development personnel in order to access new markets and customers.

3.4.10 Norwegian Marine Technology Research Institute AS (MARINTEK)

MARINTEK – Overview/Key figures

Established	**1985 (**Norges Skipstekniske Forsknings-institutt from 1939)	**Research areas/ Departments**	Maritime Transport Systems Energy Systems and Technical Operations Ship Technology Offshore Hydro-dynamics Structural Engineering
Ownership	SINTEF Foundation (56%) Norwegian Shipowners' Association (26%) Det Norske Veritas (9%) The Federation of Norwegian Industry (4%) Norwegian Maritime Directorate (4%) Federation of Norwegian Coastal Shipping (1%)	**Centres**	

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	312.2	310.1	328.3
Core funding %	4.9	4.9	5.1
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	2.3	2.8	5.9
Other Norw. contrib. income %	0.0	5.4	4.5
Norwegian comm. research:			
Trade and industry %	56.8	54.9	57.5
Public administration %	4.9	0.8	1.8
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	4.5	1.6	3.9
Other int. sources %	26.6	29.4	21.2
Other operating revenues %	0.1	0.0	0.1
Operating profit MNOK	**11.7**	**13.8**	**22.6**
Equity MNOK	**138.8**	**238.5**	**252.4**

Personnel			
Total full-time equivalents(FTEs)	189	193	200
Researcher FTEs	116	120	125
of this women	17	18	18
Per cent researcher FTEs	61	62	63
PhDs per researcher FTE[3]	0.41	0.46	0.43
Resignations per researcher FTE	0.09	0.08	0.10

Specific concerns/other information:
Co-located with Department with Marine Technology at NTNU. Works to establish Ocean Space Centre.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.24	0.25	0.33
Reports to commissioners (#)	237	203	234
Researcher education			
Number of dr. candidates/students	5	2	2
Number of awarded dr. degrees	0	0	0
of this women	0	0	0

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	131
Field normalised	140

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	71%
International	28%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	36%
with other TI institutes	10%
with international partners	16%
	FP7
# Norwegian industry partners in EU projects[2]	13
# Norwegian public adm. partners in EU projects	2

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] MARINTEK participated in 19 FP7 projects, and had at least one Norwegian partner in 14 of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by MARINTEK ('prosjektansvarlig'). Data may be incomplete at some projects coordinated by MARINTEK may be registered under SINTEF in the RCN database.

Major strengths

MARINTEK are co-located with NTNU department of Marine Technology and they run an impressive number of large laboratories (ocean labs, towing tanks, cavitation testing etc.) and also develop software. MARINTEK is strongly anchored in the Norwegian business and they also have a strong international business. In 2014, 21% came from foreign trade, indicative of a good reputation and high quality of the work. The financial key performance indicators are good and stable. Many international clients also use the labs/test facilities. MARINTEK is also involved in international standardization in the field. The long and strong Norwegian track-record in the maritime area is a strong asset for

MARINTEK and they seem to have utilized this in a very good way. The strong focus on realizing the future Ocean Space Centre is certainly a way of building an even stronger institute.

Major weaknesses

While MARINTEK has a clear focus on very relevant issues and a strong international customer base there has been only a marginal growth during the last years. The majority of the turnover comes from contract research and only a small fraction from strategic research and from public grants. This is far from an optimal condition for a TI institute and will, in the long run, result in difficulties in maintaining a state of the art competence in the field of activity and in recruiting the best staff. The IPR strategy is not as clear as it should be. In fact IPR seems not to be part of the strategy at all. While the labs and test facilities are strong assets, several of them have waiting lists for up to a year. This might of course imply a risk of losing important customers if not solved by either expanding the lab capabilities or running them 24-7 when possible.

Important focus points for the coming years

1. A more clear growth strategy and utilizing the full potential of the whole SINTEF group should be explored.
2. Measures need to be taken to ensure that investments in new labs and test facilities, as well as in maintaining the existing ones, can continue. MARINTEK has here a potential to develop even further on the international scene and meet existing as well as future customer demands. The efforts to realize the future Ocean Space Center should continue.
3. An IPR policy coherent with the overall SINTEF IPR policy should be developed.
4. A strategy for obtaining more public funded research projects should be developed which in turn will lead to stronger publication in international journals and also the possibility of obtaining more international clients. In this respect a closer interaction with NTNU could help.

3.4.11 SINTEF Energy Research AS

SINTEF Energy Research – Overview/Key figures			
Established	**1998**	**Research areas/**	Energy systems
Ownership	SINTEF Foundation (61 %) Energy Norway (33.4%) The Federation of Norwegian Industry (5.6%)	**Departments**	Electric power technology Gas Technology and Thermal Energy
		Centres	Hosts 3 FMEs (BIGCCS, CEDREN, NOWITECH), and coordinates 1 (CenBio).

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	400.9	399.0	399.3
Core funding %	4.7	5.0	5.6
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	35.5	32.6	36.1
Other Norw. contrib. income %	9.9	16.9	30.1
Norwegian comm. research:			
Trade and industry %	32.1	29.6	17.7
Public administration %	5.5	4.0	1.1
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	6.6	4.0	2.6
Other int. sources %	8.3	7.6	11.5
Other operating revenues %	0.4	0.3	0.0
Operating profit MNOK	**22.0**	**24.4**	**17.2**
Equity MNOK	**359.0**	**385.2**	**406.1**

Personnel			
Total full-time equivalents(FTEs)	209	212	225
Researcher FTEs	166	167	176
of this women	36	35	36
Per cent researcher FTEs	79	79	78
PhDs per researcher FTE[3]	0.53	0.58	0.59
Resignations per researcher FTE	0.07	0.10	0.09

Specific concerns/other information:
Elektrisitetsforsyningens Forskningsinstitutt (EFI established 1952 by NTNF and part of SINTEF since 1986) and SINTEF Energi merged in 1998.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0.9	2.2	1.5
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.89	0.89	0.86
Reports to commissioners (#)	76	49	46
Researcher education			
Number of dr. candidates/students	106	74	68
Number of awarded dr. degrees	6	7	14
of this women	0	2	4

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	92
Field normalised	93

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	50%
International	47%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	42%
with other TI institutes	23%
with international partners	29%
	FP7
# Norwegian industry partners in EU projects [2]	11
# Norwegian public adm. partners in EU projects	3

[1] As explained in Aksnes 2015/the separate report on the publication analysis.

[2] SINTEF Energy Research participated in 30 FP7 projects, and had at least one Norwegian partner in 17 of them (source, RCN/Fact report).

[3] Number of employees with a PhD divided by researcher FTEs.

[4] Includes only projects coordinated by SINTEF Energy ('prosjektansvarlig'). Data may be incomplete at some projects coordinated by SINTEF Energy may be registered under SINTEF in the RCN database.

Major strengths

SINTEF Energy's interaction with the SINTEF Group seems to be working well. They have a clear vision and a focus on very relevant areas for the Norwegian society but at the same time being topics that are globally relevant. The latter is manifested also by the fact that they have a strong position internationally not at least in the EU framework programs and a strong international publishing track-record. They also have a good and fruitful cooperation with NTNU and they operate a number of experimental laboratories together. In addition to their experimental facilities they have a strong software development of relevance for their customers. Their reputation among Norwegian industry seems to be good and they have all the major large industries as their customers.

Major weaknesses

While SINTEF Energy has a clear focus on very relevant issues there has been a lack of growth during the last years in spite of the importance of the energy field. They argue that the slow growth reflects e.g. consumers' willingness to invest in research and that there is an adverse market situation at present. These arguments while perhaps are true in Norway (due to the oil price situation) are not necessary true internationally. Also the IPR situation is unclear. They focus on their commercialization activities through established industry and claim that there is not much room for them to initiate start-ups.

Important focus points for the coming years

1. A more clear growth strategy with a clear customer focus and utilizing the full potential of the whole SINTEF group should be explored.
2. The ongoing focusing activities should be continued but also taking into account areas of cooperation and competition with other institutes.
3. An IP policy coherent with the overall SINTEF IP policy should be developed.
4. There should be continued focus on international activities and visibility, where the potential is very good.

3.4.12 SINTEF Petroleum Research AS

SINTEF Petroleum Research – Overview/Key figures

Established	**1975**	**Research areas/ Departments**	Drilling and Well Multiphase Flow Formation Physics Exploration and Reservoir Technology
Ownership	SINTEF Foundation (100 %)	**Centres**	

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	199.0	171.6	187.8
Core funding %	6.9	7.8	7.3
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	10.5	16.3	25.0
Other Norw. contrib. income %	0.0	0.0	0.0
Norwegian comm. research:			
Trade and industry %	65.9	50.3	43.6
Public administration %	0.0	3.3	5.8
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	0.0	1.2	0.0
Other int. sources %	11.8	21.0	14.7
Other operating revenues %	0.0	0.0	3.6
Operating profit MNOK	**0.1**	**-15.3**	**23.1**
Equity MNOK	**237.4**	**228.9**	**256.4**

Personnel			
Total full-time equivalents(FTEs)	102	92	86
Researcher FTEs	92	82	77
of this women	17	16	15
Per cent researcher FTEs	90	89	90
PhDs per researcher FTE[3]	0.63	0.65	0.69
Resignations per researcher FTE	0.08	0.27	0.13

Specific concerns/other information:
Until 1999: Institutt for kontinentalsokkelundersøkelser (IKU). Originating from 'Norges Teknisk-Naturvitenskaplige Forskningsråds kontinentalsokkelkontor' (established 1969).

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	13	6	2
Revenues from licencing (MNOK)	1.0	1.5	1.5
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.13	0.40	0.44
Reports to commissioners (#)	34	25	40
Researcher education			
Number of dr. candidates/students	6	8	4
Number of awarded dr. degrees	0	2	2
of this women	0	1	1

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	78
Field normalised	103

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	67%
International	30%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	47%
with other TI institutes	7%
with international partners	47%
	FP7
# Norwegian industry partners in EU projects [2]	6

[1] As explained in Aksnes 2015/the separate report on the publication analysis.

[2] SINTEF Petroleum Research participated in 5 FP7 projects, and had at least one Norwegian partner in 4 of them (source, RCN/Fact report).

[3] Number of employees with a PhD divided by researcher FTEs.

[4] Includes only projects coordinated by SINTEF Petroleum ('prosjektansvarlig'). Data may be incomplete at some projects coordinated by SINTEF Petroleum may be registered under SINTEF in the RCN database.

Major strengths

SINTEF Petroleum has clear focus on areas highly relevant to the Norwegian industry with an overall focus on upstream technology development. They work both with experimental studies utilizing their own laboratories as well as with modelling through software development. One of their laboratories (Multiphase flow laboratory) is operated together with IFE. They have a strong interaction with industry and seem to deliver on time with quality appreciated by the industry. They also have a strategy to develop spin out companies.

Major weaknesses

While SINTEF Petroleum has a clear focus on very relevant issues there has been a lack of growth during the last years and fluctuating financial performance (the results 2014 were however good) in spite of the importance of the field for Norway. While this can partly be explained as a result of the

market situation the issue needs to be addressed. It will become difficult over time to run large experimental facilities without a sound financial situation. The international research cooperation is weak partly due to the fact that there are very limited opportunities within the EU programs in this area. While there is a focus on spin out companies the IPR strategy is not clear. The publication track-record is rather weak. This is partly due to the low amount of public funded research projects. The interaction with NTNU could be improved.

Important focus points for the coming years

1. A more clear growth strategy with a clear customer focus and utilizing the full potential of the whole SINTEF group should be explored.
2. An IPR policy coherent with the overall SINTEF IPR policy should be developed.
3. A strategy for obtaining more public funded research projects should be developed which in turn will lead to stronger publication in international journals and also the possibility of obtaining more international clients. In this respect a closer interaction with NTNU could help.
4. There is a need to ensure that the overall interaction with other institutes in the field is conducted such that possible overlap is minimised and the synergies are developed. SINTEF Petroleum would benefit from a closer collaboration with other national actors, in particular due to the recent, significant changes within the oil and gas sector, which probably necessitates a consolidation of oil related research in Norway.

3.4.13 Telemark Technological Research and Development Centre (Tel-Tek)

Tel-Tek – Overview/Key figures			
Established	**1986**	**Research areas/**	Powder Science
Ownership	Independent foundation	**Departments**	Carbon capture and storage Energy Smart manufacturing
		Centres	

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	36.7	32.0	31.5
Core funding %	8.7	11.6	12.1
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	13.4	9.4	14.6
Other Norw. contrib. income %	0.0	15.3	28.9
Norwegian comm. research:			
Trade and industry %	61.9	56.6	34.6
Public administration %	8.4	0.0	0.0
Other comm. research %	0.0	0.0	0.0
International revenues:			
EU research funding %	0.0	0.0	9.8
Other int. sources %	0.0	0.0	0.0
Other operating revenues %	6.0	7.2	0.0
Operating profit MNOK	**-0.2**	**-0.6**	**1.6**
Equity MNOK	**1.3**	**0.2**	**3.1**

Personnel			
Total full-time equivalents(FTEs)	30	29	25
Researcher FTEs	27	26	22
of this women	8	10	8
Per cent researcher FTEs	88	88	88
PhDs per researcher FTE[3]	0.30	0.38	0.41
Resignations per researcher FTE	0.35	0.08	0.09

Specific concerns/other information:
Currently considering closer cooperation/merger with Telemark University College.
http://www.hioa.no/Om-HiOA/Senter-for-velferds-og-arbeidslivsforskning/AFI/Publikasjoner-AFI/Hoegskolen-i-Telemark-og-TEL-TEK

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.37	0.55	0.72
Reports to commissioners (#)	7	17	16
Researcher education			
Number of dr. candidates/students	6	6	2
Number of awarded dr. degrees	1	0	1
of this women	1	0	1

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	99
Field normalised	71

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	92%
International	12%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	14%
with other TI institutes	0%
with international partners	14%
	FP7
# Norwegian industry partners in EU projects [2]	0

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] Tel-TEK participated in no FP7 projects (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Includes only projects coordinated by Tel-Tek ('prosjektansvarlig'). For Tel-Tek most of these projects are institutional support (57 per cent) or PES (29 per cent).

Major strengths

Tel-Tek was established as a regional institute in 1986 to provide a link between Telemark University College and the industry in the region. Tel-Tek is a truly applied oriented institute in the areas of powder handling processes, industrial CCS, new capture methods, transportation. The institute has a large part of its revenues from the industrial sector and good connections with e.g. Elkem and Norcem. Tel-Tek has many staff members with an industrial background, and a flexible staffing model, with several part timers and students from Telemark University College. While SINTEF and NTNU are strong on making particles/powders, Tel-Tek has the knowledge with respect to handling. In sum, this is a strong position for joint R&D applications and an approach that fits well with H2020.

It is positive to note that Tel-Tek has recognized its challenges concerning size and sustainability and has taken first steps with respect to discussing potential mergers with logical parties.

Major weaknesses

Tel-Tek is very small, with weak finances, and does not have sufficient financial back-bone for major investments and new developments, including with respect to positioning in Brussels and participating in EU projects. Tel-Tek had a growth strategy, but it has not succeeded so far: A large part of base funding has been spent on writing applications for research projects resulting in limited success, and no resources have been allocated for new investments/infrastructures.

Important focus points for the coming years

1. The main challenge is to identify and execute a strategy to
   - improve the financial situation
   - grow/merge attract financial investor(s)
   - commercialize results and products.
   - implement new technical topics, e.g. 3D printing.
2. 3D printing is a good example of an area with a tremendous international activity, and Tel-Tek needs to develop a strategy for how to compete and collaborate in that space.
3. In parallel Tel-Tek needs to extend its project cooperation with other institutes.
4. Tel-Tek is encouraged to take a more pro-active position with respect to discussing potential mergers beyond local university colleges, i.e. including other research institutes. The merger negotiations need to address the risk of diluting Tel-Tek's knowledge base.

3.4.14 Uni Research AS

Uni Research (TI part) – Overview/Key figures

Established	**2003**	**Research areas/ Departments**	**CIPR:** Enhanced oil recovery; Geosciences; Microbiology; Reservoir Simulation
Ownership	UiB (85%) Foundation for University Research in Bergen (15%)		**Computing:** Big data and ICT; Environmental Flow; Language and Information
		Centres	(CIPR was a SFF hosted by UiB 2003-12)

Economy	**2012**	**2013**	**2014**
Operating revenues MNOK	99.8	89.4	86.5
Core funding %	0.0	0.0	0.0
Management tasks %	0.0	0.0	0.0
RCN (contribution income) %	51.6	39.5	32.3
Other Norw. contrib. income %	8.0	2.4	2.7
Norwegian comm. research:			
Trade and industry %	16.6	30.0	36.7
Public administration %	12.9	19.1	16.7
Other comm. research %	13.1	0.0	0.0
International revenues:			
EU research funding %	0.4	0.5	0.2
Other int. sources %	8.1	8.2	11.1
Other operating revenues %	0.0	0.2	0.6
Operating profit MNOK	**1.6**	**2.5**	**4.6**
Equity MNOK	**NA**	**NA**	**NA**

Personnel			
Total full-time equivalents(FTEs)	92	87	77
Researcher FTEs	76	70	60
of this women	18	18	15
Per cent researcher FTEs	83	80	78
PhDs per researcher FTE[3]	0.66	0.58	0.62
Resignations per researcher FTE	0.21	0.20	0.05

Specific concerns/other information:
Uni Research has 6 departments (of which only Uni Computing and Uni CIPR are included in this evaluation and in the key figures): Uni Computing; Uni CIPR; Uni Climate; Uni Environment; Uni Health; Uni Rokkan Centre.
Mergers in the Bergen region are presently considered.

Outcome	**2012**	**2013**	**2014**
Innovation results			
Number of patent applications	0	0	0
Revenues from licencing (MNOK)	0	0	0
Number of new spin-off companies	0	0	0
Publication / reporting			
Publ. points per researchers FTE	0.73	0.91	0.87
Reports to commissioners (#)	0	12	16
Researcher education			
Number of dr. candidates/students	23	18	13
Number of awarded dr. degrees	5	4	7
of this women	1	2	1

Citation indicators	
NCR publications. % of world average[1]	**2009-12**
Journal normalised	116
Field normalised	166

Collaboration (% of publications/projects with collaboration)	
Co-authorship	**2011-13**
Norwegian public research organisations	79%
International	31%
Collaboration in RCN projects[4]	**2009-13**
with Norwegian industry	-
with other TI institutes	-
with international partners	-
	FP7
# Norwegian industry partners in EU projects [2]	2

[1] As explained in Aksnes 2015/the separate report on the publication analysis.
[2] Uni Research participated in 24 FP7 projects, and had at least one Norwegian partner in 11 of them (source, RCN/Fact report).
[3] Number of employees with a PhD divided by researcher FTEs.
[4] Missing data as Uni Research was not defined a TI institute in the period.

Major strengths

Uni Research Centre for Integrated Petroleum Research (CIPR) and Uni Research Computing are two departments in the company Uni Research Ltd, which started up as the outlet for applied scientific research of the University of Bergen (UiB) founded in 2003.

Uni Research CIPR has a recognized position in the niche areas ‘increased oil exploitation’ and ‘secure CO_2 storage’. The customer base, with major oil and gas industries present, is well developed. About 60% of the department revenue is industry-funded, which is high compared to Uni Research Ltd (about 16% revenue from the private sector). Both Uni Research CIPR and Uni Research Computing have good cooperation with the main owner, University of Bergen.

Major weaknesses

The six departments in Uni Research have different profiles and goals so possibilities for synergy through inter-departmental cooperation are limited. Uni Research was founded as an instrument to do commissioned research in close alignment with the university, but changing the academic profile of the organization has been difficult. A clear strategy for developing Uni Research into an internationally acknowledged, applied scientific research institute, governed/supported by the owner University of Bergen, is missing.

Except for Uni Research CIPR, industry involvement in Uni Research projects is still low. Furthermore, competences to valorise and commercialise research activities are poorly developed at Uni Research. Uni Research should improve its research institute profile by implementing UR-internal measures, not by creating new structures outside Uni Research which will need a lot of management attention and will not add to strengthening the research instituteprofile of UR itself.

The international profile of Uni Research is weak. About 11% of the revenues is the result of projects with partners from abroad. Uni Research has the ambition to increase international visibility by increasing the participation in EU H2020 projects of all departments. This strategy may add some value to the academic profile of the organization abroad, but will not improve the applied scientific research profile of the company. In summary, Uni Research is not fulfilling its mandate.

Important focus points for the coming years

1. The profile of Uni Research Ltd. should be changed through merging with a partner institute (or institutes) meeting the following criteria:
    - a strong applied scientific research track record and culture
    - a high percentage of revenue from the private sector, including the oil and gas industry
    - a competence base with complementarity and good possibilities for synergy
    - an international acknowledged position
2. High priority should be given to building up a strong national, industrial network in all research areas. This private sector network should be used to develop an international profile, through participation in EU H2020 projects and commissioned research.
3. A strategy and implementation plan for valorisation and commercialisation of Uni Research activities is needed.

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Appendix 1 Terms of Reference

Evaluation of the technical-industrial institutes:

Mandate and terms of reference

The Research Council of Norway has a strategic responsibility for the research institute sector in Norway, and is charged with organising the evaluation of Norwegian research activities.[1] On this ground The Research Council has decided to evaluate Norwegian research institutes in the technical-industrial arena. The evaluation will be conducted by a panel appointed by the Research Board of the Division for Science.

Background

The Research Council grants basic funding to approximately 50 research institutes.[2] The most recent government white paper on research mandates the Research Council to conduct evaluations of research institutes for the purpose of policy making and design of funding instruments.[3]

Norwegian research institutes are suppliers of high-quality research for trade, industry, the public administration and society at large. It is the Research Council's responsibility to help the research institutes to strengthen and further develop their special role within the Norwegian research and innovation system.

Three objectives of the evaluation

The Research Council's five-year plan for evaluation of research institutes gives three overarching objectives for the evaluations.[4]

Firstly, the evaluation shall be useful for the *institutes' own strategic development efforts*. This evaluation will therefore focus on areas in which the technical-industrial institutes can improve and further develop.

Secondly, the evaluation shall *strengthen the knowledge base* for the Research Council and the ministries in developing an effective, targeted research institute policy. It is also to provide an assessment of how the institutes are fulfilling their responsibility to society. In particular, this evaluation shall provide up-to-date knowledge on the basic conditions of the research institutes, and how the institutes have adapted to these. It is a goal to identify areas of improvement both for the system as a whole and for the individual institutes.

Thirdly, the evaluation is to provide a basis for *assessing the funding instruments of the Research Council*. This includes evaluating how well suited these instruments are from a policy perspective and if further development of these is needed.

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1 Statutes of the Research Council of Norway

2 Norwegian guidelines for public basic funding of research institutes laid down by Royal Decree of 19 December 2008, amended guidelines approved on 1 July 2013.

3 Meld. St. 18 (2012–2013) Long-term perspectives – knowledge provides opportunity, white paper from the Ministry of Education and Research.

4 *Overordnet plan for instituttevalueringer*, approved by the Research Board of the Division for Science on 5 September 2013 (in Norwegian).

Delimitation

There are thirteen research institutes in the technical-industrial arena that receive public basic funding via the Research Council.[5] These institutes operate in a wide range of research fields, including ICT, energy, petroleum, industrial processes, marine resources, geoscience and technology.

The 13 institutes are:

- Christian Michelsen Research AS (CMR)
- Institute for Energy Technology (IFE), independent research foundation
- International Research Institute of Stavanger AS (IRIS)
- Norwegian Marine Technology Research Institute AS (MARINTEK)
- Norwegian Geotechnical Institute (NGI), independent research foundation
- NORSAR, independent research foundation
- Northern Research Institute AS (Norut) – Norut Tromsø
- Northern Research Institute AS (Norut) – Norut Narvik
- Norwegian Computing Center (NR), independent research foundation
- SINTEF Energy Research AS
- SINTEF Petroleum Research AS
- SINTEF Foundation
- Tel-Tek, national research institute

Six additional technical-industrial institutes have asked the Research Council to assess whether they satisfy the requirements for inclusion in the basic funding scheme. The Executive Board of the Research Council has concluded that of the six, only Uni Research AS satisfy the requirements. Uni Research AS[6] will therefore be included in the evaluation.

Henceforth, the term 'technical-industrial institutes' will be used to refer to the above mentioned institutes.

Three of the limited companies listed above (MARINTEK, SINTEF Energy Research and SINTEF Petroleum Research) have the SINTEF Foundation as their owner or majority shareholder.

The technical-industrial institutes vary in size. The largest is the SINTEF Foundation, with operating revenues of NOK 1 808 million and 781 scientific full-time equivalents in 2013, while the smallest institute under the basic funding scheme is Norut Narvik, with NOK 27.9 million in operating revenues and 23.7 scientific full-time equivalents in 2013. A decision has been taken to break down the two largest institutes, the SINTEF Foundation and IFE, into four units and two units, respectively:

- SINTEF Building and Infrastructure
- SINTEF ICT
- SINTEF Materials and Chemistry
- SINTEF Technology and Society
- IFE nuclear research activities
- IFE other research activities

[5] Norwegian guidelines for public basic funding of research institutes laid down by Royal Decree of 19 December 2008, amended guidelines approved on 1 July 2013.

[6] Departments Uni CIPR and Uni Computing

Thus, this evaluation encompasses a total of 18 entities. It is, however, essential that the evaluation panel incorporates into its deliberations the fact that there are a few large-scale actors in the arena as well as the dominant role played by the SINTEF Group. For the two institutes divided into smaller units, the strengths and weaknesses inherent in a large organisation must also be assessed.

The perspectives of the evaluation

The evaluation shall focus on conditions under which the research institutes both together and individually manage their role in a national and international context. This will require an overall assessment of the technical-industrial arena, as well as an assessment of the individual entities encompassed by the evaluation.

According to the political direction indicated in the three most recent government white papers on research, the research institutes are to[7]:

- supply relevant expertise and research services of high international quality to trade, industry, the public administration, and society at large;
- develop knowledge in national priority areas, sharing tasks with universities and university colleges;
- carry out public administration-oriented tasks and provide specialised services for the government authorities;
- promote innovation and value creation in the private and public sectors.

The evaluation panel shall include the following perspectives into its evaluation efforts:

1. The distinctive features and basic conditions of the institutes;
2. The fact that research itself and the research system are changing;
3. The various forms of interaction between the actors in the research system;
4. Future challenges and opportunities.

The *distinctive features and basic conditions of the institutes* will form a point of departure for the evaluation. The research institutes have been established to carry out applied research and produce knowledge for use within society at large, the public administration and trade and industry. The technical-industrial institutes are by and large market-oriented and obtain most of their revenues from the national and international markets for commissioned research, or from the Research Council and the EU research programmes. A challenge the institutes are facing is how to balance both building up and applying their competency, as well as balancing the applied and the academic aspects of their activities.

The evaluation must take into account *the fact that research itself and the research system are changing*. Research topics, resources and results are becoming increasingly international and global in scope. Dealing with the great societal challenges will require a greater degree of interdisciplinarity in research and more research that incorporates perspectives from several societal and policy areas. Public investment in R&D is growing, and clearer requirements relating to quantifiable results and impacts of research activity are emerging. A greater share of national public funding is being allocated to multilateral cooperation. For the institutes, this means tougher competition for research funding and thus more stringent requirements regarding quality and international cooperation. The evaluation is also to shed light on how shifts in the higher education sector, the research institute sector and the research community's work methods and

[7] Report No. 20 (2004–2005) to the Storting, Commitment to Research; Report No. 30 (2008–2009), Climate for Research; Meld. St. 18 (2012–2013) Long-term perspectives – knowledge provides opportunity, white paper from the Ministry of Education and Research.

forms of cooperation, nationally and internationally, are leading to changes in established roles and work methods.

The *forms of interaction* between the institutes within the technical-industrial arena, with other national and international R&D actors, and with R&D users (trade and industry, the public administration, the higher education sector, etc.) shall comprise a key perspective of the evaluation. The evaluation is to assess the capacity of the institutes to form networks and participate in international collaborative efforts to solve knowledge challenges. The evaluation is also to assess how the institutes compete in the market for commissioned research and how cooperation and task-sharing are carried out among the technical-industrial institutes and between the institutes and other research environments. The evaluation shall also address cooperation and task distribution between the institutes and government bodies and agencies as well as competition between the institutes and the consultancy sector.

Finally, the evaluation shall focus on *future challenges and opportunities*. The evaluation shall address how the technical-industrial institute arena will appear in five to ten years, with regard to expertise, capacity, national and international cooperation, and the number of institutes. It shall also address which challenges the institutes will have to face and which strategies and opportunities they have to address these challenges.

Key questions

The evaluation panel is to:

1. **Assess how the technical-industrial institutes fulfil their national responsibility of supplying applied research as commissioned by trade and industry and the public administration (role as research contractor).**
   Relevant questions and issues may include:
   - Do the technical-industrial institutes have a scientific profile, orientation and size/organisation that enables them to supply their users and customers with the services they seek?
   - Do the institutes promote innovation in the private and public sectors through the development of new products and services or improved processes? What role do the institutes play in the establishment of new companies?
   - To what extent and under which terms do the technical-industrial institutes work to orient themselves towards new markets and areas of application?
   - How do the institutes combine and balance the need to earn revenues from commissioned research with requirements for scientific quality in the form of publications? Does scientific production as demonstrated by scientific publications enhance the competitiveness of the institutes?

2. **Assess how the technical-industrial institutes maintain and fulfil their role in the Norwegian research system.**
   This involves examining how cooperation, task distribution and competition function between the technical-industrial institutes, between the institutes and universities and university colleges (higher education sector), and between the institutes and other research environments.
   Relevant questions and issues may include:
   - Do the technical-industrial institutes exhibit adequate scientific quality, as documented by publication and success in competition for research funding, etc.?
   - Is the structure of the technical-industrial institute arena (number of institutes, size, scientific profile, regional affiliation, etc.) appropriate for satisfying the need for

interdisciplinarity, cooperation, task distribution and competitiveness? If not, what are the weaknesses?
- Are there any challenges or problems associated with the boundaries and role distribution between the technical-industrial institutes and institutions in the higher education sector?
- Are the expertise and resources of the technical-industrial institutes adequately utilised in doctoral education? If not, what are the reasons for this?
- How do the institutes promote competence development and value creation within their respective subject fields through recruitment, professional development of their own staff and competence-building among users and partners, among others?

3. **Assess the international collaborative activities of the technical-industrial institutes.**
   Relevant questions and issues may include:
   - To what extent do the technical-industrial institutes mobilize Norwegian trade and industry and the public administration into international research cooperation?
   - Is the current level of participation in international research programmes, including EU Framework Programmes and Horizon 2020, satisfactory? What stimulates and what limits the institutes' participation in EU research programmes?
   - What are the benefits of international research cooperation for the institutes?
   - What strategies do the institutes employ for establishing international cooperation? How and to what extent do the institutes also compete in the international market for commissioned research? To what extent do they succeed, both in terms of research and financially?
   - In what ways do the Norwegian institutes take part in international cooperation on new and existing infrastructure?

4. **Assess the financial situation, infrastructure and basic conditions for the technical-industrial institutes.**
   Relevant questions and issues may include:
   - Does the public basic funding scheme (design, distribution criteria, size, etc.) provide incentives and room for strategic development?
   - Does the design of the Research Council funding instruments (programmes, centre schemes, etc.) help to strengthen strategic, long-term knowledge development?
   - How vulnerable are the institutes to changes in the market situation? Are there any major actors in the market that can significantly affect the technical-industrial institutes' situation by altering their profile or strategy?
   - To what extent and in what ways do the technical-industrial institutes compete with consultancy firms in the same markets?
   - How do the institutes utilise large-scale infrastructure individually and in cooperation, and how does this affect the activities of the individual institutes and the sector as a whole? Is there a need for new infrastructure in the future?

The evaluation panel may address questions other than those listed when these are of relevance in relation to the evaluation objectives and perspectives specified above.

Final report and follow-up

The evaluation panel shall prepare a report documenting the findings of the evaluation in collaboration with the panel secretary. The reports shall give advice and recommendations both to the Research Council, the government authorities, and the institutes themselves. The report shall contain an overall assessment of the arena in light of the key questions listed above, as well as a description of each entity/institute with an assessment of its strengths, weaknesses and potential

for development. If warranted, the Research Council will consider whether the conclusion of the evaluation effort and presentation of the report will take place in the form of a launch seminar and/or press conference.

Organisation and implementation of the evaluation

Evaluation panel

The evaluation will be conducted by an international panel of experts appointed by the Research Board of the Division for Science. The panel will be comprised of five to seven members, including the chair. The panel will include individuals with expertise and experience in technical-industrial research, as well as commissioners and users of such research. The panel must have thorough knowledge of the research institute sector in Norway and R&D institutions in other countries that are comparable to the Norwegian research institute sector. The evaluation panel will also include members with expertise in evaluation activities.

None of the panel members are to have interests in or ties to the institutes to be evaluated.

Secretariat

The Research Council will hire an external secretary to assist the panel in its efforts, including the preparation of the evaluation report. The Research Council administration will provide other administrative support to the panel, organise meetings and travel, and be responsible for the printing and publication of the evaluation report.

Referencegroup

To ensure that the evaluation adequately reflects the research institute sector and that the evaluation results are actively applied in the development of research institute policy, a reference group will be appointed comprising representatives of e.g. relevant ministries (the Ministry of Trade, Industry and Fisheries, the Ministry of Education and Research, the Ministry of Petroleum and Energy), the Association of Norwegian Research Institutes (FFA), Abelia, Innovation Norway and the Research Council.

Timetable

The evaluation panel will start its work at the beginning of 2015 and deliver its report to the Research Council at the end of 2015. The panel is requested to draw up a detailed timetable for its activities early on in the evaluation process.

Working language

The evaluation report is to be written in English. All of the working documents, including the internal evaluation and user survey, to be employed by the panel must be written in English.

Supporting documentation and material for the evaluation

1. **Internal evaluation**

The Research Council administration will design an internal evaluation form to be sent to all the entities encompassed by the evaluation. The internal evaluation will include a description of each institute's distinctive features, scientific fields and research profile as well as questions relating to items 1–4 above under *Key questions*. The institutes divided into smaller units (SINTEF and IFE)

will each receive a special form to briefly address questions relating to the institute as a whole. The internal evaluations must be carried out within a timeframe that ensures that the results are available prior to the first meeting of the evaluation panel.

2. Factual report on the technical-industrial institutes

The Research Council administration will prepare a report with factual information on the institutes, based on key figures provided by the institutes and information from the Research Council's own sources. The report is to be completed prior to the first meeting of the evaluation panel.

3. Discussions

The evaluation panel will have talks with all of the institutes/entities. These will be carried out over the course of three to four days, and up to two hours will be set aside for each entity. Effectuating this will require appropriate task division among the panel members.

4. User survey

A user survey will be conducted. Relevant users comprise partners in Research Council-funded projects and research commissioners and partners in trade and industry and the public administration, nationally and internationally. This survey will be commissioned by the Research Council, but conducted by an external, professional provider. The survey will primarily be qualitative in nature and will focus on the quality and relevance of the services provided by the institute, user satisfaction, benefit to users, and cooperation between users and the institute, among other things. The user survey will culminate in a report to be submitted to the evaluation panel at an early stage of their efforts.

5. Bibliometric analysis

An analysis of bibliometric indicators at the institute level will be conducted. This will provide a picture of the scientific production in the sector based on publications through recognised publication channels (i.e. that give publications points in the basic funding scheme) over the past three to five years. It will also include a citation analysis. The analysis will be commissioned by the Research Council, but conducted by an external, professional provider. It will be submitted to the evaluation panel at an early stage of their efforts.

6. **Impact analysis**

An impact analysis of the technical-industrial institute arena will be conducted. This is intended to shed light on the arena's direct and indirect contribution to value creation in society in the form of economic value, development of competency, application of technology, employment, etc. The analysis will be commissioned by the Research Council, but conducted by an external, professional provider. It will be submitted to the evaluation panel at an early stage of their efforts.

7. **Other relevant documents**

Norwegian guidelines for public basic funding of research institutes.

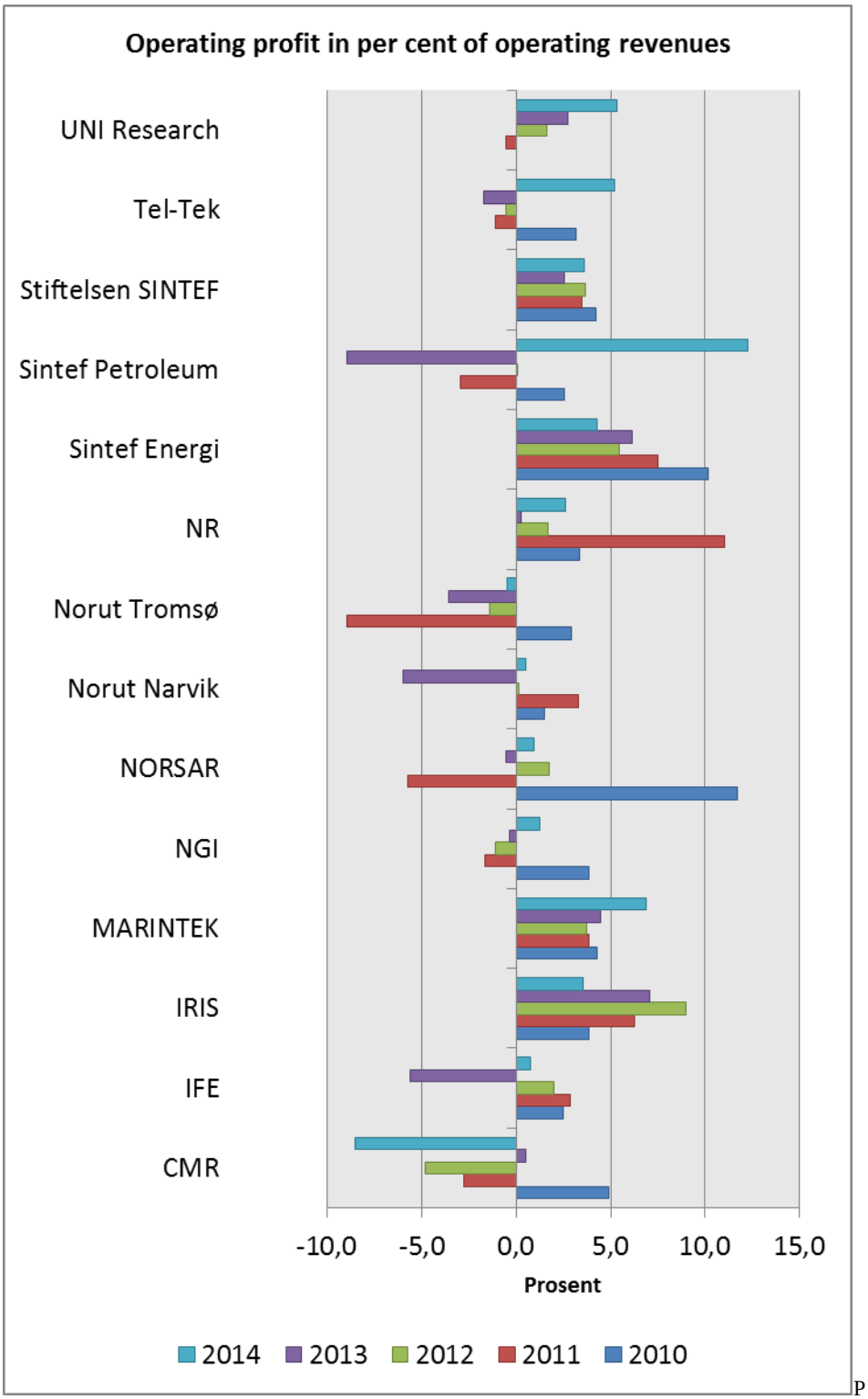
Appendix 2 Meetings with the institutes

Location: Radisson Blu Airport Hotel, Gardermoen

15 June 2015	**Institute**	**Participants from the institutes**
8h30-9h45	SINTEF Group	Unni Steinsmo, President, CEO Oddvar Eide, President MARINTEK Lars Sørum, President SINTEF Petroleum Inge R. Gran, President SINTEF Energy
10h00-12h00	SINTEF Energy Research AS SINTEF Petroleum Research AS	Inge R. Gran, President Mona J. Mølnvik, Research Director Lars Sørum, President Maria Barrio, Senior Business Developer
13h00-14h00	MARINTEK AS	Oddvar Eide, President Birger Åldstedt, Finance Director Atle Minsaas, Vice President Strategic R&D
14h15-15h45	SINTEF Building and Infrastructure SINTEF Technology and Society	Hanne Rønneberg, Executive Vice President Terje Jakobsen, Research Director Per J. Lillestøl, Executive Vice President Thomas Langø, Research Director
16h00-17h30	SINTEF Materials and Chemistry SINTEF ICT	Duncan Akporiaye, Executive Vice President Rudie Spooren, Research Director Aage J. Thunem, Executive Vice President Bjørn Skjellaug, Research Director
16 June 2015		
9h30-11h30	IFE overall and IFE Nuclear	Eva Dugstad, President Atle Valseth, Research director nuclear Margaret McGrath, Project Manager Halden Reactor Project Bjørn Hauback, Head of Physics Department
12h30-14h15	IFE Other activities	Tore Gimse, Research Director petroleum Arve Holt, Research Director energy and environmental technology Jon Kvalem, Research director MTO
14h45-16h45	IRIS	Ole Ringdal, President Kristin M. Flornes, Senior Vice President, Energy Oddvar Skjæveland, Senior Vice President, Ullrigg Drilling and Well Centre Torkell Gjerstad, General Manager IRIS Forskningsinvest AS
24 Aug 2015		
9h00-10h00	CMR	Arvid Nøttvedt, President and CEO Christopher Giertsen, Vice President, Business Development Kari Marvik, Vice President, CMR Science & Technology (tbc)
10h30-11h30	Tel-Tek	Marit Larsen, Managing Director Hans Aksel Haugen, Department Leader
12h30-13h30	Norut Tromsø	Ivan C. Burkow, CEO Kjell Arild Høgda, Research Director, Earth Observation Group Lars Kristian Vognild, Research Director, ICT and Digital Media
14h00-15h00	Norut Narvik	Terje Nordvåg, Managing Director Bård Arntsen, Research Director, Material Technology
15h30-16h30	Norsar	Anne S. Lycke, Managing Director Arve E. Mjelva, Senior Vice President
25 Aug 2015		
9h00-10h00	NGI	Lars Andresen, Managing Director Mimoun Bouhmidi, Head of Finances Anders Solheim, Research Director, Natural Hazards
10h30-11h30	Uni Research	Aina M. Berg, Managing Director Arne Skauge, Research Director, CIPR Klaus Johannsen, Research Director, Uni Research Computing
12h30-13h30	NR	Lars Holden, Managing Director André Teigland, Deputy Director Åsmund Skomedal, Research Director, DART

Appendix 3 Tables and figures

Figure A 1 Operating profit as a share of operating revenue (per cent), 2010-2014



Source: Figure 4.3 in RCN Fact Report/NIFU, key R&D statistics for the institute sector.
Note: Only the technical industrial parts of the institutes are included in the figures (see note to Table 1.1).

Figure A 2 **The extent to which collaboration with the TI institute in R&D projects has contributed to intermediate impact for the organisation. Source: Åström et al. 2015, page 20 Figure 9.**

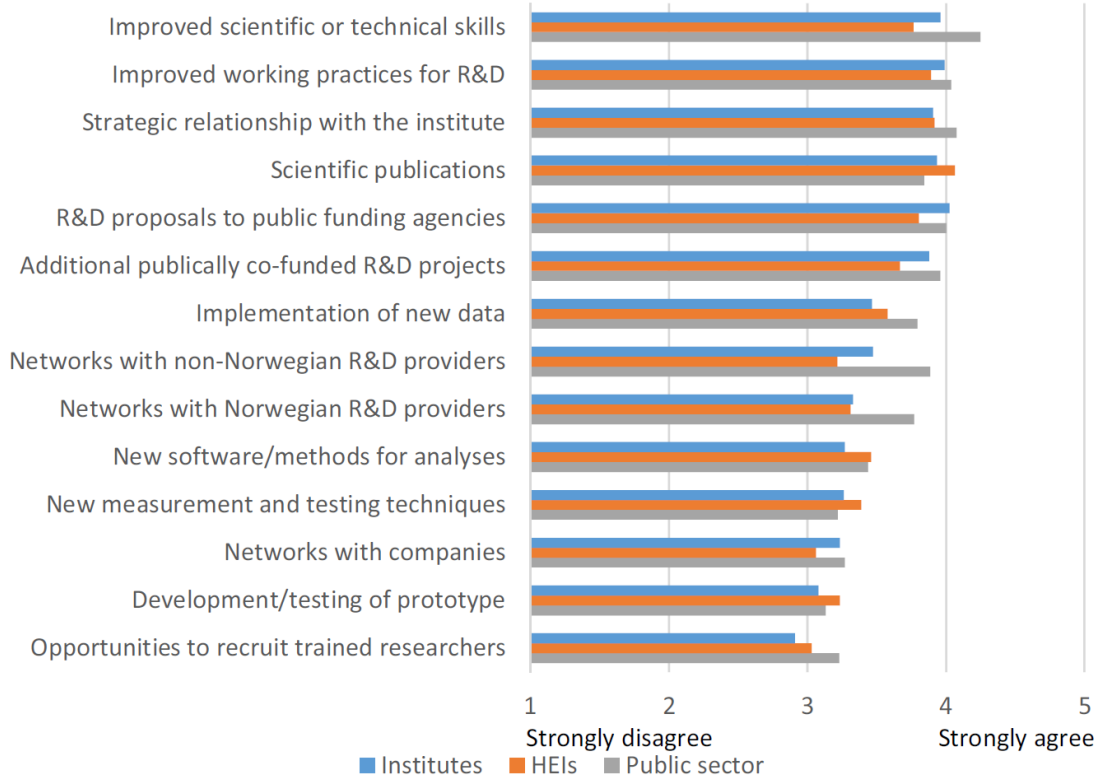


Table A 1 **The technical-industrial institutes in the National Financing Initiative for research infrastructure calls 2009 and 2010**

	Applications		Grants	
	# applications**	NOK	# grants	NOK
2009 TOTAL TI participations	**255**	**6 749 647 000**	**34**	**424 496 619**
TI as responsible applicant	58	1 317 458 000	7	52 009 177
	23 %	20 %	21 %	12 %
TI only as partner	*NA	*NA	9	142 945 334
			26 %	34 %
2010 TOTAL TI participations	**138**	**3 818 551 000**	**18**	**502 299 999**
TI as responsible applicant	21	828 267 000	4	108 199 999
	15 %	22 %	22 %	22 %
TI only as partner	*NA	*NA	2	73 000 000
			11 %	15 %

Source: The Research Council of Norway.
*Data not available. For the two first calls (2009, 2010) information about partners in the applications that did not go through to a grant has not been made available to the panel.
** In the 2009 call a high number of applications, mainly small ones, were submitted even if they did not qualify as having a character of a national research infrastructure. In the calls following after 2009 the applicants have been more aware of the conditions for funding, so the number of applications has been considerably lower. It is also worth mentioning that on the calls after 2009 several applications are repeated applications of previously rejected projects. This means that the number of unique infrastructures having applied for funding is considerably lower than 547.

Table A 2 The technical-industrial institutes in the National Financing Initiative for research infrastructure calls 2012 and 2014

	Applications		Grants*	
	# applications	NOK	# grants	NOK
2012 TOTAL TI participations	68	2 395 054 000	18	575 705 399
TI as responsible applicant	17	603 038 000	3	94 459 000
	25 %	25 %	17 %	16 %
TI only as partner	7	370 185 000	7	261 735 000
	10 %	15 %	39 %	45 %
2014 TOTAL TI participations	86	4 134 247 000	30	1 581 798 000
TI as responsible applicant	16	761 312 000	5	215 790 000
	19 %	18 %	17 %	16 %
TI only as partner	20	1 326 596 000	9	496 696 000
	23 %	32 %	30 %	31 %

Source: The Research Council of Norway.
* For the grants from the 2014 call, the exact amounts are not decided yet. The amounts in the table represent preliminary grants.

Table A 3 The National Financing Initiative for research infrastructure calls: Collaboration pattern in applications 2012-2014.

	N (number of applications)	Organisations collaborating in the application			
		Other TI	Other institute (not TI)	HE-institution	Industry or public sector
TI in lead	33	10	3	19	7
TI as partner (other in lead)	28	8	10	27	7

Source: The Research Council of Norway.

Table A 4 The National Financing Initiative for research infrastructure calls: Collaboration pattern in grants 2009-2014.

	N (number of grants)	Organisations collaborating in the grant			
		Other TI	Other institute (not TI)	HE-institution	Industry or public sector
TI in lead	19	5	2	12	1
TI as partner (other in lead)	27	8	6	27	9

Source: The Research Council of Norway.

Appendix 4 Template for the self-assessments

This self-assessment form is to be filled in by each of the 18 entities[9] that are included in the evaluation of the technical-industrial research institute sector facilitated by The Research Council of Norway. The leader of the institute is responsible for the assessments made, but it is assumed that information and assessments are collected from different departments/sections of the institute or entity. *The template below must be used.*

Please write shortly. The total number of pages should not exceed 15.

Supplementary information and data might be included as appendices. All fields in the template below can be expanded as needed.

<table>
<tr><td>1</td><td>Institute / entity name and name of the person in charge of the evaluation</td></tr>
<tr><td></td><td>Name of institute / entity:
Contact person:
Tel.:
email address:</td></tr>
<tr><td>2</td><td>Research areas and scientific profile</td></tr>
<tr><td></td><td>a) Describe shortly the institute's /entity's research profile today. Give an overview over the number of scientific employees for each research area/department divided into the relevant job categories/titles (included part-time employees). Please also give the number of researchers with a doctoral degree within each category.
Please use the table template below adjusted with the correct categories and the relevant number of rows and columns:
<table>
<tr><th rowspan="2">Job title / position</th><th colspan="2">Area 1</th><th colspan="2">Area 2</th><th colspan="2">Area 3</th><th colspan="2">TOTAL</th></tr>
<tr><th># empl</th><th># PhD</th><th># empl</th><th># PhD</th><th># empl</th><th># PhD</th><th># empl</th><th># PhD</th></tr>
<tr><td>Title I</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Title II</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Title III</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>TOTAL</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td></td><td>b) Has the scientific profile changed significantly over the last 10 years? In case so, describe shortly the changes the institute/entity has been through.</td></tr>
<tr><td></td><td>c) In what areas or disciplines do you consider the institute/entity to be especially strong related to
- Scientific quality
- User relevance</td></tr>
</table>

[9] This means that each institute must fill in one form, except SINTEF Foundation (4 entities: Building and Infrastructure, ICT, Materials and Chemistry, Technology and Society) and IFE (2 entities: nuclear research activities, other research activities)

	Specify if you regard the institute/entity to be leading nationally or internationally in some of these areas or disciplines.
	d) Has any of the institute's/entity's research areas been subject to assessment in any of The Research Councils subject-specific evaluations in recent years? If so, please state which evaluations and describe shortly the conclusions made in these evaluations regarding the institute/entity . How do these conclusions correspond to your opinion of the research performed at the institute/entity in the relevant field today?
3	**Impact, innovation, market strategy and company establishments**
	a) Do you consider that the research performed at the institute/entity promote innovation in public or private sector? Give examples of new products and/or processes developed at the institute/entity over the last 5-10 years that is now in use in society.
	b) Have any new companies been established during the last 5-10 years as a direct result of the research performed at the institute/entity? Give the names of these companies, and for each company, give a short description of the activity in the company today and the formal relationship between the institute/entity and the company.
	c) What are the most important impacts for wider society from the research performed at the institute/entity?
4	**Users/costumers and market opportunities for commissioned research**
	a) Prepare on a separate sheet a list of the institute's/entity's most important users/costumers? State the full name of the company/institution, in which area it operates and information details to contact person. (**NB: To be used for the user survey**)
	b) What challenges do you face in meeting existing and potential users with respect to competence (on both sides), expectations about the outcome of the research project, time needed to perform the tasks and price for commission?
	c) Do you experience that the institute/entity compete with consultancy companies in the same market? In case so, what are the institute's/entity's strengths and weaknesses in this competition?
	d) How important do you consider scientific merits in terms of publications to be in

	order to succeed in the competition for commissioned research contracts?
	e) Has the institute/entity any experience in mobilizing users/costumers from industry or public administration into international research cooperation? In case so, describe this experience shortly.
	f) When the institute/entity wins or loses in competition, what are the most decisive factors today? Describe shortly if the institute/entity has experienced changes in the market in terms of what factors the commissioners of research emphasize most strongly.
5	**Research collaboration, task distribution and competition**
	a) Which are the institute's/entity's most important partners in research collaboration nationally and internationally? - State name and in which sector these partners operate. - Specify if this collaboration is within programmes financed by the Research Council, in commissioned research projects and/or internationally. - If the institute/entity operates in different research areas, state also in which area each partner operate.
	b) Who are the institute's/entity's most important competitors nationally and internationally? - State name and in which sector these competitors operate. - Specify if this competition is within programmes financed by the Research Council, in commissioned research projects and/or internationally. - If the institute/entity operates in different research areas, state also in which area each partner operate.
	c) How do you perceive the collaboration and/or competition between the institutes in the technical-industrial arena. How do you perceive the collaboration and/or competition between the institutes and the higher education sector (universities and university colleges)? If you have identified any challenges in this collaboration and competition, please describe them shortly.
	d) Is the institute/entity linked to other institutions in terms of formal collaboration agreements or similar? To what degree do the institute/entity consider these as important and essential alliances and business relations?
	e) Have you planned or considered to merge or develop a more formal relationship with any other institutions in the Norwegian research system? In case so, what are the Pros and Cons in this process, and what do you expect to be the outcome of these plans/considerations?

6	**Recruitment, competence development and doctoral education**
	a) Do you face challenges/difficulties in recruiting enough competent personnel to the scientific staff? If so, what do you consider to be the most important reasons for that?
	b) What is the institute's/entity's strategy for developing the competence among the scientific staff? How is the need for multidisciplinary competence accounted for?
	c) How do you assess the conditions for using the institute's/entity's competence in the doctoral education in terms of economical frames, recruitment and performance?
7	**International research activities**
	a) Describe to what extent the institute/entity participates in international research programmes like EU Framework programmes and Horizon 2020. Is the level of participation in such programmes satisfactory from your point of view? What stimulates and what limits such participation?
	b) Describe shortly your strategy for establishing international cooperation. What are the main benefits for the institute/entity of international research cooperation?
	c) Do the institute/entity take part in international cooperation on existing or new research infrastructure, including research infrastructures on the ESFRI roadmap?
	d) To what extent is the institute/entity engaged in the competition on the international markets for commissioned research? In case the engagement is low, what is the reason for that? In case the engagement is high, to what extent does the institute/entity succeed in these markets?
8	**Basic financial conditions, research funding, infrastructure**
	a) To what degree gives the public basic funding opportunities to strategic development and long-term build-up of competence?
	b) Describe to what extent you find that the funding instruments of the Research Council (programmes, centre schemes, etc.) contribute to strengthen the institute's/entity's strategic, long-term knowledge development. What strengths and weaknesses are there in these instruments today?
	c) Describe briefly to what extent the institute/entity uses research infrastructure in its activities. Do you use research infrastructure in cooperation with others? In case so, how does this cooperation work?
	d) Do you see any specific needs for new research infrastructure in the future?

9	**SWOT-analysis – Future perspectives**
	a) Based on the questions answered above and how you see the institute's/entity's over-all situation today, please give a short SWOT-analysis (Strengths – Weaknesses – Opportunities – Threats).
	b) What aims and strategies do the institute/entity have for the next 5-10 years in terms of: - Growth / consolidation - National collaboration - Internationalization - Other aspects
10	**Other information**
	Please give any information that you regard to be relevant for the evaluation and which is not covered by the issues above.

The Research Council of Norway
Drammensveien 288
P.O. Box 564
N-1327 Lysaker

Telephone: +47 22 03 70 00
Telefax: +47 22 03 70 01
post@rcn.no
www.rcn.no

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