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Science & Technology Indicators for Norway 2021

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Foreword

The Research Council of Norway is delighted to present a new English version of the Report on Science and Technology Indicators for Norway. This report, being abridged from the Norwegian version and adapted to an international audience, presents essential statistics and indicators depicting the development of the Norwegian research and innovation system, as well as international comparisons. Relevant and reliable statistics and indicators are crucial for understanding the present state for the research and innovation system, as well as for its further development.

At the time of writing, we are two years into the corona pandemic which has clearly shown the urgent need for high quality, relevant and available knowledge to deal with the challenges – both those that we know of, and the unforeseen ones. The research and innovation system has demonstrated its strengths by rapidly adapting to new challenges, needs for restructuring and cooperation with society at large. This way we have coped with the first phases of the pandemic. Coping with the next phases requires knowledge on how to share vaccines with the large populations in developing countries and, hopefully, for a post-pandemic society.

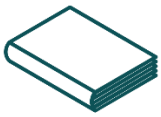
The corona pandemic is not the only crisis in our modern societies. The challenges related to climate chance and biodiversity are even greater and demand even bigger transformations. These are in addition well known and documented. The pandemic has demonstrated that dramatic measures can be implemented if the political willingness is there. Also for this challenge, available and relevant knowledge is essential for developing solutions.

The present state of affairs is what the Indicator report documents. It contains long and comparable time series data on R&D investments, innovation activities and results, broken down by industries, institutions, and priority areas. This information is essential for setting new priorities and contributing to solving the big challenges. The methodology is compatible with international standards, allowing for comparisons with other countries.

The report is produced as a collaboration between the Nordic Institute for Studies in Innovation, Research and Education (NIFU), Statistics Norway and the Research Council of Norway, with contributions also from other institutions. I wish to thank everybody involved for their effort!

Oslo, December 2021
Mari Sundli Tveit
CEO
Research Council of Norway

Findings and trends

	Nearly NOK 77 billion was spent on research and development (R&D) in Norway in 2019. This equals a real growth of just over 2 per cent from 2018, the same as from 2017. The industrial sector's share increased the most (5 per cent), followed by the higher education sector (1 per cent), while the institute sector had a small real decline (2 per cent). Preliminary 2020 figures show that Norway spent NOK 78.4 billion on R&D in 2020. At constant prices, this is equal to zero growth from 2019.
	The industrial sector is the largest R&D performing sector in Norway. In 2019, the sector accounted for 46 per cent of total R&D in the country. The higher education sector accounted for 34 per cent, and the institute sector accounted for 20 per cent.
	In 2019, close to 90,000 people participated in R&D in Norway. They performed a total of 48,700 R&D full-time equivalents (FTEs). Nearly three quarters of the FTEs were performed by researchers and academic staff, the rest by technicians or other supporting staff. The distribution has been stable for several years.
	Among the researchers who participated in R&D in Norway in 2019, there were 37,900 men and 23,800 women. The gender balance varies between the sectors. In the industrial sector, the proportion of women was almost 23 per cent, in the institute sector it was 45 per cent and 50 per cent in the higher education sector. In the health trusts, the share was 53 per cent.
	Statistics on diversity in research (NIFU and Statistics Norway) show that 29 per cent of researchers and academic staff at educational institutions, health trusts and in the institute sector were immigrants or descendants of immigrants in 2018. This is a significant growth from 2007, when the proportion was 18 per cent.
	In 2020, 1,634 doctorates completed their dissertation at Norwegian institutions. This is the highest number so far. Since 2012, the proportion of women has been between 47 and 53 per cent. The proportion of foreign doctorates now amounts to around 40 per cent, while it was just over 10 per cent at the beginning of the 2000s.
	The state budget analysis estimates that NOK 40.8 billion will be allocated to R&D in Norway in 2021, 1.6 billion more than in 2020. This is estimated to amount to 1.10 per cent of GDP.
	The Research Council of Norway, the EU and SkatteFUNN (tax deduction) have a high proportion of recipients in Oslo and Viken, while Innovation Norway and Siva have recipients spread throughout Norway.
	As of April 2021, Norway had received almost 2.5 per cent of the funds announced through Horizon 2020. The Norwegian ambition was 2.0 per cent. Norway participates in more than 1,800 granted projects and through them gains access to research and innovation with a total funding of around NOK 100 billion.
	The number of patent applications filed in Norway declined in 2020. It is difficult to point to the corona pandemic as decisive for fewer patent applications, since there has been a negative trend since 2017.
	The OECD and the European Commission have developed categorszations of patents according to whether or not they are related to green technology. The number of patents related to green technologies has grown significantly in recent years, which may indicate increased momentum in green conversion.
	Norwegian research achieves a high scientific influence measured by citation frequency. With a citation index of 120 (2018–2019), Norway ranks as number 10 of the world's 43 largest nations. This means that the Norwegian articles from the period were quoted 20 per cent above the world average.
	An increasing number of Norwegian scientific publications are openly available. In 2020, this applied to about three out of four publications published in journals. In 2013, the proportion was just over one third.
	Norwegian research increasingly involves international cooperation. 55 per cent of the publications in 2020 had co-authors from institutions in other countries. The share was 40 per cent in 2011.
	Innovative enterprises are doing better through the corona pandemic so far, compared to the non-innovative. This is especially true for the large group of enterprises with between 50 and 500 employees.
	An enterprise's reputation and expectation of demand are the most important factors for the development of green innovations. Fees and taxes, both current and expected, play a small role in the development of green innovations among Norwegian enterprises.
	The most important drivers for innovation in the public sector, both in the state and municipal sector, are colleagues and immediate managers.

Contents

Introduction

The main report in Norwegian

This report presents science and technology (S&T) indicators for Norway. It is based on the more comprehensive Norwegian report, http://www.forskningsradet.no/indikatorrapporten. The abridged English report has been published biennially since 2001, aiming at providing useful information and perspectives on a range of S&T issues for foreign readers who may not be familiar with the Norwegian S&T system and its context. In this way it complements the full version.

R&D and innovation statistics

The report draws on measurements and indicators with a long history and time series. Statistics on resources devoted to research and experimental development (R&D) in Norway, in terms of expenditure, full-time equivalents and personnel, have been compiled since 1963. This report continues the series' original aim of presenting a wide range of relevant statistics and indicators and of ensuring their ongoing development.

Norwegian R&D statistics are based on the guidelines of the 7th edition of the OECD Frascati Manual from 2015. Innovation studies were first introduced in the 1990s, and the range of innovation indicators has been considerably extended following the revision of the Oslo Manual in 2018.

Structure of the report

This abridged English report offers information across a wide range of topics. Some key findings are presented at the beginning of the report, and following this introduction, a brief description of the Norwegian system of education, research and innovation is presented. Chapter 1 presents main results from Norwegian R&D by sector and region. While the Norwegian main report is based on R&D figures for 2019, we have been able to include (partly preliminary) R&D statistics for 2020 in this English abridged version of the report. Chapter 2 provides a look at Norwegian R&D in an international context. Chapter 3 presents available data on human resources in knowledge production. Chapter 4 presents public instruments for support of R&D and innovation, including Norwegian participation in the EU framework programmes. Chapter 5 includes indicators for intellectual property rights, while Chapter 6 presents bibliometric results of scientific publishing. Chapter 7 is devoted to indicators on innovation in Norwegian industrial and public sectors including a few international comparisons.

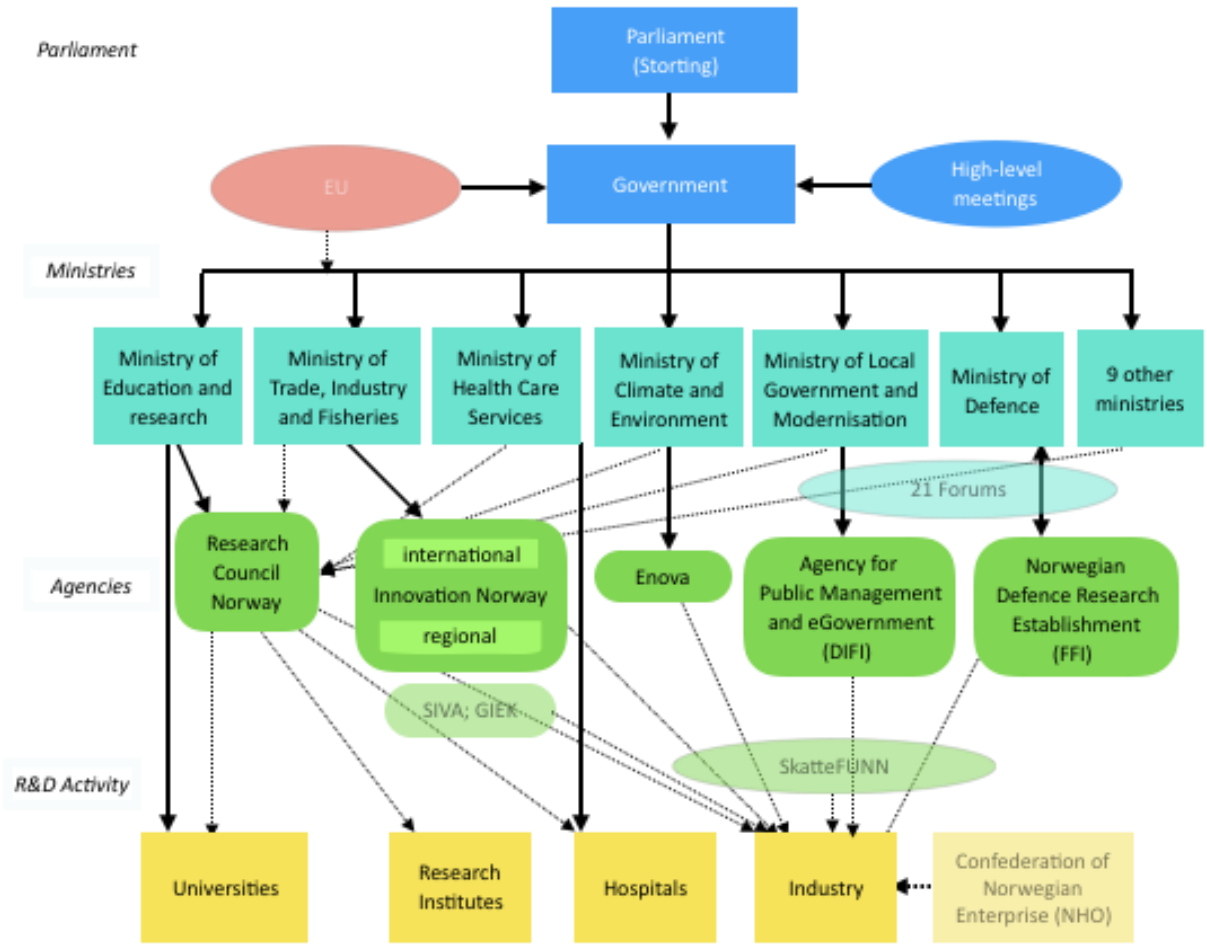
This English edition is less extensive than the original Norwegian report. However, it includes several "fact boxes" with supplementary information such as sectoral differences, reforms in Norway or special projects. We should also mention that this abridged report does not feature full references. These can be found in the Norwegian report, which is available online, together with a complete set of updated tables: http://www.forskningsradet.no/indikatorrapporten.

Exchange rates

2019	Year average	1 US dollar =	8.8 Norwegian kroner
2020	Year average	1 US dollar =	9.4 Norwegian kroner
November 2021	Month average	1 US dollar =	8.7 Norwegian kroner
2019	Year average	1 Euro =	9.9 Norwegian kroner
2020	Year average	1 Euro =	10.7 Norwegian kroner
November 2021	Month average	1 Euro =	10.0 Norwegian kroner

Source: Norges Bank

The Norwegian system of education, research and innovation



Main Science, Technology and Innovation (STI) actors in Norway.

SIVA–The Industrial Development Corporation of Norway.
GIEK–The Norwegian Export Credit Guarantee Agency.
ENOVA: A state-owned enterprise for the restructuring of energy use and energy production.
SkatteFUNN: The Norwegian tax deduction scheme.

The Norwegian research and innovation system includes a large number of institutions with different roles. It is common to distinguish between three levels: *the political*, *the strategic* and *the performing* level. Extensive internationalisation also applies to Norwegian research and is increasingly important for all parts of the Norwegian R&D system. The figure above provides a simplified picture of the organisation and the division of labour in the R&D and innovation system, including the international dimension (EU).

The political level

The system can be characterised by considerable pluralism at the political level. According to the "sector principle", all 15 ministries (after the 2021 election) are responsible for financing both short-term and long-term research within their respective sectors. Hence, public research funding and science policy involves extensive coordination. At the same time R&D funds are fairly concentrated, as five ministries account for 85 per cent of total R&D funding. The most important one is the Ministry of Education and Research. This ministry also prepares the long-term plan for research and higher education and is responsible for coordinating research policy across ministries at the national level.

Other important contributors are the Ministries of Trade, Industry and Fisheries, Health Care Services, Climate and Environment, Local Government and Modernisation and Defence. The Research Council of Norway (RCN) also supplies advice to the government on STI policy and network governance between various actors in the STI system.

The strategic level

At the strategic level, there are several agencies that are important for Norwegian STI policy. The two most important players are RCN, which focuses on research and technological funding, and Innovation Norway and SkatteFUNN, which focus on innovation. More than half of the budgetary funding for Norwegian R&D activity goes through the Ministry of Education and Research and the RCN. The RCN has more than 25 per cent of public R&D funding and receives funding from all 15 ministries. Innovation Norway encourages innovation at the regional and national level, with a focus on small and medium sized enterprises. SkatteFUNN R&D tax incentive scheme is organised under RCN and has become a major tool for encouraging innovation by supplying tax credits for the R&D activity.

In addition to RCN, Innovation Norway and SkatteFUNN, there are several other key players. SIVA encourages the development of science parks, incubators, and services to start-up firms. GIEK supplies long-term guarantees that encourage Norwegian industry to take part in more international trade and export. Enova, owned by the Ministry of Climate and Environment, encourages environmentally friendly production and consumption of energy and exploration of new sources of clean energy. Difi aims to strengthen the Norwegian public sector and improve the organisation and efficiency of government administration. Finally, FFI aims to advance knowledge in artificial intelligence, additive manufacturing, quantum computing, nanotechnology, the Internet of Things, and autonomy.

The performing level

At the performing level in Norway, there is the higher education sector (including university hospitals), the institute sector and the industrial sector. The higher education sector performed about one third of Norwegian R&D activity in 2020. There is a broad variety of institutions in the higher education sector, including universities, state university colleges and private higher education institutions. At the same time, research activity is concentrated, as universities, including university hospitals, accounted for more than 87 per cent of the higher education sector's total R&D expenditure.

Compared with other countries, a relatively high share of Norwegian R&D is performed by research institutes (22 per cent). The Norwegian institute sector is rather heterogenous in terms of institute size, profile and legal status. The sector includes both public sector oriented and industry-oriented institutes, of which the latter group plays an important role in carrying out contract research for Norwegian and foreign companies.

Even though the industrial sector accounts for nearly half the R&D expenditure in Norway, the proportion of research performed in this sector is low compared with other countries. Given the resource-based structure of the economy, there are relatively few large R&D-intensive companies in Norway.

The S&T statistical infrastructure

The production of STI statistics has been distributed across different parts of Norway's statistical system. The official statistical agency, Statistics Norway, is a key pillar. The agency produces R&D and innovation statistics for the industry, conducts evaluations and research and provides a macro and micro-data warehouse.

NIFU is the other major actor in S&T studies. NIFU has produced R&D statistics for the government and higher education sector since the 1960s and is also involved in evaluations and research projects

covering education, innovation and research studies. Statistics Norway and NIFU have collaborated in reporting R&D statistics to Eurostat and the OECD.

The Ministry of Education and Research has decided that public authority tasks must be put out to tender or be performed by a public agency. As from 2022 the production of R&D statistics for all sectors will be performed by Statistics Norway. NIFU's staff who have produced the statistics willmove to Statistics Norway. In this way the quality of the statistics will be maintained.

Norway has recently undergone a process of transformation in digital support services to the research and higher education sector by reforming the key agencies. A new agency, UNIT (Directorate for ICT and joint services in higher education and research), organises administrative data on research and the higher education sector, students and Cristin (the current Research Information System in Norway). The availability of administrative data resources minimises the need for ad hoc inquiries addressed to STI actors.

The Norwegian Directorate for Higher Education and Skills (HK-dir) was established in 2021 and is subordinate to the Ministry of Education and Research. The Directorate is a result of the merger of Diku, Competence Norway, Universell and parts of Unit and the Norwegian Centre for Research Data (NSD) and will also be taking over tasks for the Norwegian Agency for Quality Assurance in Education (NOKUT). The Directorate has an overall, national responsibility for administrative tasks within higher education, higher vocational education and competence policy and gives advice to the ministry, implements the policy and coordinates the tools.

Key indicators

The following two tables present a set of key indicators to introduce essential trends of Norwegian research and innovation. The first table shows main trends in Norway. The second table compares the status of Norway with that of the other Nordic countries, the EU and the OECD.

Key indicators for R&D and innovation in Norway in 2015–2019.

	2015	2016	2017	2018	2019
Resources for R&D and innovation					
R&D expenditure as a percentage of GDP	1.94	2.04	2.10	2.05	2.15
R&D expenditure per capita in constant 2015 prices (NOK)	11,601	11,837	12,588	12,773	12,953
R&D expenditure funded by the government as a percentage of total R&D expenditure	44.9	45.7	46.7	48	47
R&D expenditure funded by the industrial sector as a percentage of total R&D expenditure	44.2	43.2	42.8	42	43.2
R&D expenditure in the higher education sector as a percentage of total R&D expenditure	31.1	32.6	33.7	34.6	34.3
Human resources					
Percentage of the population with higher education, 25–64 year-olds	42.7	43.0	43.2	43.6	44.1
R&D full-time equivalents per 1,000 capita	8.2	8.4	8.8	8.8	9.1
R&D full-time equivalents of R&D personnel per 1,000 capita	5.9	6.1	6.4	6.5	6.7
Percentage of doctoral degree holders among the R&D personnel	34.5	34.4	34.3	34.5	34.9
Percentage of women among the R&D personnel	37.4	37.6	38.1	38.8	38.6
Cooperation in R&D and innovation					
Purchases of R&D services as a percentage of total R&D expenditure in the industrial sector	24	24	23	23	22
Enterprises with R&D cooperation as a percentage of enterprises with R&D in the manufacturing sector	39	..	36	..	33
Enterprises with innovation cooperation as a percentage of innovative enterprises in the manufacturing sector	..	38	..	30 [1]	..
Articles in international scientific journals co-authored by Norwegian and foreign researchers as a percentage of all articles by Norwegian researchers	65	67	68	66	67
Results of R&D and innovation					
Percentage of innovative enterprises in the industrial sector[2]	..	53	..	61 [1]	..
Percentage of turnover from product innovations in the industrial sector [2]	..	6.8	..	7,5 [1]	..
Number of articles in international scientific journals per 100,000 capita	253	275	281	299	317
Number of patent applications to the European Patent Organisation per million capita [3]	89	107	94	82	

[1] The Community Innovation Survey 2016–2018 is based on definitions in the 4th edition of the Oslo Manual. This means a break in time series.
[2] The population includes enterprises with at least 5 persons employed except NACE groups F and H (41-43, 49-53) and NACE 56 covering enterprises with at least 20 persons employed.
[3] OECD's Patents by Technology by inventor's country of residence and priority date
Source: NIFU, Statistics Norway, Eurostat, OECD

Key indicators for R&D and innovation in Norway, Sweden, Denmark, Finland, OECD and EU in 2018–2019.

	Year	Norway	Sweden	Denmark	Finland	OECD	EU27
Resources for R&D and innovation							
R&D expenditure as a percentage of GDP	**2019**	2.15	3.39 [1]	2.91 [2]	2.79	2.48 [1]	2.12 [1]
R&D expenditure per capita in current prices (NOK)	**2019**	14,366	18,302 [1]	17 406 [2]	14,068	11,231 [1]	9,524 [1]
R&D expenditure funded by the government as a percentage of total R&D expenditure	**2019**	47.0	..	28,7 [3]	27.8	24.5 [1]	30.0 [1]
R&D expenditure funded by the business enterprise sector as a percentage of total R&D expenditure	**2019**	43.2	..	59.6 [2]	54.3	62.8 [1]	58,2 [1]
R&D expenditure in the higher education sector as a percentage of total R&D expenditure	**2019**	34.3	23.7	34.1 [2]	25.4	16.5 [1]	21.6 [1]
Human resources							
Percentage of the population with higher education, 25–64 year-olds	**2019**	44.1	44.0	40.4	45.9	38.0	37.4 [4]
R&D full-time equivalents per 1,000 capita	**2019**	9.1	8.9 [1]	10.7 [2]	9.3	..	6.5 [1]
R&D full-time equivalents of R&D personnel per 1,000 capita	**2019**	6.7	7.6	7.7 [2]	7.2	..	4.1 [1]
Cooperation in R&D and innovation							
Enterprises with innovation cooperation as a percentage of innovative enterprises in the business enterprise sector [5,6]	**2018**	42.8 [7]	24.8	25.8	47.3		26.4
Enterprises with innovation cooperation as a percentage of innovative enterprises in the manufacturing sector [5]	**2018**	47.2	29.3	29.3	51	..	..
Results of R&D and innovation							
Percentage of innovative enterprises in the business enterprise sector [5,6]	**2018**	67.6 [7]	63.1	57.1	61.9	..	50.3
Percentage of innovative companies in the manufacturing sector [5]	**2018**	68.8	63.1	59.3	66.5	..	54.0
Percentage of turnover from product innovations in the business enterprise sector [5,6]	**2018**	8 [7]	13.7	10.5 [2]	14.3	..	12.9
Percentage of turnover from product innovations in the manufacturing sector [5]	**2018**	10.4	18.9 [8]	14.4 [2]	15.3	..	..
Number of articles in international scientific journals per 100,000 capita	**2019**	317	317	382	273	..	..
Number of patent applications to the European Patent Organisation per million capita [9]	**2018**	82	297	239	248	101	122 [10]

[1] Estimated.

[2] Provisional.

[3] Definition differs.

[4] Based on EU23 average.

[5] Covers enterprises with at least 10 persons employed.

[6] Covers "Innovation core activities (Com.Reg. 995/2012)", see Annex II in Com.Reg. 995/2012.

[7] NACE group H (49–53) includes enterprises with at least 20 persons employed.

[8] Low reliability.

[9] OECD's Patents by Technology by inventor's country of residence and priority date.

[10] Break in time series and provisional figures for the population.

Source: NIFU, Statistics Norway, Eurostat, OECD

Chapter 1: R&D in Norway

1.1 Total R&D expenditure

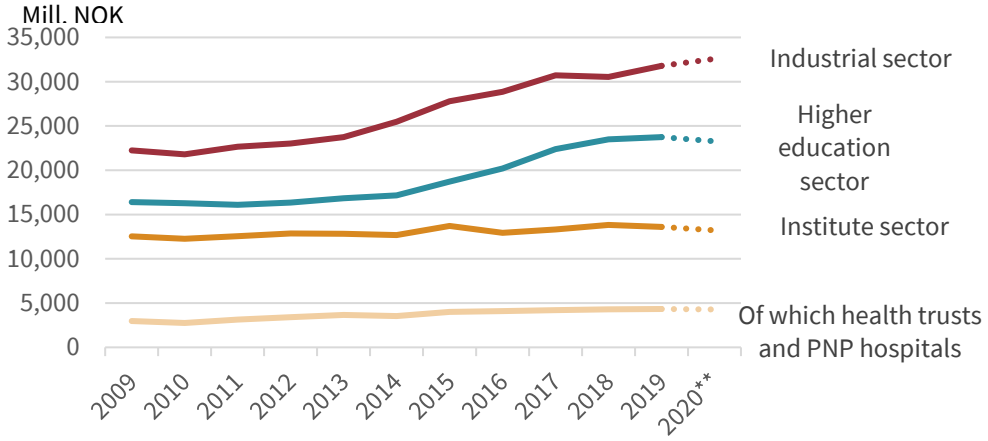
In 2019, Norway's total expenditure on research and development work (R&D) amounted to NOK 77 billion. This is NOK 4 billion higher than in 2018. At fixed prices, the growth makes up just over 2 per cent from 2018, the same real growth as from 2017 to 2018.

This abridged English version is based on the full Norwegian S&T report 2021 where R&D figures for 2019 are the most recent. As preliminary 2020 figures were published late in 2021, we are also able to include some main preliminary 2020 figures for the industrial and higher education sector and some final 2020 figures for the institute sector. The preliminary 2020 figures for Norway show that the total R&D effort amounted to just over NOK 78 billion. In current prices, this gives an increase of NOK 1.5 billion from 2019, corresponding to almost zero growth in fixed prices.

The industrial sector had the strongest growth in 2019

The R&D performing sectors had different dynamics from 2018 to 2019. The industrial sector showed a real growth in R&D expenditure of 4 per cent, the largest of all the sectors. It was followed by the higher education sector with a real increase of 1 per cent, while the institute sector had a small real decline of almost 2 per cent. The decline in the institute sector was primarily related to lower capital expenditures. In 2020, the R&D expenditure of the industrial sector grew only 2 per cent from 2019, while the two other sectors cut their spending on R&D compared with 2019.

Figure 1.1 R&D expenditure in Norway by sector of performance. 2009–2020. Fixed 2015 prices.*



* The industrial sector covers enterprises with at least 10 employees.

** Preliminary figures.

Source: Statistics Norway and NIFU, R&D statistics

Figure 1.1 shows the real growth in the Norwegian R&D expenditure over the last 10 years. The industrial sector and the higher education sector have experienced the largest increase in R&D expenditure. In 2018, the higher education sector had

the largest increase, while in 2019 and 2020 (preliminary figures) the industrial sector had the strongest largest growth.

Until 2013–2014, the R&D performing sectors had followed a similar path. The institute sector did not expand as much as the other sectors, but in years with large capital investments, its growth was higher. The R&D activity of health trusts and hospitals is included in the R&D statistics for the higher education sector (health trusts with university hospital services) and the institute sector (health trusts not conducting education and private non-profit hospitals), respectively, see more about the sector division in the fact box below. The development in the health trusts and hospitals has remained steady, with a slightly higher growth in 2015 followed by a small real growth in the later periods. In 2019, health trusts not conducting education and private non-profit hospitals achieved the strongest growth, while health trusts with university hospital services had zero growth.

Norwegian performing sectors for R&D

In Norway, national R&D statistics are categorised according to three basic sectors:

The industrial sector: Companies and enterprises aimed at commercial production of goods and services for sale at an economically significant price.

The institute sector: Private non-profit (PNP) research institutes mainly serving industry (the business enterprise sector in the OECD classification); research institutes and other R&D-performing institutes (other than higher education) mainly controlled by and funded by the government (government sector in the OECD classification); and health trusts not conducting education and PNP hospitals.

The higher education sector: Units providing higher education; universities, specialised university institutions, state university colleges and university hospitals. To highlight the R&D activities in health trusts these are presented separately where appropriate and possible (data from 2007).

The institute sector's R&D below 20 per cent for the first time since 1979

The distribution of R&D expenditure between the sectors has changed over time. Back in 1979, the institute sector had the largest R&D expenditure. Since the end of the 1990s, the higher education sector has outperformed the institute sector, and in 2019 the former accounted for more than a third of Norwegian R&D, while the institute sector for the first time since 1979 made up less than 20 per cent. One explanation is mergers between several research institutes and units in the higher education sector. However, the total volume of activity in the institute sector has remained nearly constant over time, so that the relative decline is primarily due to R&D growth in the other sectors.

The industrial sector share has increased over the period 1979–2019, but in recent years has been about 46 per cent of Norway's total R&D expenditure. Compared

with other countries, R&D activity in the Norwegian industrial sector is low, which has its background in the sector structure and a large proportion of small and medium-sized enterprises. Note that the sectoral division is different when we make international comparisons, see chapter 2; business-oriented institutes are a part of the business enterprise sector, and public institutions are included in the government sector.

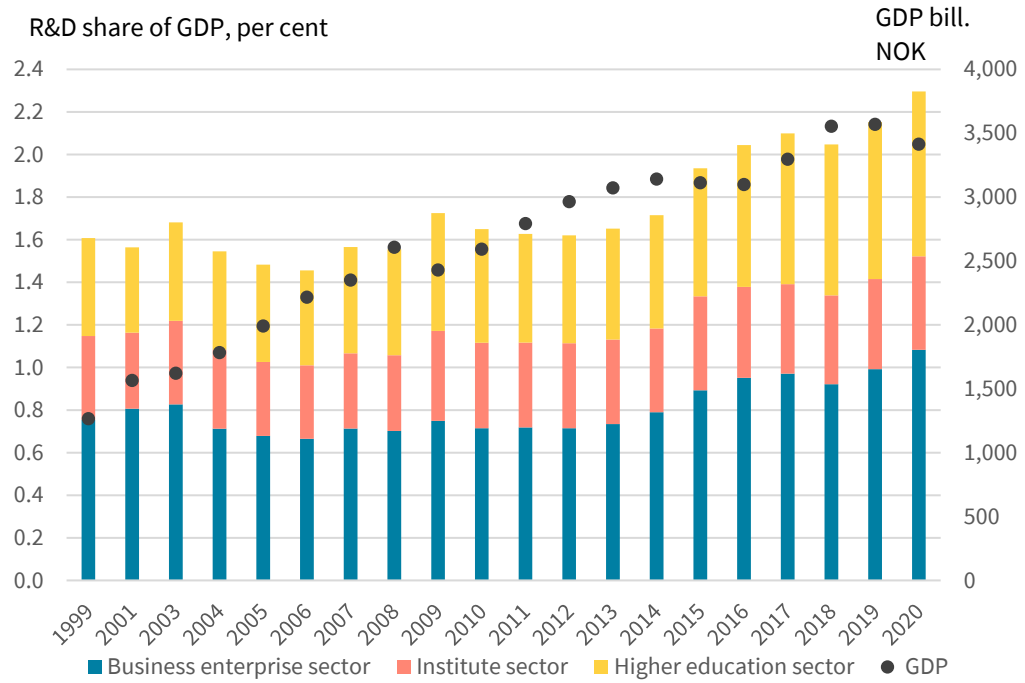
R&D expenditure as a share of GDP

The R&D share of GDP is a widely used indicator that provides an overall picture of how much a country invests in R&D. The indicator is easy to understand and communicate and it has been used in research policy as a measure of R&D activity. In its Long-Term Plan for Research and Higher Education 2018–2019 (Report to the Storting 4 (2018–2019)), the Norwegian Government confirmed that the national target for the R&D share of GDP is 3 per cent. However, the indicator depends on both the level of R&D activity and the development of a country's economy. In bad economic times, one meets the target R&D share of GDP with lower R&D expenditure. We saw this during the financial crisis in 2009, see figure 1.2.

Norway's R&D share of GDP has been above 2 per cent since 2016, and in 2019 the share was 2.15 per cent. In 2017 and 2018, the real GDP saw a growth of 4–5 per cent, while in 2019 it had a slight decline. The R&D expenditure experienced a strong real growth in 2015 and 2017 (9 and 7 per cent, respectively) while the growth rates in 2016, 2018 and 2019 were lower, at 2–3 percent. In 2019, the decline in Norway's real GDP and a small growth in the real R&D expenditure resulted in the highest R&D share of GDP ever.

In 2020, preliminary figures show a R&D share of 2.30 per cent, partly due to a lower GDP this year.

Figure 1.2 R&D expenditure as a share of GDP by sector of performance. 1999–2020.*



* Preliminary figures for GDP in 2019 and 2020. Preliminary figures for R&D 2020. The industrial sector covers enterprises with at least 10 employees.

Source: Statistics Norway and NIFU, R&D statistics

Public funding accounts for nearly half of Norwegian R&D expenditure

In 2019, public R&D funding amounted to roughly NOK 36 billion or 47 per cent of the total R&D expenditure in Norway. The industrial sector, with its contribution of NOK 31 billion, is the second largest source of R&D funding. Most of the business-funded R&D (NOK 27 billion) was performed by the sector itself (enterprises with at least 10 persons employed). Sources from abroad also play an important role in financing Norwegian R&D. In 2019, they contributed with over NOK 6 billion, the largest part covering the R&D performed by business. The foreign-funded R&D in the industrial sector was NOK 4 billion, most of this coming to Norwegian affiliates from their parent companies abroad. The R&D funding from other public sources was worth NOK 3.6 billion. These sources include tax deduction (SkatteFUNN) in the industrial sector and various (medical) funds.

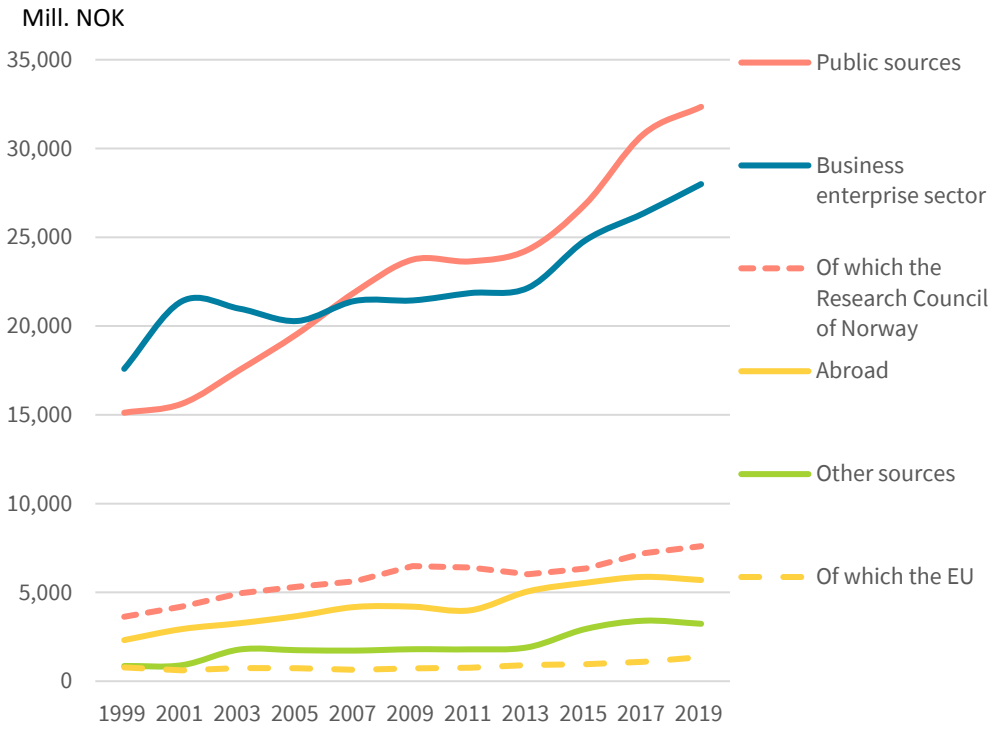
Funding from the EU had the strongest growth in 2019

From 2017 to 2019, the R&D funding from the EU had a real growth of 11 per cent, which is the highest growth rate compared with other sources. Business funding increased by slightly over 3 per cent and public funding by 2.5 per cent. Other national sources and funding from abroad both had a slight real decline in R&D expenditure.

Figure 1.3 shows the development in the 1999–2019 period. Public and business funds are the two most important sources of R&D funding. Both have grown over time; public funds had the largest increase. The share of public funding has risen

from 42 to 47 per cent in the twenty-year period 1999–2019, while the share of business has fallen from 49 to 40 per cent.

Figure 1.3 R&D expenditure by main source of funding. 1999–2019. Fixed 2015 prices.



Source: Statistics Norway and NIFU, R&D statistics

R&D by thematic area and area of technology

The Norwegian R&D statistics also comprise rather unique long time-series data on R&D expenditure by thematic area and area of technology. There is no one-to-one correspondence between the thematic areas or technology areas and codes in the industrial classification or classification by field of R&D. Different Norwegian governments have given priority to different thematic areas and technology areas over the years, which means that the length of time-series for different areas varies. In recent years, the focus has been on the priority areas in the Government's Long-term plan for research and higher education, please see the fact box below.

Mapping of the priority areas in the Government's long-term plan

The revision of the Government's second Long-term plan for research and higher education (2017–2024) highlighted the need for more comprehensive data on R&D in the prioritised thematic and technology areas. Some areas have previously been mapped only at a highly aggregated level in the main R&D survey, while others have been mapped in additional surveys containing varying questions and occurring with different frequency. In connection with the R&D survey for 2017, the Research Council of Norway, Statistics Norway and NIFU reviewed the definitions and data collection routines to coordinate mapping of companies with R&D in thematic and technology areas.

Statistics Norway surveys R&D in the industrial sector and collects data on areas and sub-areas that are assumed to be the most relevant for the sector. The survey for 2019 mapped the technology areas of biotechnology and ICT and other thematic areas like energy, climate, environment, agriculture, maritime, marine, aquaculture and fisheries.

In the institute sector and the higher education sector, respondents reporting R&D in the prioritised thematic or technology areas received a short additional standard survey. This included questions about sub-areas, financing and staff. The following areas were mapped in 2019: energy, climate, environment, agriculture, maritime, marine, aquaculture, fisheries, education and welfare, as well as the technology areas biotechnology and ICT.

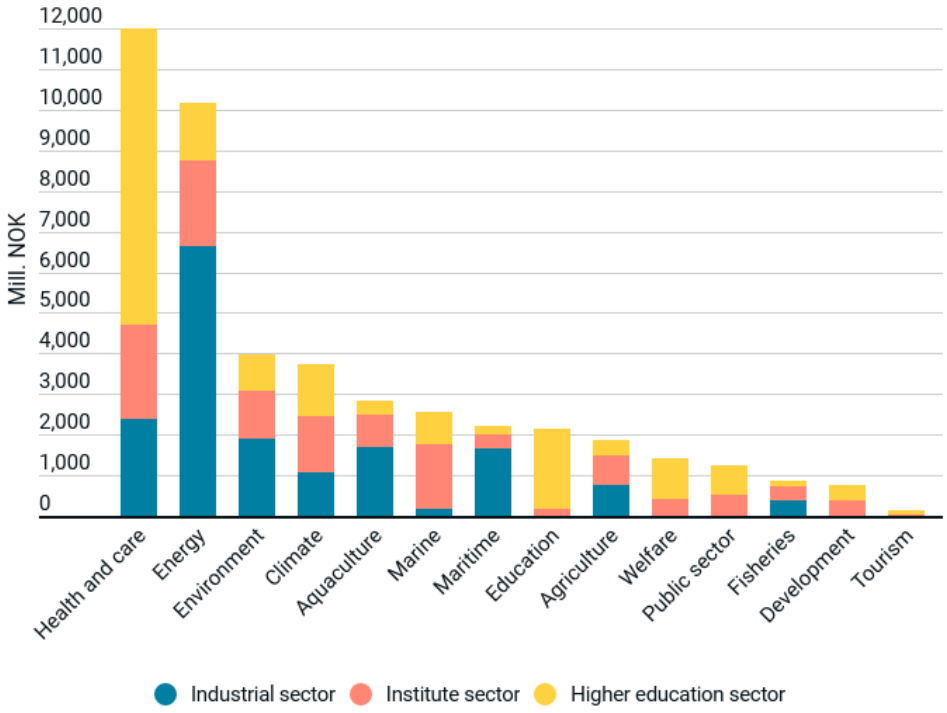
Most R&D in health and care

Figure 1.4 shows current expenditure on R&D by thematic area in 2019 by R&D performing sector. As in 2017, health and care is the largest thematic area with a total of over NOK 12 billion. University hospitals are included in the higher education sector.

The importance of different thematic areas varies between the R&D performing sectors. In the industrial sector, the R&D spending is largest in energy, with over NOK 6.6 billion, followed by health and care with NOK 2.4 billion, environment with NOK 1.9 billion and aquaculture and maritime, both with R&D expenditure of NOK 1.7 billion NOK. The institute sector has most of its R&D activity in the following thematic areas: health and care (NOK 2.3 billion), energy (NOK 2 billion) and marine (NOK 1.5 billion). In the higher education sector, health and care is also the largest thematic area with NOK 7.3 billion. In addition to the R&D activity at the medical faculties, R&D at the university hospitals is included here. Other major R&D areas in this sector are education (NOK 2 billion), energy (NOK 1.4 billion) and climate (NOK 1.3 billion).

From 2017 to 2019, the current expenditure on R&D in Norway had a real growth of 4 per cent. Only three of the thematic areas showed higher growth rates than the total, namely marine, climate and education. Seven areas had a real decline or almost zero growth in R&D expenditure: tourism, fisheries, welfare, public sector, environment, aquaculture and energy.

Figure 1.4 Current expenditure on R&D by thematic area and performing sector. 2019.* Mill. NOK.



* Overlaps between thematic areas are possible.

** The industrial sector covers enterprises with at least 10 employees. The survey for this sector does not cover the thematic areas of welfare, education, tourism, development research and other public sector activities.

Source: Statistics Norway and NIFU, R&D statistics

1.2 R&D in the industrial sector

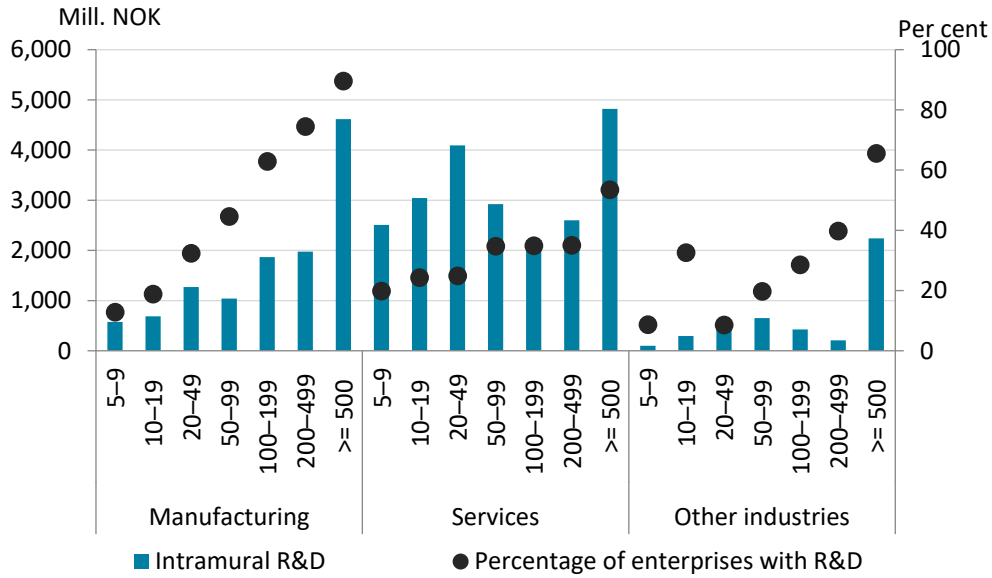
The industrial sector is the largest R&D performing sector in Norway. The sector carried out research and experimental development (R&D) in enterprises with at least 10 employees for NOK 35.4 billion in 2019. Preliminary figures for 2020 show that the industrial sector carried out R&D for almost NOK 37 billion, 4 per cent more than in 2019. Adjusted for inflation, the increase is 2 per cent. The remaining text is based on final 2019 figures as they are presented in the main S&T report 2021 in Norwegian.

The service industries accounted for more than half of R&D expenditure

Enterprises in service industries carried out R&D for almost NOK 19.7 billion in 2019, which is 56 per cent of the total R&D expenditure in the industrial sector. By comparison, enterprises in manufacturing carried out R&D for slightly under NOK 11.5 billion.

Service enterprises contributed most to the sector's R&D growth from 2018 to 2019, and had an increase of NOK 1.8 billion, or 10 per cent in current prices. By comparison, R&D in manufacturing increased by 6 per cent.

Figure 1.5 Expenditure on intramural R&D and share of enterprises with R&D by main industry and employment group. 2019.



Source: Statistics Norway, R&D statistics

Figure 1.5 shows that the distribution of R&D expenditure between small and large enterprises in each subgroup is quite different. In services, small enterprises accounted for a large part of the R&D expenditure. This can be seen in connection with the fact that there are many small enterprises in the service industries.

The R&D expenditure in the subgroup of other industries is lowest. Here, companies with at least 10 employees performed R&D for slightly less than NOK 4.3 billion. Most of the R&D expenditure was performed in the industries *Fishing and aquaculture*, *Extraction of crude petroleum and natural gas* and *Support activities for petroleum and natural gas extraction*.

Many R&D companies with 5–9 employees

Industrial sector R&D covers enterprises with at least 10 employees. Every other year, R&D activity is also mapped in enterprises with 5–9 employees. Their R&D expenditure amounted to just NOK 3.2 billion in 2019.

In the R&D population survey, 17 per cent of the enterprises in this employment group had R&D, which is slightly more than 1,000 enterprises. Both the R&D expenditure and the share of R&D performers in this employment group are slightly lower than for enterprises with 10–19 persons employed.

There are clearly most R&D enterprises with 5–9 employees in the service industries, and they carried out R&D for NOK 2.5 billion. This is slightly more than one tenth of the service industries' R&D expenditure.

Compared with 2017, enterprises with 5–9 employees have increased their R&D by 15 per cent at current prices. Growth has taken place in manufacturing and services, while the subgroup including other industries has shown a sharp decline.

Business R&D mainly financed by own funds

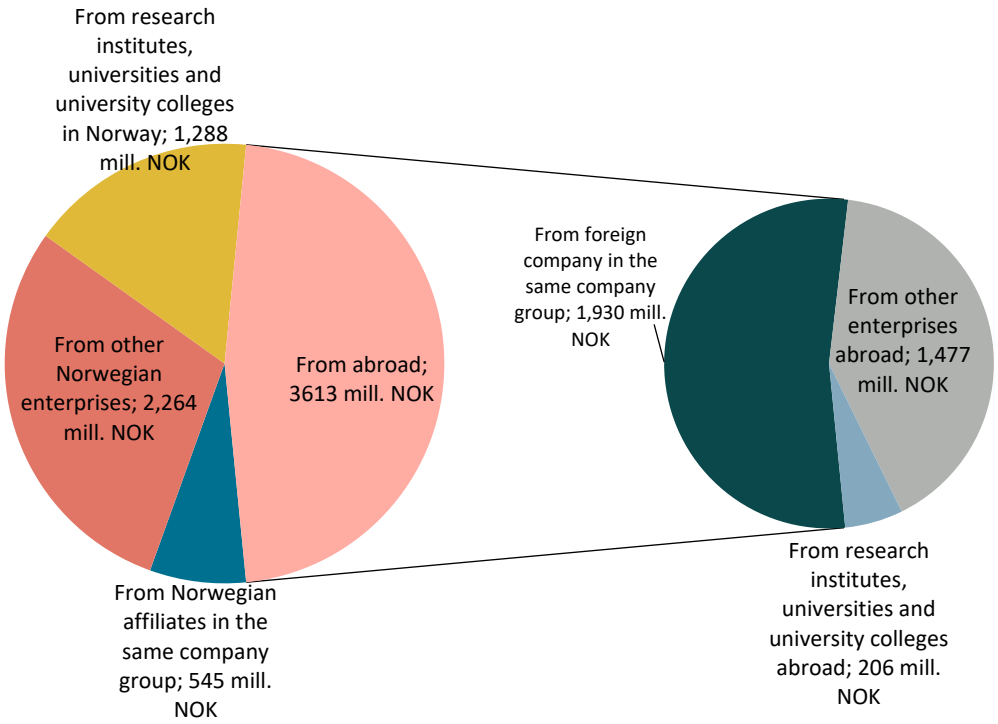
In 2019, business-funded R&D made up 75 per cent of the R&D expenditure performed by the industrial sector (companies with at least 10 employees). Many Norwegian companies also receive funds from the corporations they belong to, typically from foreign companies in their company group. This is more characteristic of large than small enterprises.

Purchase of R&D

In addition to performing their own R&D, many companies use external expertise by purchasing R&D services from others. In 2019, the extramural R&D in the industrial sector covering companies with at least 10 employees amounted to NOK 7.7 billion. Also, companies with 5–9 employees acquired R&D for NOK 520 million.

Figure 1.6 shows the distribution of the industrial sector extramural R&D by supplier. The sector covers enterprises with at least 10 employees. The purchases from foreign companies accounted for 46 per cent of the sector's extramural R&D.

Figure 1.6 Extramural R&D in the industrial sector by R&D supplier. 2019.



* Enterprises with at least 10 employees.

Source: Statistics Norway, R&D statistics

Higher R&D growth in services than manufacturing

The service industries have contributed most to R&D growth in the industrial sector over the 2009–2019 period. In recent years, the growth of this sector has been a result of a longer positive trend for the service industries. Manufacturing, on the other hand, had a weaker development from 2003 to 2010. The financial crisis hit the latter harder than services. The shift between manufacturing and services is due to both a real decline in manufacturing and transition of manufacturing enterprises to services.

1.3 R&D expenditure in the higher education sector

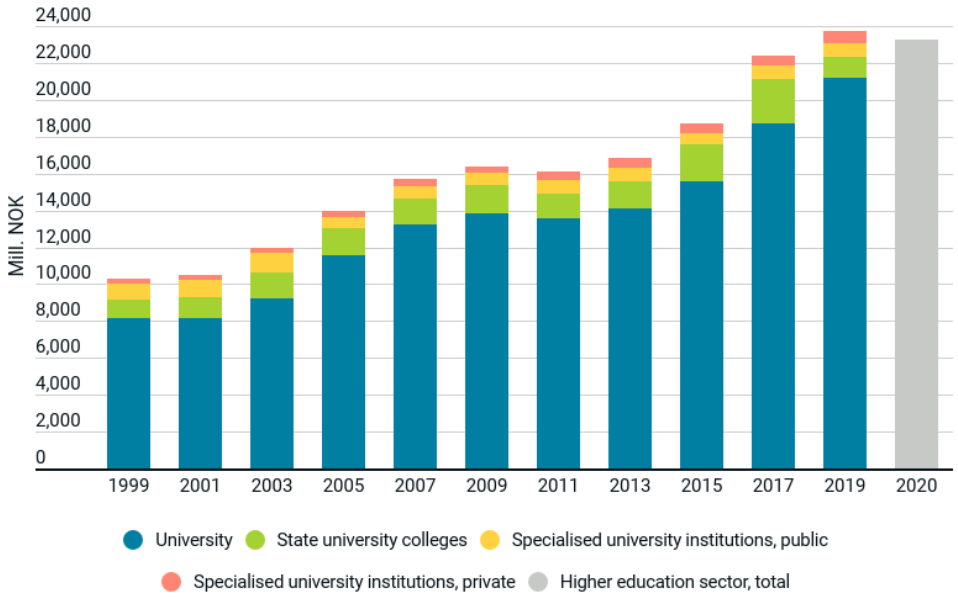
R&D in the higher education sector is surveyed every second year. 2019 is the latest year with a full survey; in addition, we present some preliminary results for 2020.

R&D more concentrated at universities

In recent years, the higher education sector has undergone several structural changes. One of the consequences is a larger share of R&D at the universities. In 2019, they accounted for almost 90 per cent of the R&D expenditure in the sector, compared with 84 per cent in 2017, see figure 1.7. Several state university colleges increased their R&D in the years preceding 2019, among other things because of applying for university status, which the growth of the green area in the figure illustrates, especially in 2015 and 2017. Since 2017, many former university colleges have been granted university status. Thus, a larger part of the R&D expenditure is now carried out by the universities, at the same time as the R&D expenditure at the state university colleges was halved in value from NOK 2.5 billion in 2017 to NOK 1.2 billion in 2019.

Preliminary results for 2020 show zero nominal growth in R&D for the higher education sector. During the corona pandemic, many units have had lower costs related to daily operations (cleaning, canteen, etc.) and staff travel activities.

Figure 1.7 R&D expenditure in the higher education sector by type of institution. Fixed 2015 prices. 1999–2020.[1]



[1] Preliminary 2020-figures.

Source: NIFU, R&D statistics

90 per cent of R&D expenditure in the sector publicly funded

In 2019, the General University Funds (GUF) accounted for more than two thirds of the total public funding, corresponding to NOK 18 billion. The second largest source of financing comprises other funds from the Research Council programmes, with NOK 3.9 billion. It is followed by R&D allocations from ministries and state enterprises, which in 2019 amounted to slightly less than NOK 1.5 billion. Financing from funds, organisations, etc. in the category “Other national sources” accounted

for slightly above NOK 1 billion in 2019. So did the funding from abroad, of which two thirds came from the EU's framework programmes for research, Horizon 2020. In 2019, the business-funded R&D in the higher education sector was equal to slightly above NOK 600 million. Except for the group "Other national sources", there was real growth in all sources of funding between 2017 and 2019.

1.4 R&D in the institute sector

The institute sector is the smallest of the three R&D performing sectors in the Norwegian research system. In 2020, the research institutes accounted for one-fifth of the R&D in Norway. The sector's activity level has been stable over time, but the sector's share of Norway's R&D has fallen by about 8 percentage points compared with the beginning of the millennium.

R&D expenditure in the institute sector amounted to NOK 15 billion in 2020. This is about NOK 100 million below the 2019 level, which means a real decline of almost 3 per cent. In fixed prices, wage costs for R&D were approximately at the same level as the year before, and the same applied to capital expenditure. The entire decline in 2020 applies to lower operating expenses, which is related to reduced costs of daily operations, less travel activity and fewer events as a result of the corona pandemic.

A heterogeneous sector

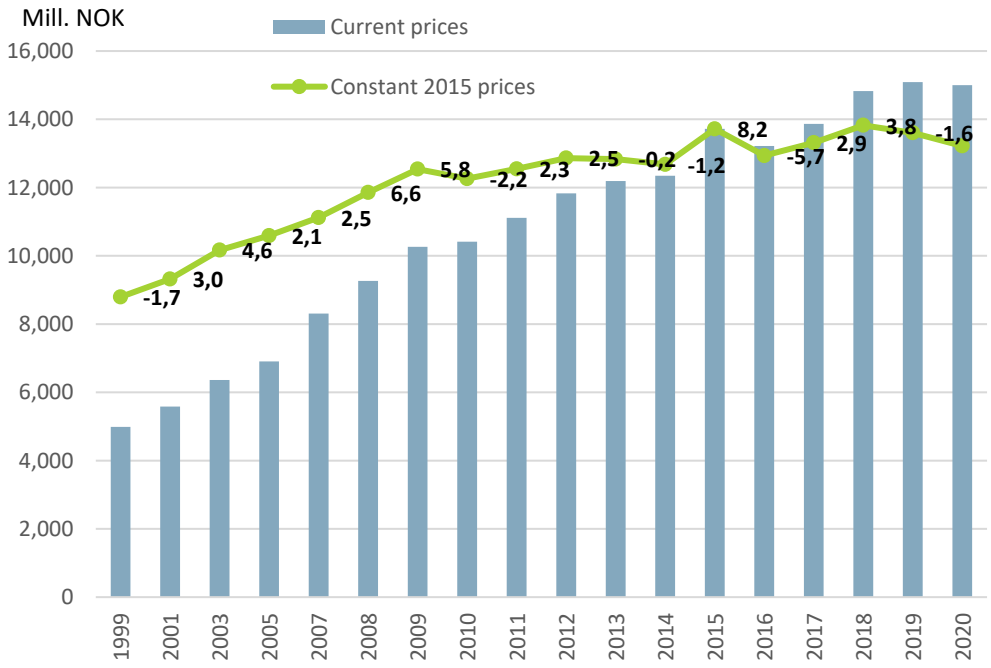
The institute sector is a heterogeneous group, where many institutes have R&D as their core activity. In the sector, however, we also find institutions with limited R&D. The common denominator for institutions belonging to the institute sector is that they do not pay dividends to the owner or other stakeholders, and they are not part of educational institutions. See also the fact box at the start of the chapter.

The R&D survey for the institute sector in 2020 included about 85 units, of which almost half are usually referred to as research institutes. These are institutes where R&D constitutes a core activity. Most research institutes are entitled to public funding according to *the guidelines for public basic funding of research institutes and research groups.*[1] Some state research institutes do not fall into this category, as they receive basic funding directly from the ministries they are attached to.

In addition to the research institutes, the sector comprises more than 40 institutions, both private and public, which to a greater or lesser extent carry out R&D. Also, here belong health trusts without university hospital functions, private non-profit hospitals and museums, whose R&D is calculated based on estimates.

[1] In 2009, the Ministry of Education and Research introduced a results-based scheme for government basic funding of research institutes. The scheme was later revised, most recently by the Ministry of Education and Research on 14 January 2020. It includes institutes that receive basic funding channelled through the Research Council of Norway. A total of 32 research institutes and research groups are currently covered by the state basic funding scheme.

Figure 1.8 R&D expenditure in the institute sector. 1999–2020. Current and fixed 2015 prices. Average annual real change in per cent.



Source: NIFU, R&D statistics

1.5 R&D in health trusts and hospitals

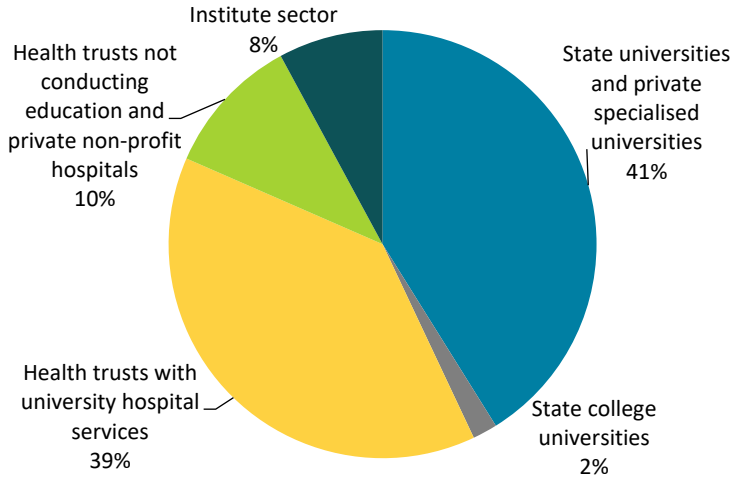
In this subsection, we describe the main features of R&D in health trusts and hospitals. Their R&D is part of the R&D activity in the higher education sector which is presented in subsection 1.3 (university hospitals) and the institute sector in subsection 1.4 (health trusts not conducting education and private non-profit hospitals). The health trusts, or specialist health services, account for about half of medical and health R&D that is carried out in Norway, excluding the industrial sector. In 2019, they performed R&D for nearly NOK 4.8 billion. This is an increase of slightly above NOK 200 million from 2018, or 4 per cent at current prices. The specialist health service includes public hospitals organised as health trusts and private non-profit hospitals that have an agreement with a regional health trust. The terms specialist health service and health trusts are used synonymously.

Figure 1.9 presents the current medical and health R&D expenditure in the higher education sector and the institute sector in Norway in 2019. The industrial sector is excluded. The current expenditure on the medical and health R&D totalled NOK 9.7 billion, of which the university hospitals made up almost NOK 3.7 billion or 39 per cent. It was a little lower than the corresponding expenditure at the state universities and private specialised universities, totalling NOK 4 billion or 41 per cent. Health trusts not conducting education and private non-profit hospitals performed R&D to a value of nearly NOK 1 billion, which is slightly more than one-tenth of the total current medical and health R&D in 2019. All in all, the health trusts and hospitals accounted for almost half of the medical and health R&D. The institute sector includes several significant R&D environments in the field of

medicine and health, including large state research institutes, such as the National Institute of Public Health and the Norwegian Cancer Registry. In total, they contributed with slightly more than NOK 750 million in 2019, or 8 per cent of the current R&D expenditure on medicine and health, while state university colleges with a little less than NOK 200 million accounted for 2 per cent of the current medical and health R&D in 2019.

Main preliminary R&D figures for 2020 show a nominal growth of 1.1 per cent in the health trusts.

Figure 1.9 Current medical and health R&D expenditure by type of performing institution and sector. 2019.



Source: NIFU, R&D statistics

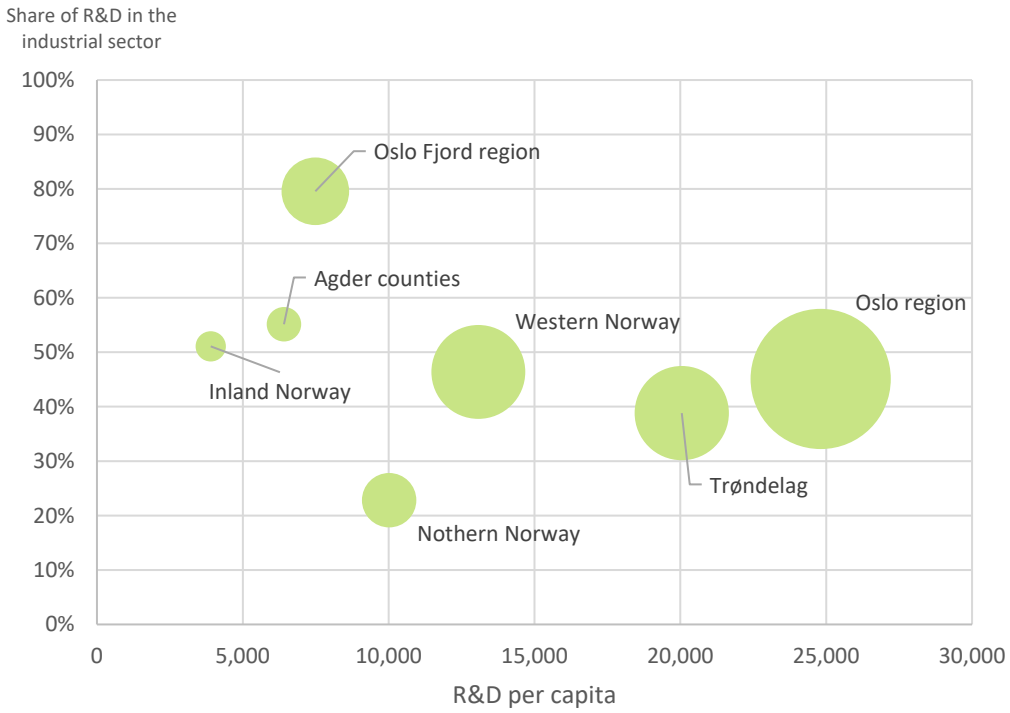
1.6 R&D in the regions

In Norway, a total of NOK 77.4 billion was spent on R&D in 2019. The Oslo region accounted for about 42 per cent of this amount. It is followed by Trøndelag and Western Norway with about 19 per cent each. Inland Norway and the Agder counties are the two smallest regions which together accounted for about 5 per cent of the total R&D in Norway. The Oslo Fjord region and Northern Norway accounted for 10 and 6 per cent of the Norwegian R&D, respectively.

The Oslo region performs most R&D

Most R&D was carried out in the Oslo region, both in absolute terms and in R&D expenditure per capita, see figure 1.10. More than NOK 24,800 per inhabitant was spent on R&D in the region in 2019. The University of Oslo and the country's biggest university hospital, Oslo University Hospital HF, contribute considerably to the region's high share of R&D. Other important educational institutions in the region are OsloMet, the Norwegian university of Life Sciences (NMBU), BI Norwegian Business School and the Norwegian Sports Academy. In the institute sector, the biggest contributors are the National Institute of Public Health, the Norwegian Institute of Bioeconomy Research (NIBIO), Norwegian Institute for Water Research (NIVA), Norwegian Defence Research Establishment (FFI), Institute for Energy Technology (IFE), NGI and SINTEF Oslo. The industrial sector accounted for about 45 per cent of the Oslo region's R&D expenditure in 2019.

Figure 1.10 Total R&D expenditure (bubble size), R&D expenditure per capita (x-axis) and share of R&D expenditure in the industrial sector (y-axis) by region. 2019.

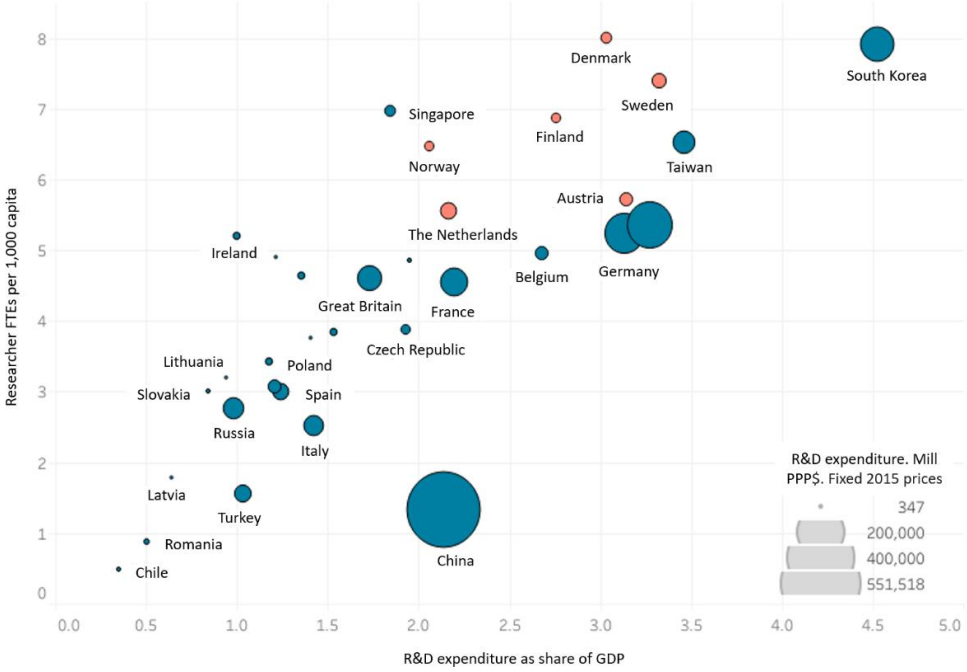


Source: Statistics Norway and NIFU, R&D statistics

Chapter 2: International trends in R&D

This chapter presents international trends in research and experimental development (R&D).

Figure 2.1 R&D expenditure in PPP dollars (fixed 2015 prices), as a share of GDP and the number of research full-time equivalents (FTEs) per 1,000 inhabitants. OECD area and selected countries (barometer countries in red). 2019 or last available year.



Source: OECD - MSTI, September 2021

2.1 Developments in international R&D

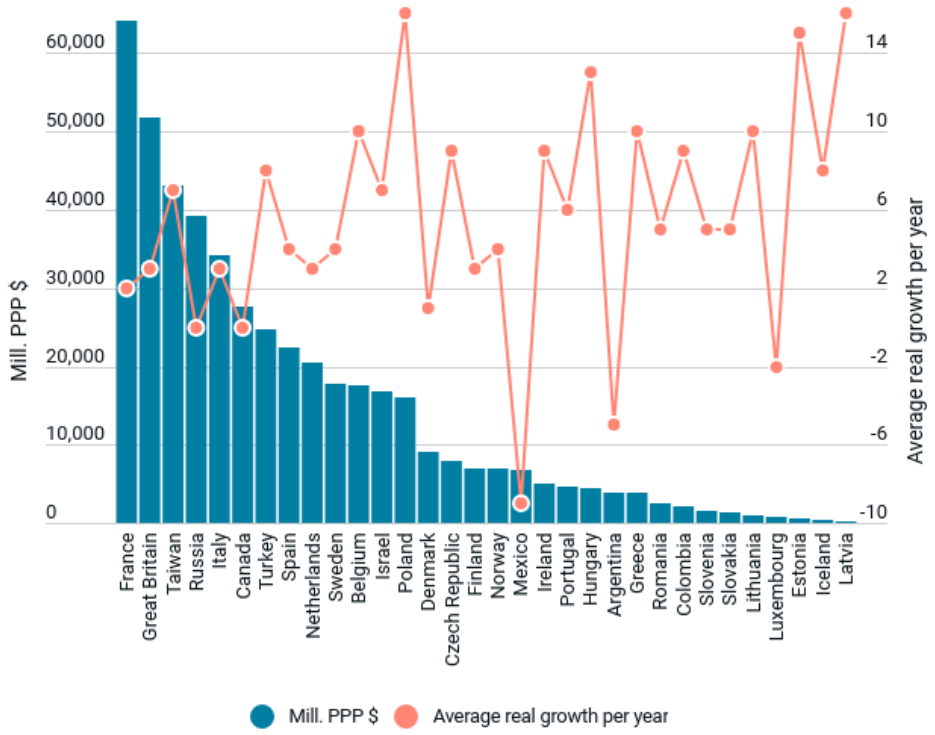
R&D activity in different countries can be measured in several ways. The most common is to measure the expenditure or human resources spent on R&D. To compare small and large countries, it is also common to look at the extent of R&D activity in relation to the countries' population or gross domestic product (GDP).

Measured in total R&D expenditure, the United States, China, Japan, Germany and South Korea dominate. Britain and France are still R&D nations of considerable sizes, although they earlier had a stronger position. Israel and South Korea are the most R&D intensive countries. That is, they spend a relatively large share of GDP on R&D. The same countries also score high on the number of research full-time equivalents (FTEs) per 1,000 inhabitants, but so do Norway and the other Nordic countries.

Changed balance of power between the R&D powers

Measured in total R&D expenditure, the five "R&D superpowers" the United States, China, Japan, Germany and South Korea dominate. In 2018, these five countries accounted for approximately 65 per cent of the world's total R&D expenditure.

Figure 2.2 Total R&D expenditure in 2019 (columns) and average annual real growth in selected OECD and EU countries. 2016–2019 (curve). Fixed 2015 prices.



Source: OECD – MSTI, September 2021

There have been clear changes in the balance of power between the various countries, see Figure 2.2. In 1998, the United States and Japan were the dominant R&D nations, while the United Kingdom, France and Germany were larger than China. Throughout the 2000s, China and South Korea, in particular, have increased their R&D efforts. The Western R&D powers have displayed a more moderate growth, while Japan's R&D spending has been virtually at a standstill. Several small R&D nations have also experienced strong growth in recent years. This is especially true for the Eastern European countries which in the 1990s and 2000s became members of the EU and the OECD.

Strongest R&D growth in the OECD since the 1980s

For the OECD area as a whole, the downward trend after the financial crisis has reversed. According to the OECD, we must go back to the mid-1980s to find stronger growth than we have seen in the OECD area over the past three years. For the first time, US R&D spending accounts for more than 3 per cent of GDP. Germany has also crossed this "magic border", while South Korea is approaching its national target of 5 per cent (4.7 per cent in 2019).

The figures for 2019 show that China's R&D spending corresponds to 84 per cent of spending in the United States. If the growth rate continues from the last three years, China will overtake the United States in R&D spending during 2025.

Norway is reducing the distance to the barometer countries

The so-called barometer countries, i.e. the Nordic countries as well as the Netherlands and Austria, have long been used as comparable countries for Norway. In relation to these, Norway has stronger R&D growth, both measured against GDP and in annual real growth. Growth in Norway is driven by both public and business R&D.

In the years following the financial crisis, many countries have had to limit public spending, which has also affected R&D funding. Norway, on the other hand, has had strong and steady growth throughout the period, albeit with a certain flattening after 2017.

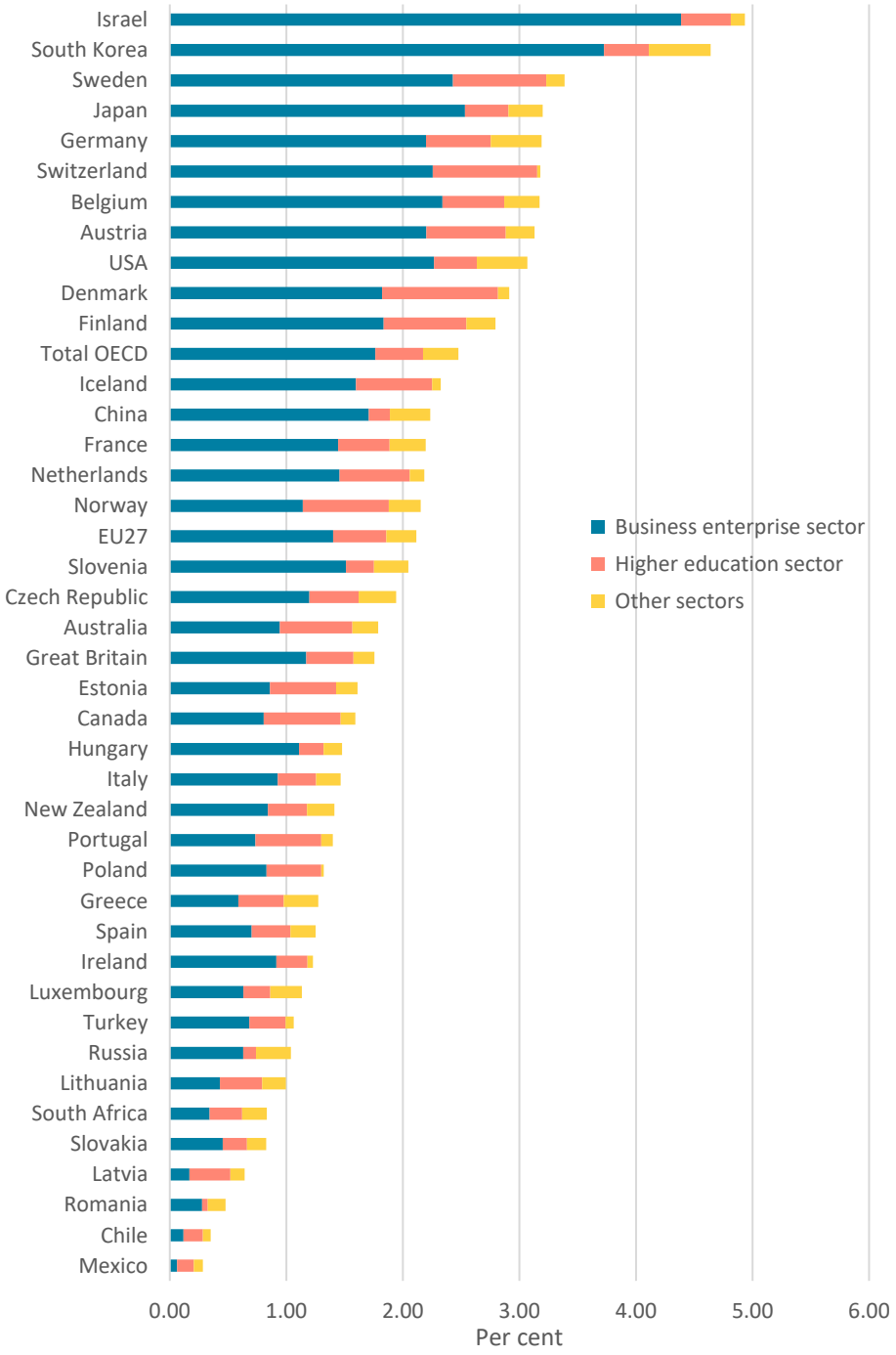
Norway's R&D expenditure exceeds 2 per cent of GDP

Norway's R&D expenditure in 2019 is estimated at 2.15 per cent of GDP, a slight increase from 2.07 per cent in 2018. It is still a long way from the other Scandinavian countries and the adopted long-term goal of an R&D share of GDP at 3 per cent by 2030. Norway's moderate position on this indicator must be seen in connection with the country's generally high GDP level and the great importance of resource-based industries such as oil and gas, aquaculture and metal products.

Preliminary R&D figures for 2020 show a growth in this indicator for Norway with expenditure at 2.30 per cent of GDP. This is influenced by a decline in GDP.

In countries where R&D efforts make up a high proportion of GDP, much of the R&D activity often takes place in the business enterprise sector, see Figure 2.3.

Figure 2.3 R&D expenditure as a share of GDP by performing sector.[1] OECD countries. 2019 or last available year.



[1] Other sectors include both the public sector and the private non-commercial sector (PNP).

Source: OECD - MSTI, September 2021

Here we see that Norway is on a par with comparable countries when it comes to R&D carried out in the higher education sector as a share of GDP. Only Denmark, Sweden and Switzerland come ahead of Norway on this indicator. When it comes to R&D in the business enterprise sector, the level in Norway, on the other hand, is noticeably lower.

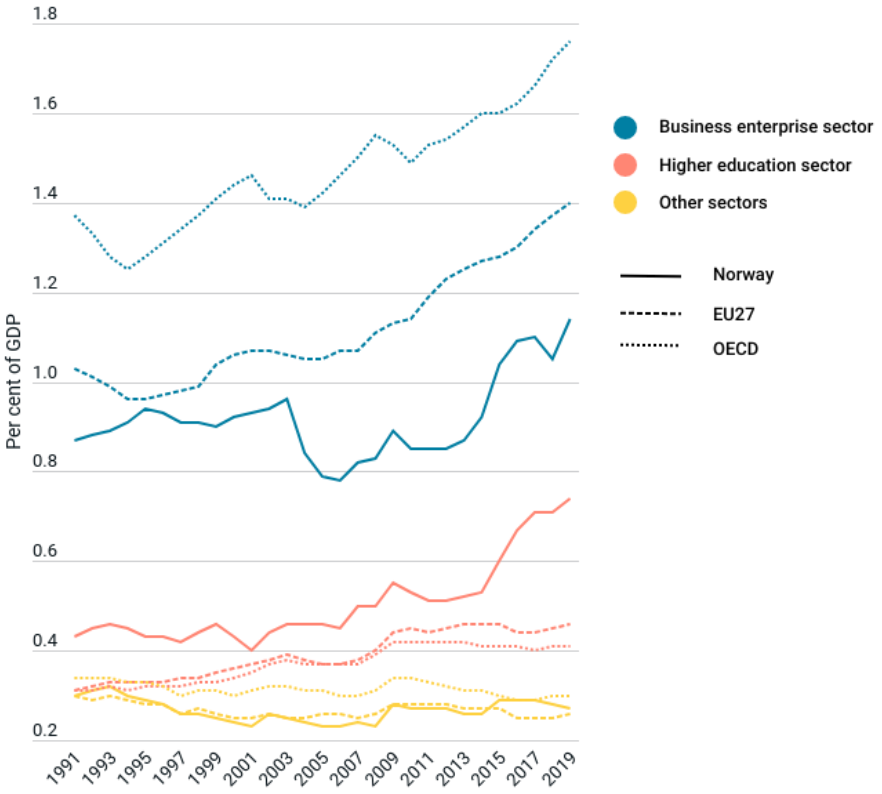
International sector classification

According to OECD guidelines (OECD 2015, Frascati manual) the production of R&D statistics is to be based on four performing sectors: business enterprise sector, government sector, private non-profit sector (PNP) and higher education sector. In Norway, the business enterprise sector includes, in addition to the enterprises, business-oriented institutes that primarily serve business (the industrial sector in national R&D statistics, see Chapter 1). The government sector comprises units in the institute sector which are government-related, as well as other public institutions. The PNP sector is small in Norway and is only included as an R&D funding sector. The higher education sector is identical in national and international statistics. In terms of R&D funding, own revenues and public and private parts of the general university funds are classified differently in national and international statistics, which may cause minor discrepancies. Both the sector division and sources of funding in national statistics thus deviate somewhat from international R&D statistics.

The higher education sector is increasing its share

Over time, both the business enterprise sector and the higher education sector in the OECD area have increased their shares of total R&D. The category "Other sectors" consists of research institutes, private foundations and public agencies. Their share has declined somewhat, although the distribution between sectors is relatively stable.

Figure 2.4 R&D expenditure as a share of GDP by performing sector.[1] OECD countries. 1991–2019 or last available year.



[1] Other sectors include both the public sector and the private non-commercial sector (PNP).

Source: OECD - MSTI, September 2021

For Norway there is nevertheless a certain shift over time, which is partly due to the fact that a number of independent institutes and research centres have been transformed into private enterprises or incorporated into educational institutions or university hospitals. There is also a general trend that more R&D takes place either in the higher education sector or in the business enterprise sector. Among other things, figures from the EU framework programmes show that universities and colleges raise an ever-increasing share of the programme's funding. This development is to a large extent also noticeable in Norway.

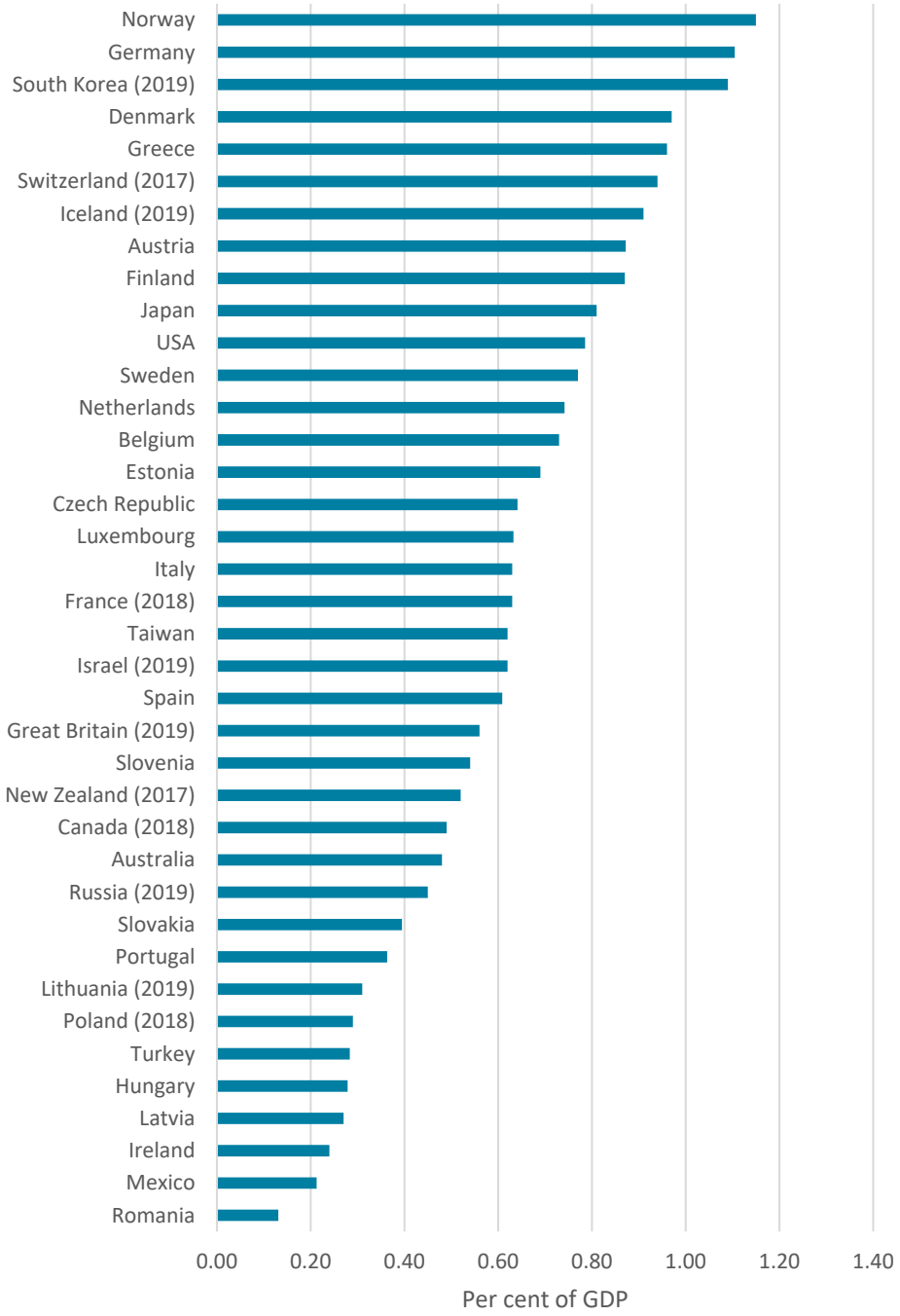
2.2 International comparisons of R&D budgets

In this subchapter, we take a closer look at the OECD countries' government budget allocations for R&D (GBARD), both in terms of amount, structure and development. We focus in particular on how the "corona year" 2020 has affected R&D appropriations. We also include a comparison of indirect public support through tax relief for R&D investments.

Norway at the top in budget R&D allocations as a share of GDP

The latest internationally comparable figures for R&D allocations are from 2020, see Figure 2.5. They show that public R&D allocations in Norway amounted to 1.15 per cent of GDP. This is above Norway's national target of 1 per cent and the highest level in the entire OECD area.

Figure 2.5 Government budget allocations for R&D (GBARD) as a share of GDP in selected countries. 2020 or last available year.



Source: OECD – MSTI, September 2021

Unclear "corona effect" on government R&D funding

R&D budget allocations in 2020 must be seen in the light of the corona pandemic, which affected all countries for much of 2020. On the one hand, the corona situation led to a fall in GDP, which in turn affects all indicators measured against GDP. Across the OECD area, GDP fell by almost 5 per cent in 2020. Spain, France, Italy and the United Kingdom were among the countries hit particularly hard by the pandemic, and where GDP has had an overall decline of almost 10 per cent. In

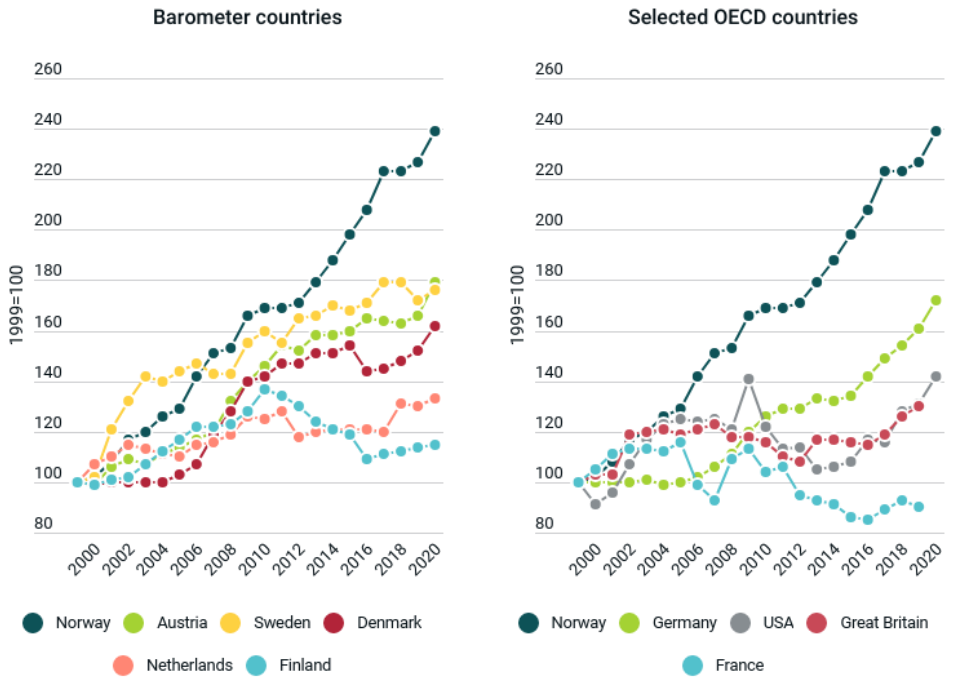
comparison, Norway's total GDP fell by less than 1 per cent, while mainland GDP fell by 2.5 per cent. Norway's relatively high level of R&D appropriations as a share of GDP is therefore more related to growth in R&D appropriations than a fall in GDP.

On the other hand, the corona pandemic may have generated increased R&D funding as a result of "crisis packages" and counter-cyclical measures. Figure 2.6 shows real growth in the countries' R&D allocations in 2020 compared with the growth the year before. Of the 26 countries that have reported R&D allocations for 2020, we see that well over half had stronger growth in 2020 compared with 2019. Nevertheless, we see that as many as 10 countries have had a real decline in R&D allocations in 2020.

Sustained growth in Norway's R&D funding

Norway's high level of R&D funding is due to a development that has taken place over time. At the beginning of the 2000s, Norwegian R&D allocations were around 0.7 per cent of GDP, but have increased steadily since then, reaching 1 per cent for the first time in 2016. The figure shows real growth in public R&D allocations since 2000 for Norway compared with the barometer countries and selected major R&D nations, respectively. In both comparisons, we see that R&D allocations in Norway have increased both more sharply and more evenly than in most comparable countries. Germany is the only one of the selected countries that during the last ten years has had a development curve in line with Norway.

Figure 2.6 Real growth in government allocations for R&D from 1999 to 2020. Barometer countries and selected OECD countries. 100 = 1999 level.



Source: OECD – MSTI, September 2021

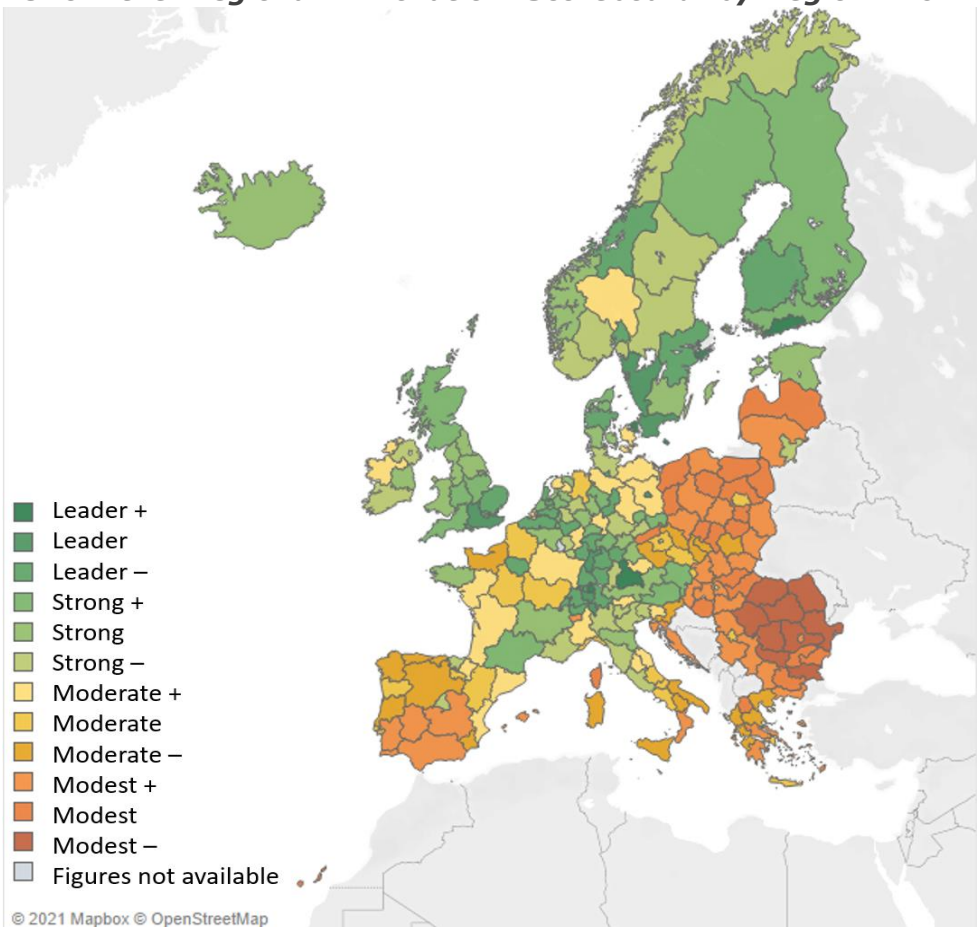
2.3 Regional distribution of R&D in a European perspective

Trøndelag among the most R&D-intensive regions in Europe

Trøndelag is the fourth most R&D-intensive region in Europe, measured in R&D expenditure in relation to the region's value creation (GDP). R&D expenditure accounts for 4.8 per cent of value creation in the region. Only Karlsruhe in Germany, Styria in Austria and Western Sweden score higher than Trøndelag. The Danish Capital Region is also one of Europe's 10 most R&D-intensive regions.

Inner London in the United Kingdom, the Capital Region of Denmark and Brabant in Belgium are among the regions in Europe with the highest proportion of researchers per employee. Of Norwegian regions, we find both Trøndelag and Oslo and Akershus among the top 10. This reflects the fact that Norway has a strong concentration of universities, institutes and knowledge-based businesses around Trondheim and Oslo.

Figure 2.7 Scores in relation to average innovation activity in the EU on the Regional Innovation Scoreboard by region. 2021.



Source: Regional Innovation Scoreboard 2021, EU Commission

Regional Innovation Scoreboard ranks European regions

The EU Regional Innovation Scoreboard (RIS) measures innovation activity in European regions. The most innovative regions are mainly in Central Europe, the United Kingdom and the Nordic countries, while the least innovative regions are concentrated in Southern and Eastern Europe. The map (Figure 2.7) shows how the regions in Europe score in relation to average innovation activity in the EU in 2021.

Many innovation-leading regions in Sweden, Switzerland and Germany

Among the most innovative regions in Europe, we find several Nordic. Stockholm in Sweden, Helsinki in Finland and the Capital Region of Denmark are in first, second and fourth place respectively in the ranking of innovation activity in European regions in 2021. Otherwise, Switzerland and Germany, among others, dominate the top of the ranking of innovation activity in the European regions. Oslo and Akershus and Trøndelag are also categorised as innovation-leading regions, and are ranked number 17 and 31, respectively.

2.4 R&D and demonstration projects in the field of energy and the environment

This subchapter is based on data from the International Energy Agency (IEA). In total, the countries that report data to the IEA account for more than half of the world's energy production and 75 per cent of energy consumption.

Steady growth in funding for energy research in 2020

The IEA countries' total investments in energy research, development and demonstration (RD&D) are estimated at over 18 billion euros in 2020. Adjusted for inflation, there was a growth of about 4 per cent from the previous year. RD&D expenditure increased in all technology areas, with the exception of nuclear power. Hydrogen and fuel cells and other power and storage technologies stood out with the strongest percentage growth (11 per cent) but are still the smallest technology area with RD&D for 730 million euros. However, the largest RD&D effort is in energy efficiency, which has been the dominant technology area for the past five years.

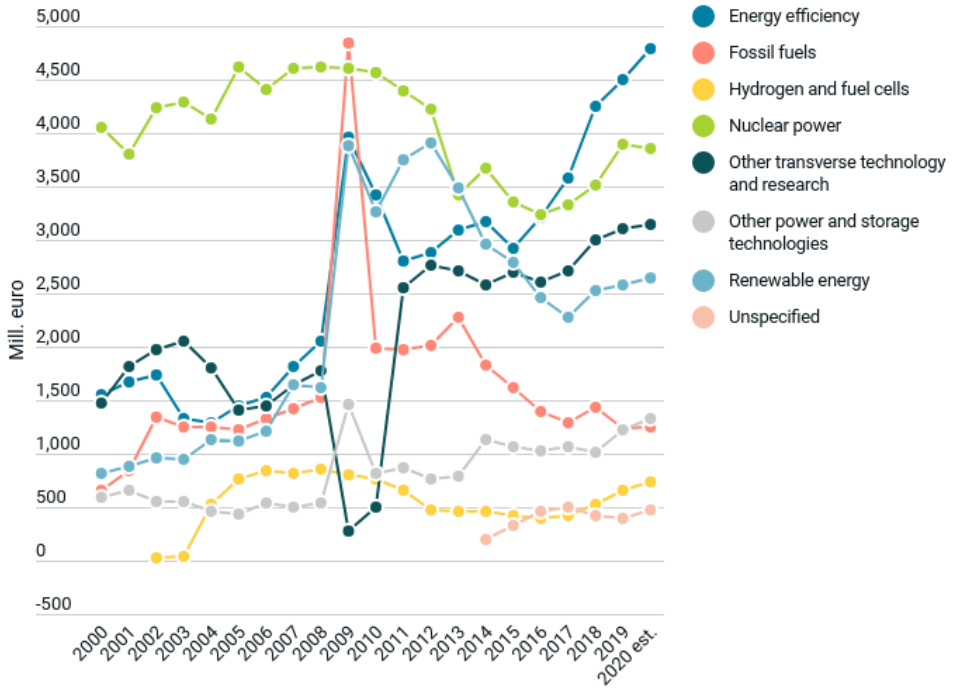
We see that research on nuclear power has been clearly dominant in the first part of the period. With the financial crisis in 2009, many countries used RD&D grants to stimulate other parts of the energy industry, both fossil fuels, energy efficiency and renewable energy sources. In the last decade, the allocations for RD&D on both renewable energy and energy efficiency have remained higher than before 2009. From 2017, more has been allocated for energy efficiency than for nuclear power.

Norway spends more on energy research than other barometer countries

In the last five years, Norway's public RD&D expenditure has averaged 350 million euros (fixed 2015 prices), more than three times as much as Denmark, which was lowest of the barometer countries in the same period (111 million euros). Compared with the 1990s, public RD&D expenditure on energy has increased in all countries, but both Denmark and Finland had higher investments in the period 2010–2014.

If we look at the barometer countries as a whole, the share of RD&D expenditure that goes to energy efficiency has increased significantly over the last 30 years. This has been the largest technology area in the entire period.

Figure 2.8 Public RD&D expenditure on energy in IEA countries by technology. 2000–2020. Fixed 2020 prices.



Source: IEA 2021

Research and innovation a key in the IEA's new roadmap

The IEA report, or roadmap, Net Zero by 2050 has been widely discussed since its launch in May 2021, primarily because it states that there is no need for new oil and gas fields or coal mines after 2021. To achieve the Paris Agreement's target of a maximum of 1.5 degrees temperature increase, the world must implement a large-scale change from fossil to renewable energy sources. The IEA has estimated that around half of the reduced emissions in 2050 will come from technology that has not yet been fully developed. Thus, large investments in RD&D and innovation in clean energy will be crucial. The IEA highlights advanced batteries, hydrogen and CO_2 capture and storage as areas with particularly great innovation potential.

Chapter 3: Human resources

3.1 R&D full-time-equivalent (FTE) and R&D personnel (headcount) in Norway

Human resources are the basis for all knowledge development. In 2019, almost 90,000 people participated in research and experimental development (R&D) in Norway. They performed just under 49,000 R&D full-time-equivalents. Of these, 36,000 were performed by researchers and academic staff. Most of the R&D activity in Norway is thus carried out by people who have research as a central part of their position. But R&D activity is also carried out by people who have main tasks other than research.

Preliminary figures for 2020 show that more than 50,000 R&D FTE were carried out in Norway; almost half of the growth in 2020 took place in the industrial sector. In the following we present the 2019 figures from the main S&T 2021 report.

Nearly 3/4 of the R&D FTE are performed by researchers

A total of 74 per cent of the R&D FTEs were carried out by researchers/academic staff in 2019, but here there were some large variations between the types of institution. At the higher education institutions, the researchers and academic staff performed 87 per cent of the R&D FTEs, corresponding to 72 per cent in the institute sector, 69 per cent in the industrial sector and 56 per cent in the health trusts.

In the health trusts, the division into full-time-equivalents differs somewhat from that at the other institutions. Here, R&D FTEs are reported for three main groups: a) doctors and psychologists in clinical positions, b) staff in research positions (research fellow, researcher and postdoctoral fellow), and c) support positions. Support positions include pharmacists, physicists, nurses and others who participate in R&D, but who do not fit into the other the other categories.

R&D personnel

Nearly 90,000 people participated in R&D in Norway in 2019. Of these, just over two thirds were researchers and one third were technical and other supporting staff. If we look at this in connection with the number of R&D FTEs above, we see that the research/academic staff in Norway spent an average of 58 per cent of working time on R&D in 2019, while for technicians and other support staff the proportion was 45 per cent.

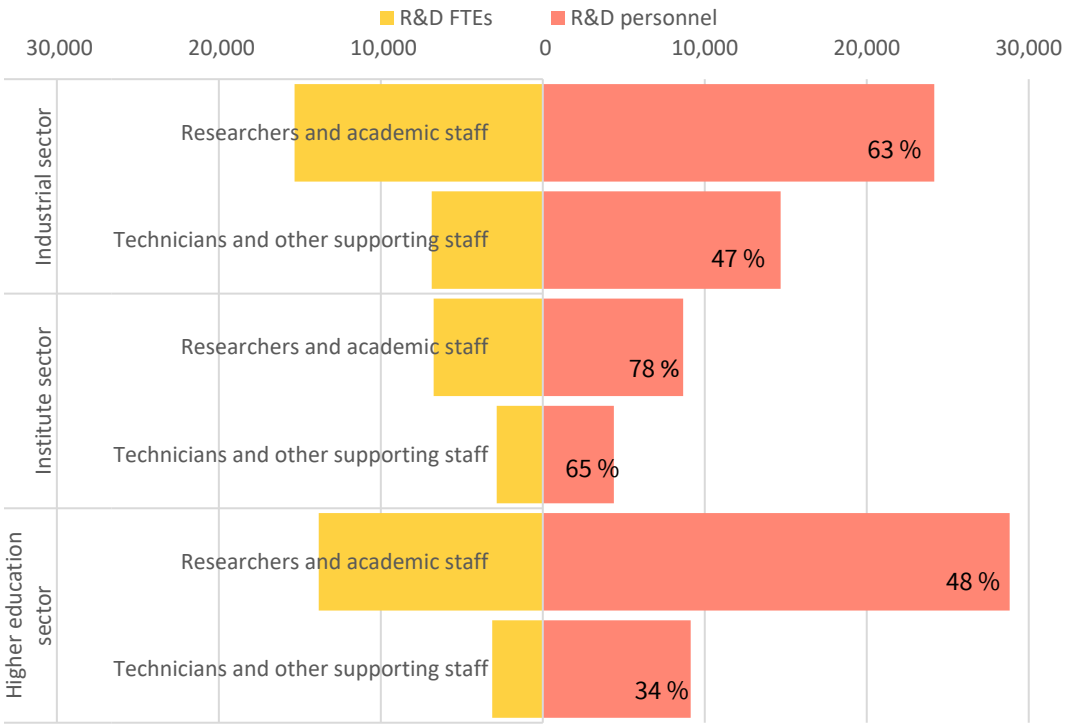
Researchers in the institute sector have the highest proportion of time for R&D

Figure 3.1 shows how the proportion of time for R&D varies between the sectors and the types of positions. We find the highest proportions of time spent on R&D for research staff and support staff in the institute sector, with 78 and 65 per cent, respectively. In the industrial sector, researcher staff spent 63 per cent of their working time on R&D in 2019, while the support staff spent 47 per cent.

Research staff in the higher education sector spend on average a lower proportion of their working time on R&D than research staff in other sectors. The majority of these staff have combined positions and spend a lot of time teaching. Similarly, many doctors and psychologists participate in clinical positions in R&D at university hospitals, with large parts of their working hours related to patient treatment. The

technicians/supporting staff in the higher education sector also spend a smaller proportion of their working time on R&D than in other sectors; many of these are also involved in work with students, administration, patient care at the health trusts and have other tasks that do not involve R&D.

Figure 3.1 R&D FTE and R&D personnel in Norway by sector of performance and type of position.[1] 2019. Time spent on R&D in per cent.



[1] For the business community, R&D staff with higher education are regarded as researchers/professional staff, while other R&D staff constitute technician/support staff.

Source: Statistics Norway and NIFU, R&D statistics

On average, R&D staff in the industrial sector spent 57 per cent of their working time on R&D in 2019. The proportion of time spent on R&D varies greatly between industries; The highest proportion of time spent on R&D is found in industries such as *the computer and electronics industry*, *the petroleum, coal and chemical industries* and *the pharmaceutical industry*, all with a proportion of R&D time of more than 80 per cent. At the other end of the scale, we find *power supply, transport and storage, the lumber and timber industry, water, sewerage* and *waste management and construction*, all with an R&D share of 30 per cent or less.

There is great variation in how R&D takes place in enterprises, and this has an impact on how much time the R&D staff spend on R&D. Some companies have their own R&D department where everyone mainly works with R&D. In other companies, the R&D activity is not separated into its own R&D department or R&D team, and the employees only spend part of their working time on R&D. The extent of technicians and other supporting staff may also have a bearing on time spent on

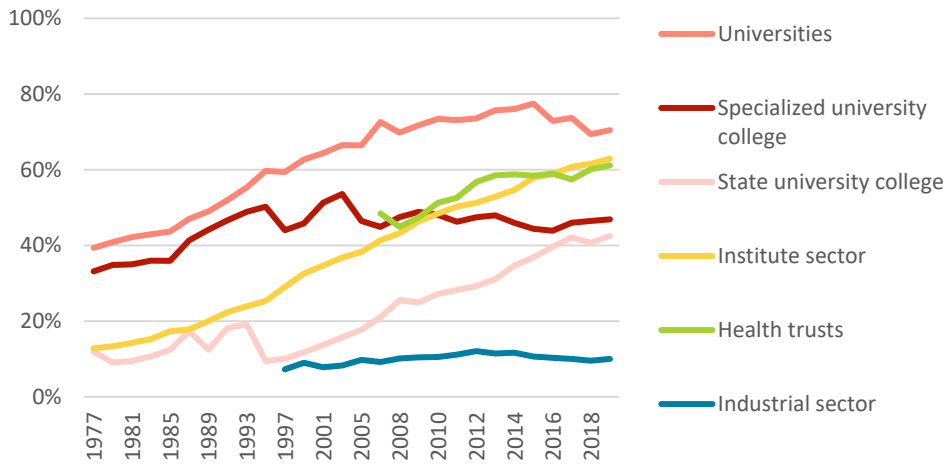
R&D, since technicians/support staff on average spend less working time on R&D than do researchers/academic staff.

The number who complete a doctoral degree has increased sharply in recent years, and we see that about 30 per cent of these continue at universities and colleges, while about 20 per cent go to the institute sector or the health trusts. The number of researchers with a doctorate in the industrial sector is increasing less than expected, the increased access taken into account. This may mean that Norway exports more doctoral candidates abroad now than before, alternatively that more people with a doctorate work in the industrial sector, but not with research. There are also a number of staff with doctoral degrees in the public sector, including the administration and the ministries.

Little increase in proportion of researchers with a doctoral degree in industrial sector

The proportion of researchers/academic staff with doctoral degrees has increased the most in the department sector after 1977, see Figure 3.2, from 10 per cent to over 60 per cent, excluding doctoral fellows. At the same time, we see that the doctoral degree share in the industrial sector has hardly changed since 1997. For the business community, information is available on the doctoral degree share from 1997 onwards.

Figure 3.2 Proportion of researchers/academic staff, excl. doctoral fellows, with doctoral degree by sector/institution type.[1] 1977–2019.



[1] Institutions in the university and college sector are categorised according to the status they had in the current year. The Norwegian School of Agricultural Sciences was a scientific college until 2003, and then a university (UMB, later NMBU). Before 1995, only the regional colleges are included in the statistical basis for the state colleges. New institutions are included in the institution type scientific colleges and others. in 1997, 2007 and 2013. The health trusts are separated as a type of institution from 2007.

Source: Statistics Norway and NIFU, R&D statistics

R&D FTE in the industrial sector

In the industrial sector, the service industries both accounts for the most R&D full-time-equivalents and has the largest proportion of R&D FTEs performed by

employees with a master's degree. 8,700 of 12,800 R&D full-time-equivalents were performed by R&D personnel with a master's degree, major or equivalent i.e. 68 per cent of all R&D FTEs in the service industries. In the manufacturing industries, employees with a master's degree account for about half of all R&D FTEs, while employees with a bachelor's degree or lower/no education perform 40 per cent of all R&D FTEs in the manufacturing industries.

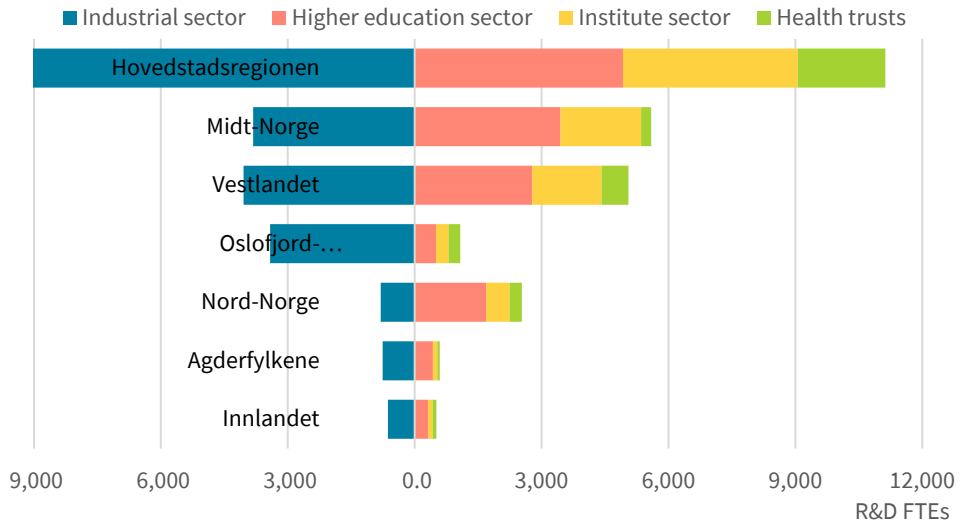
Regional distribution of R&D FTE and R&D personnel

More than 40 per cent of the R&D full-time-equivalents in Norway in 2019 were carried out in the capital. The second largest region was Central Norway, closely followed by Western Norway, both with about 20 per cent of the R&D FTEs. The Oslo Fjord region accounted for 9 per cent of the R&D FTEs, Northern Norway for 7 per cent, the Agder counties for 3 per cent and Innlandet for 2 per cent. This is the same distribution as in 2017, indicating that distribution of R&D activities between the various regions in Norway remain stable.

The capital region is central in all sectors and types of institutions

The distribution of R&D FTEs by sector and type of institution, see Figure 3.3, shows that the industrial sector was the largest sector in the Innlandet and Agder counties, with just over half of the R&D effort, accounting for as much as 76 per cent in the Oslo Fjord region. In the capital and in Western Norway, the business community accounted for about 45 per cent of the R&D full-time-equivalents, compared with 40 per cent in Trøndelag. In northern Norway, universities and colleges were the largest type of institution with 51 per cent of the R&D full-time-equivalents, while the business sector accounted for 24 per cent.

Figure 3.3 R&D FTE in Norway by sector/institution type and region. 2019.



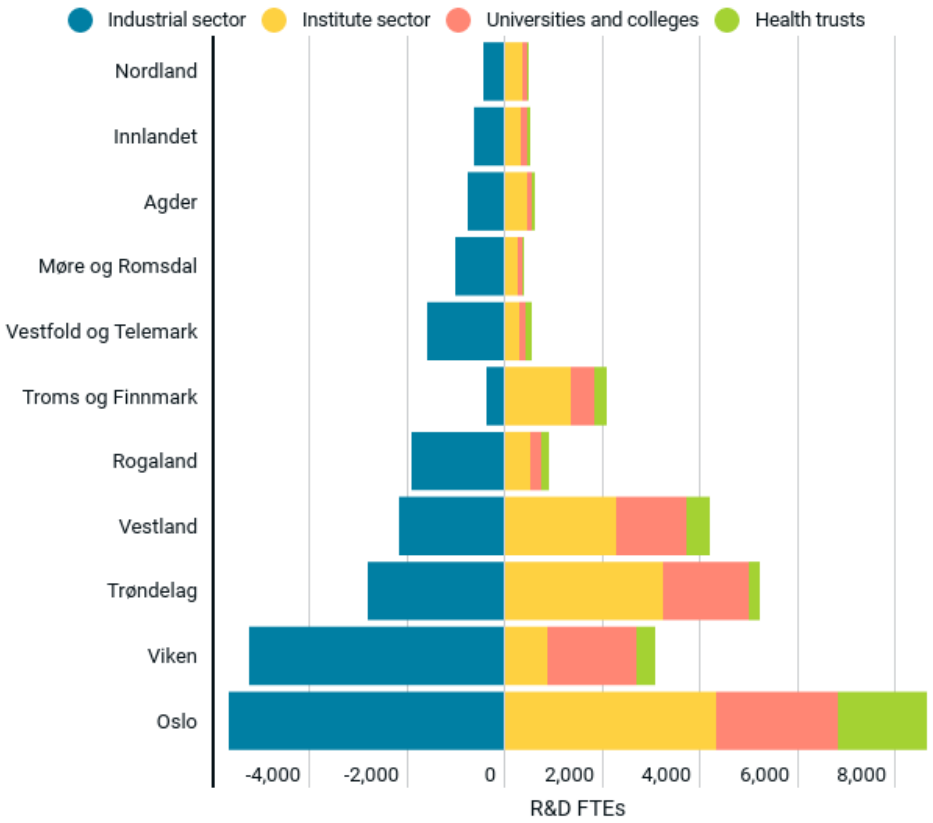
Source: Statistics Norway and NIFU, R&D statistics

In the industrial sector, the capital region with 40 per cent of the R&D FTEs was by far the largest region, followed by Vestlandet and Trøndelag. The distribution of R&D full-time-equivalents in the business sector by region was about the same as in 2017; but Vestlandet increased its share by one percentage point at the expense of the Oslo Fjord region and Trøndelag.

R&D FTE and R&D personnel according to new county divisions

With the new county division, Oslo is still the largest, while Viken is the second largest county, followed by Trøndelag, Vestland and Rogaland. Now Nordland, Innlandet and Agder are the smallest counties, see Figure 3.4. Almost as many R&D FTEs were performed in the industrial sector in Viken as in Oslo, and just under half as many R&D FTEs in the industrial sector in Trøndelag as in Viken. In the institute sector, Oslo is the largest, followed by Viken and Trøndelag, which are about the same size. In the higher education sector, Oslo dominates, followed by Trøndelag, Vestland and Troms and Finnmark. These are the counties where the four old universities are located. In the health trusts, Oslo dominates, followed by Vestland, Viken and Troms and Finnmark.

Figure 3.4 R&D full-time-equivalents in Norway by sector/institution type and county division.[2] 2020.



Source: Statistics Norway and NIFU, R&D statistics

3.2 Diversity among researchers

In this subchapter, we describe different types of diversity among Norwegian researchers. First, we present indicators for gender balance in Norwegian R&D personnel, then we present figures from statistics on diversity in research.

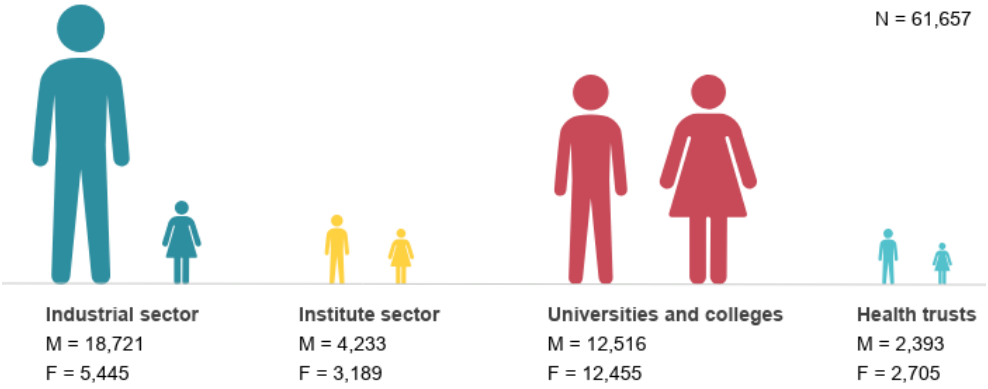
Gender balance in research staff in Norway

A total of 37,900 male and 23,800 female researchers participated in R&D in Norway in 2019. 18,700 of the men and 5,400 of the women were employed in the

[2] County division by 2020.

business sector, which corresponds to a proportion of women of almost 23 per cent in the sector. In the institute sector, the proportion of women was 45 per cent, while it was 50 per cent at universities and colleges and 53 per cent at the health trusts. The ratio between the number of women and men by sector and type of institution is given in Figure 3.5.

Figure 3.5 Female and male researchers in Norway by sector/institution type. 2019.



If we look more closely at the gender balance at the higher education institutions, we find that there is the highest proportion of women in associate professor positions, and the lowest among professors. This has been consistent throughout the last 20 years (1989–2019). The proportion of women has increased faster for associate professors and associate professors than for professors.

For staff with a fixed-term contract such as research fellow, research assistant, postdoctoral fellow and researcher employed on projects at universities, colleges and health trusts, the gender balance is fairly even, and the proportion of women has been around 50 per cent throughout the 2000s.

PhD positions usually have a duration of 3–4 years. The proportion of women passed 40 per cent, and gender balance, already in 1995, and women have been in the majority since 2007. In 2019, 56 per cent of staff in a PhD position were women. In the industrial sector, the proportion of women among researchers was somewhat higher among those with a doctorate than among those without.

In 2019, 38,900 people participated in R&D in the Norwegian industrial sector. This is 2,000 more than the year before. 8,000 of these were women. The proportion of women among R&D personnel in the industrial sector had a slight decrease by about 1 percentage point, but the proportion has been relatively stable at around 20 per cent for several years. About 22 per cent of the R&D personnel are women. The proportion of women is higher among researchers/academic staff with a doctorate. In the industrial sector, R&D personnel with a doctoral degree or higher degree education (master's degree or equivalent) are classified as researchers/academic staff.

The most even gender balance in large companies

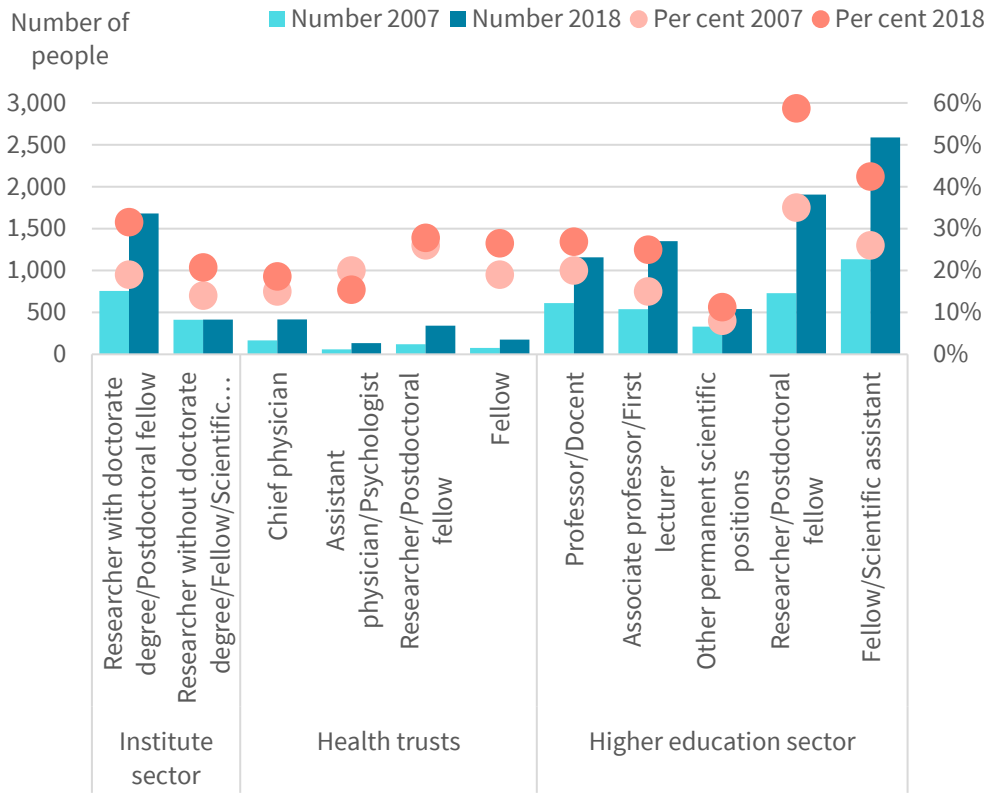
The gender balance in the industrial sector's R&D personnel improves somewhat with the size of the enterprises. In enterprises with 5–9 and 10–19 employees, 19 per cent of R&D personnel were women. The proportion of female R&D

personnel gradually increases with the size of the enterprises. In enterprises with at least 500 employees, 26 per cent were women. This pattern is evident in all three main industries, manufacturing industry, services and other industries. It is in the manufacturing industry we find the biggest difference between small and large enterprises. This is a stable pattern over time.

29 per cent of the researcher population in 2018 were immigrants

The statistics on diversity in research, which are compiled by NIFU and Statistics Norway jointly, show that 29 per cent of researchers and academic staff at the country's universities, colleges, health trusts and in the institute sector were immigrants or descendants of immigrants in 2018. This is a significant growth from 2007, when the proportion was 18 per cent. The proportion of descendants among the researchers and the academic staff is low, 0.5 per cent in 2018. There were a total of 190 descendants in the researcher population. So far this is too few to compile detailed statistics.

Figure 3.6 Immigrants and descendants of immigrants by sector of performance and type of position. 2007 and 2018. Number and per cent.



Source: NIFU and Statistics Norway, Diversity Statistics

In 2007, most immigrants and descendants of immigrants were among research fellows (26 per cent), researchers and postdoctoral fellows (35 per cent) and professors (20 per cent) at universities and colleges. There were also many among researchers with a doctorate in the institute sector (19 per cent). At the health trusts, most immigrants and descendants of immigrants were among chief physicians in clinical positions.

Most researchers from Germany, Sweden and China

Germany is the country where most of the internationally mobile researchers come from; almost 800 German men and about 550 German women hold research and professional positions in Norwegian academic institutions. This is followed by researchers/professionals from Sweden and China.

Men and women are recruited differently from different countries. Most men come from Germany, Sweden, Great Britain and India, while most women are recruited from Germany, Sweden, Denmark and China.

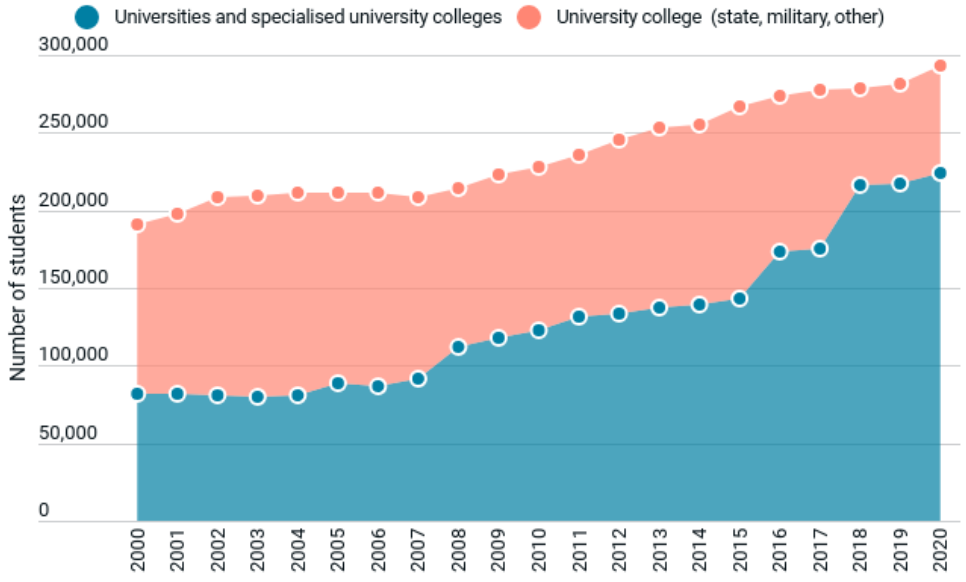
3.3 Education

In this subchapter, we present trends for student and graduate numbers. We also present figures on student mobility in and out of Norway.

11,000 more students by 2020

In 2020, there were 292,900 students in Norway, which is an increase of just over 11,000 students compared with the previous year. Figure 3.7 shows the student number development over the last 20 years, from the beginning of the 2000s. At the beginning of the 2000s, the number of students in Norway was just under 200,000 and part of a rising trend that had been going on since the late 1980s. From 2002 until 2007, the number of students was stable at just over 200,000, which can be partly explained by a period with small birth cohorts (approx. 50,000 children per year) just over 20 years earlier. From 2008, the number of students began to increase again, and there has been steady growth until 2016, before it flattened out until 2019.

Figure 3.7 Number of students in higher education in Norway by type of educational institution. 2000–2020.



Source: Statistics Norway

Today, 3 out of 4 students go to a university

From 2005, Norwegian colleges have been able to apply the authorities to become a university, and it is largely these changes that have led to a shift in the ratio

between the number of students at universities and colleges. In 2004, there were 4 universities, 8 specialised universities and 25 state university colleges in Norway, while in 2020 there are 10 universities, 6 specialised universities and 5 state university colleges. Over the years educational institutions have been merged, smaller educational institutions have become part of a larger educational institution, and colleges have changed their status to universities. Today, only one in five students attends a state university college, while 20 years ago, three out of five studied at this type of institution.

International student mobility

International student mobility increased significantly in the 2000s, but the corona pandemic has led to a decline in student mobility. For Norway, the pandemic has affected both the number of Norwegian students who travel and the number of foreign students who come to Norway. The changes have been far greater for the number of students on exchange stays than for the number of students taking a full degree in another country.

Strong growth in international student mobility in the 2000s

The number of students who took a full degree outside their own home country rose from 2.2 million in 2000 to 5.6 million in 2018 (OECD, 2021). There are no global statistics on changes in student mobility after 2018, and this means that the numerical consequences of the pandemic for international student mobility are currently uncertain.

Dramatic decline in the number of new students – but not everywhere

Several countries report a significant reduction in mobility. For example, the number of international students in Australia has been reduced by 20 per cent, and the number of new international students has been reduced from over 50,000 to almost zero in one year (Australian Bureau of Statistics, 2021). There are also reports of significantly fewer international students from the USA (University World News, 2021). But there are also countries that have experienced an increased influx of international students. Swedish universities report an increase of 13 per cent from 2019 to 2020 (University World News, 2020). British universities have also experienced an increase in influx (Khrono, 2020). When the consequences of pandemic on student mobility vary between countries, this must be seen in the light of practical and legal barriers to mobility. Some countries have introduced very strict entry restrictions, while others to a greater extent allow foreign students to enter the country.

In the Norwegian statistics for international student mobility, we can observe the early consequences of the pandemic.

Many Norwegians take full degrees abroad

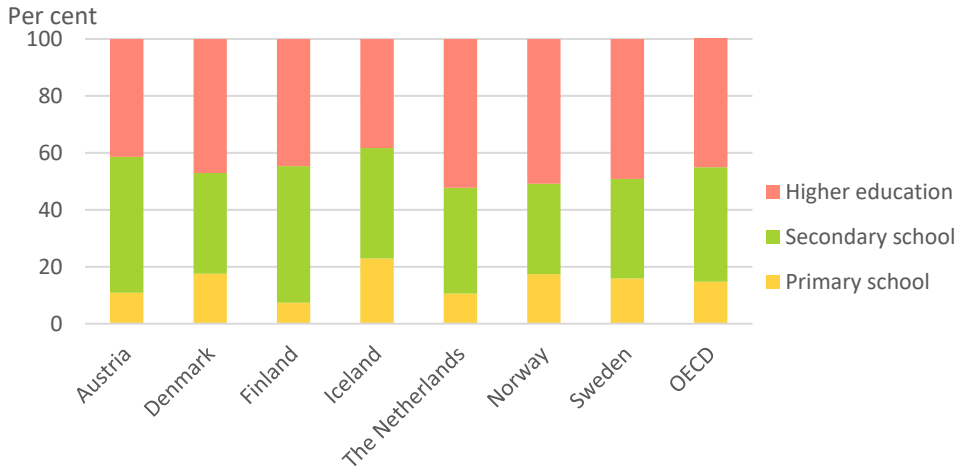
Norwegians have a long tradition of studying abroad. The reason for this is that Norway once had limited capacity in higher education. In the first couple of decades after 1945, travelling abroad was a necessity to be able to take certain educational courses, and up to a third of Norwegian students were foreign students. Student financing through student loans (Lånekassen) helped to make this possible, even for students without well-off parents.

Study capacity in Norway has gradually been expanded, and today the majority of those who travel choose to do so because they have a genuine desire to study abroad rather than in Norway (Hovdhaugen & Wiers-Jenssen, 2021). But in fields such as medicine, dentistry, veterinary and psychology, the domestic capacity is far lower than the demand for study places. In recent years, the proportion of Norwegian students taking a full degree abroad has been about 6 per cent of the total student body. The trend is slightly downward, but the share is still twice as high as the average in the OECD countries (OECD, 2020).

Large investments in education

OECD countries spent an average of 4.9 per cent of GDP on education in 2018, from primary school onwards and even higher education. In comparison, the share was 6.6 per cent in Norway in the same year. Note that the OECD uses mainland GDP for Norway. With total GDP, the share would be somewhat lower. Norway spends more than other countries, both in terms of expenditure on primary and secondary education, and in terms of higher education.

Figure 3.8 Level of education for persons aged 25–34 years. Barometer countries, Iceland and OECD averages. 2020.



Source: OECD, Education at a Glance 2021

More people with higher education

The level of education among young adults (25–34 years) has increased in recent years. In OECD countries, higher education corresponding to a bachelor's, master's or doctoral degree is the most common level of education among people in this age group, 45 per cent in 2020 against 37 per cent in 2010. In 2020, 51 per cent of the Norwegian population aged 25–34 had higher education. That is four percentage points higher than ten years earlier. The proportion of young adults with higher education is also at a high level among the other Nordic countries; with 49 per cent in Sweden, 47 per cent in Denmark and 45 per cent in Finland. Despite the fact that Finland comes out somewhat weaker in relative terms, it is worth noting that they have a very low proportion of young adults with only primary school as the highest level of education, 7 per cent compared with 17 per cent in Norway. The proportion with higher education is higher for women than for men. This is common for OECD countries. In Norway, the proportion with higher education among 25–34-year-olds was 60 per cent for women and 42 per cent for men in 2020.

3.4 Recruitment for research

In this section, we describe main features of recruitment to Norwegian research. First, we look at the path from master's degree to PhD and postdoctoral position, and where the PhD candidates are recruited from. We also present new data from the Monitoring system for researcher recruitment in Norway.

Here we take a closer look at PhD and postdoctoral positions in Norway, as well as the recruitment of staff with doctoral degrees from abroad. We use data from the Doctoral Degree Survey and the Postdoctoral Research Survey, as well as basic data from the Register of research personnel.

Most postdocs at the University of Oslo

In 2019, there were 2,162 postdoctoral fellows in Norway. Of these, 49 per cent were women and 51 per cent were men. The University of Oslo had the most postdocs, closely followed by NTNU. In total, 63 per cent of the postdocs were at one of the four old universities and 9 per cent at one of the new universities. The health trusts had 13 per cent of the postdocs, and 12 per cent were in the institute sector. Only 4 per cent of the postdoctoral fellows in 2019 were at a state university college.

Most technologists leave academia

Technology has the highest proportion of doctoral candidates leaving academia. Nearly 70 per cent left of academia in 2019. We can assume that many of these have found work in the industrial sector, but some have also left Norway. Technology has the highest proportion of non-Norwegians among the doctoral candidates, and many of them travel back to their home country or to other countries after they have obtained a doctorate in Norway.

In agriculture, fisheries and veterinary medicine and mathematics and science, a relatively high proportion of doctoral candidates go to the institute sector, about 20 per cent in both disciplines. In both of these fields of R&D, a high proportion of candidates leave Norwegian academia; 56 per cent in mathematics and science and 60 per cent in agriculture, fisheries and veterinary medicine.

Monitoring system for researcher recruitment in Norway

The monitoring system for research recruitment has been developed to follow doctoral students from entering an agreement on doctoral education at an educational institution until they retire. The monitor has been developed in collaboration between the Research Council of Norway, Statistics Norway, NIFU and NSD (Norwegian centre for research data). The Ministry of Education and Research participates as an observer. The recruitment monitor currently covers the period from 2005 to 2019, and the first results are now available. The monitor is expected to be fully operational in the spring of 2022.

The basic population consists of people who have been admitted to the doctoral programme at a Norwegian university or a Norwegian college. Information on these is obtained from the Database for Statistics on Higher Education (DBH), formerly under NSD, now under the HK Directorate. The material is then linked to information about any completed doctoral degree from the Doctoral Degree Register, which is operated by NIFU in agreement with the Research Council.

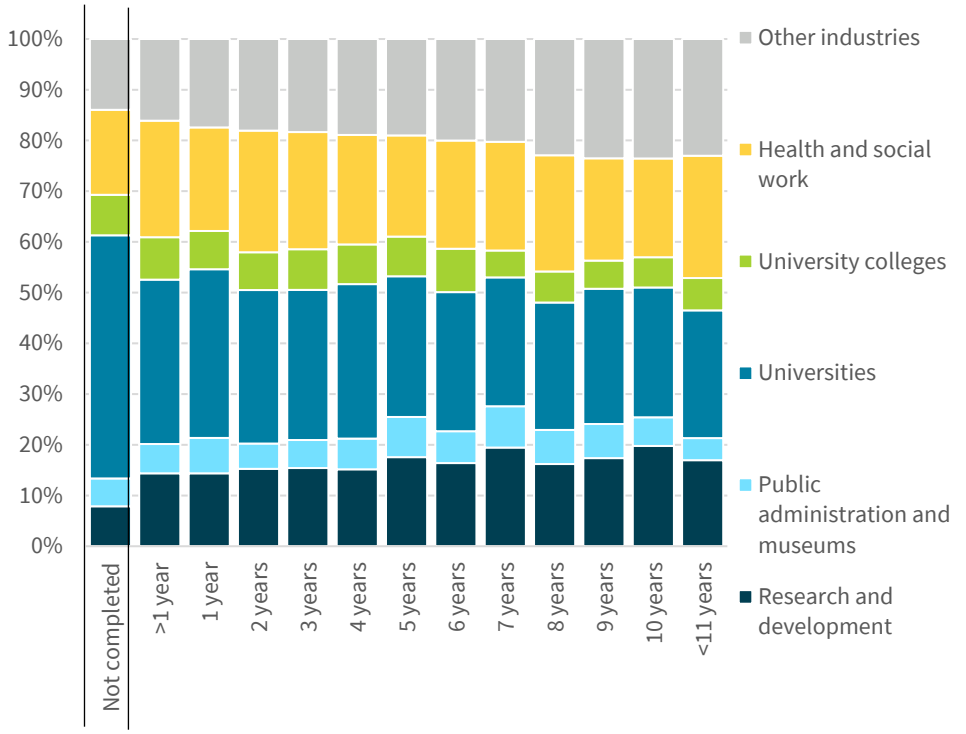
Secondly, information on careers at universities, colleges, health trusts and research institutes from the Research Personnel Register is connected to the monitor. The linked file is sent to Statistics Norway, which retrieves information from its system for personal data, including careers outside the institutions mentioned above.

The proportion employed outside academia increases over time

Of those who completed their doctoral degrees in 2019 and 2020, see Figure 3.9, about a third were employed at a higher education institution in 2020. For those completing before 2014, the corresponding proportion was 25 per cent. The figure only shows those who are employed in Norway.

The proportion of doctors employed in the research and development industry is higher for those who defended their dissertations more than five years ago, than for those with a more recent doctoral degree. The proportion found in public administration and museums, on the other hand, is stable for the entire period. The same also applies to health and social services, although this proportion fluctuates more. There is a relatively large difference between those with a recent doctoral degree and those with a somewhat older doctoral degree who go to other industries, which here primarily include the industrial sector. The proportion who go to the industrial sector increases with the number of years after the dissertation.

Figure 3.9 Labour market situation in the 4th quarter of 2020 for doctoral students admitted in the period 2005–2019 who are employed in Norway, by industry and number of years after completing a doctoral degree.



Source: Monitoring system for researcher recruitment in Norway

New top score for doctoral degrees completed in Norway

In 2020, there were 1,634 people defending their doctoral dissertations, and this is the highest number to date. 2020 was the third year in a row with a new annual

record for completed doctoral degrees. In the last 15 years, the number of doctoral degrees taken at Norwegian educational institutions has doubled.

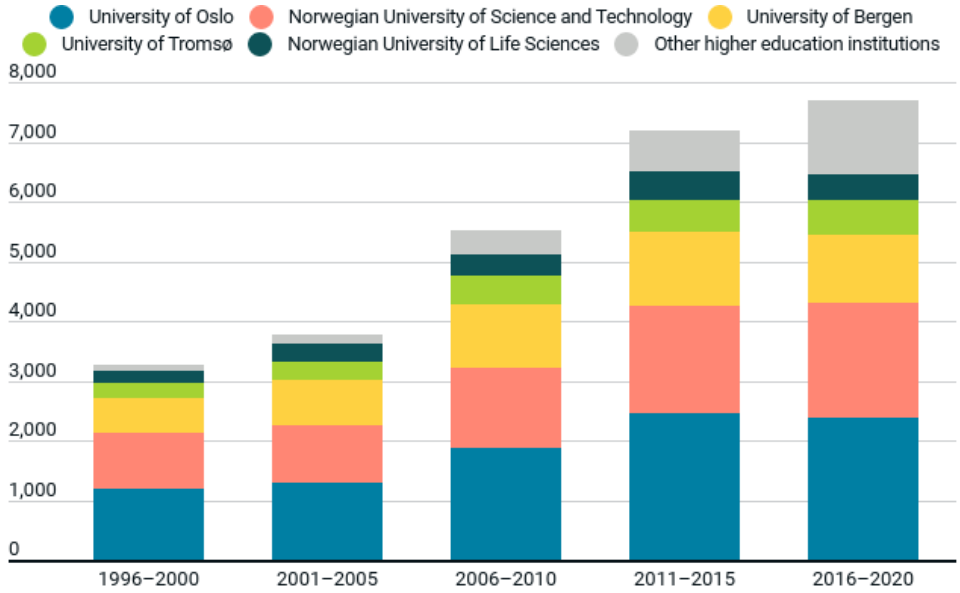
The increase must be seen in connection with major changes in Norwegian doctoral education. The degree structure has been changed, several educational institutions have been accredited to award doctoral degrees, and the allocations for PhD positions have grown significantly.

Large increase at the "new" universities

At the turn of the millennium, it was possible to obtain a doctorate at 10 Norwegian educational institutions. Since then, more and more institutions have been accredited, and by 2020, 22 institutions had the right to award doctoral degrees.

The traditional universities have always had a central position in Norwegian doctoral education. In particular, the University of Oslo and NTNU have accounted for a large part of the doctoral degrees. In the last five years, a total of 56 per cent of the awards have taken place at these two educational institutions. The proportion has nevertheless decreased somewhat compared with the situation 20 years ago, when the proportion of disputations at UiO and NTNU was 65 per cent, see Figure 3.10.

Figure 3.10 Number of doctoral degrees completed by degree-granting institution. 1996–2020.



Source: NIFU, Doctoral Degree Register

At the same time, there has been a corresponding increase at other educational institutions. This is due both to activity at new graduating institutions, but first and foremost to the fact that the new universities are now graduating significantly more doctors than when they were state university colleges. The development must be seen in connection with the fact that a larger proportion of PhD positions in recent years have been allocated to the new universities.

In the period 2018–2020, almost 600 disputations were held at the five new universities. This was almost a doubling compared with the previous three-year period. All universities can point to a solid increase in disputations in recent years.

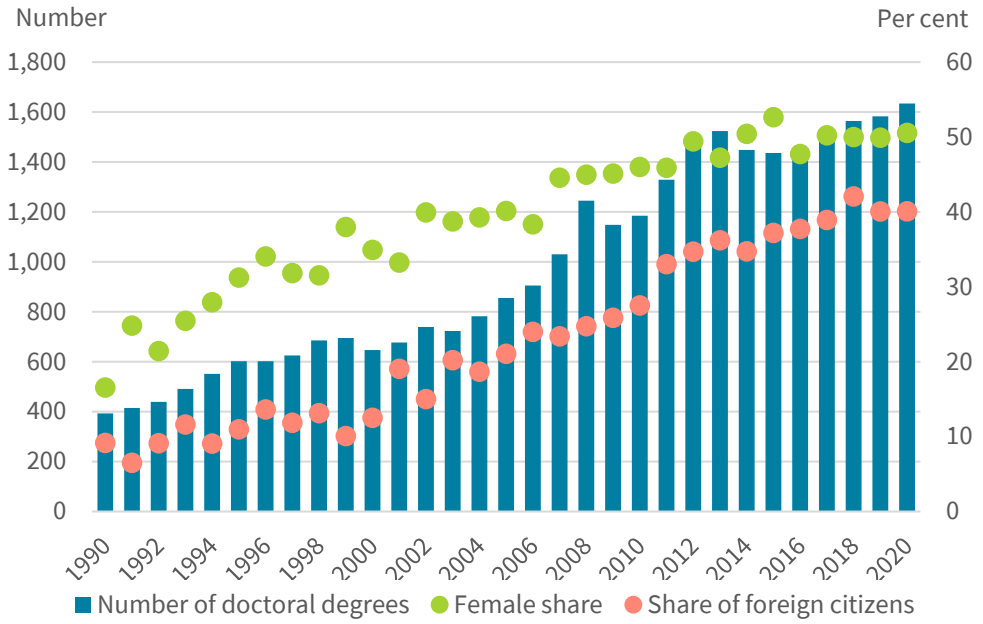
The new doctors have not become younger

Changes in doctoral education have so far not contributed to graduating younger doctors. The average age of those defending their dissertations today is generally the same as 20 years ago. Among all those who defended their dissertations in the period 2016–2020, the average age was 37.6 years. The average age among doctors who graduated during the period 1996–2000 was 37.4 years.

Gender balance from 2012

In the early 1980s, it was mostly men who earned a doctorate. Nine out of ten new doctors were men. During the first half of the 1990s, it became more common among women to take a doctorate, and in the mid-1990s, almost a third of the doctoral degrees were taken by women. The share then flattened out for a few years, before continuing to rise after the turn of the millennium. Since 2012, the proportion of women among doctoral students has been between 47 and 53 per cent annually, see Figure 3.11. This also reflects the composition of students in organised doctoral education, where 54 per cent are women and 46 per cent men.

Figure 3.11 Number of completed doctoral degrees. Percentage of women and Non-Norwegian citizenship. 1990–2020.



Source: NIFU, Doctoral Degree Register

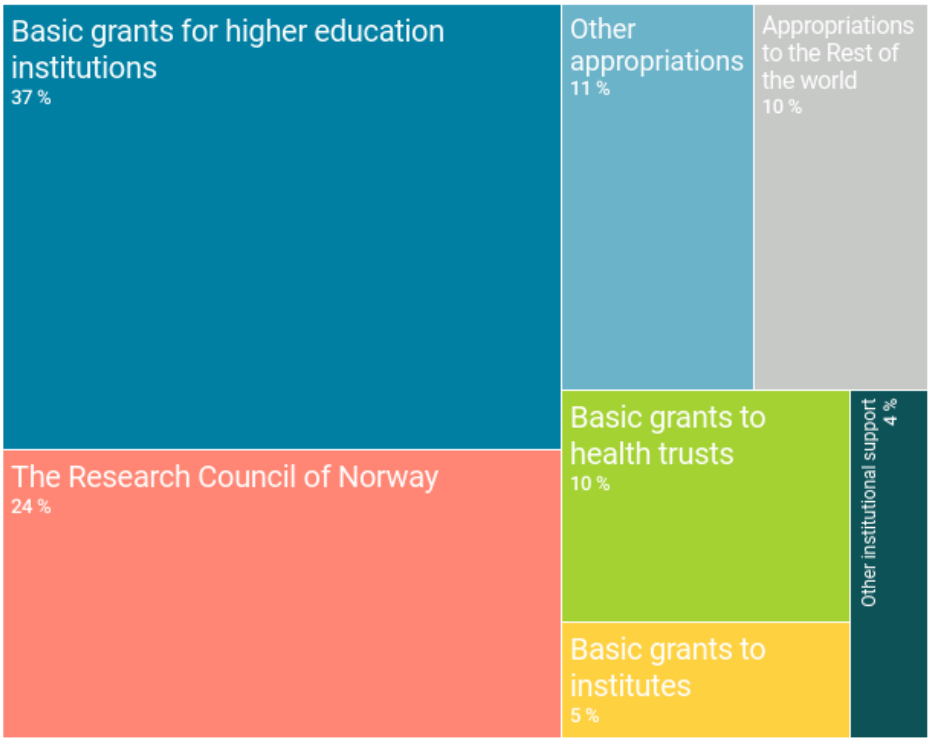
Eight times as many foreign doctoral students as 20 years ago

Another important factor in recent years is that more foreign citizens are pursuing doctoral degrees at Norwegian educational institutions. Compared with the situation 20 years ago, today there are eight times as many with a foreign background who are completing a doctorate in Norway. In the last five years, more than 3,000 foreign nationals have defended their dissertations at Norwegian educational institutions, or more than 600 annually. The proportion of foreign doctoral students now amounts to around 40 per cent, while it was just over 10 per cent at the beginning of the 2000s.

Chapter 4: Public support for R&D and innovation

Government budget allocations are key instruments when the authorities want to promote growth and prosperity and solve major societal challenges, for example related to sustainability, health and digitalisation. This chapter gives an overview of government budget allocations for R&D (GBARD). We also look at the development of key grants and support schemes for R&D and innovation under the policy instruments of the Research Council of Norway, Innovation Norway and SIVA, as well as the indirect support through the tax deduction scheme (SkatteFUNN). The chapter also presents figures for Norway's participation in the EU framework programme for research and innovation, Horizon 2020. 2020 has been a special year, where the corona pandemic has had a major impact on the policy instruments, and this is reflected in the chapter.

Figure 4.1 Main recipients of public R&D grants in Norway.[1] Estimated R&D grants in the approved state budget 2021.



[1] The research institutes' basic grant is included in the box for the Research Council of Norway, while the category basic grant to institutes covers other state research institutes that receive grants directly from a ministry.

Source: NIFU

4.1 National allocations for R&D and innovation

Public support for R&D and innovation includes both grants for R&D, indirect support in the form of tax deductions and grants for innovation that are not R&D. Below we describe these forms of support.

Weak real growth in R&D appropriations

NIFU's analysis of the adopted state budget for 2021 estimates appropriations for research and development (R&D) to amount to approximately NOK 40.8 billion,

see Figure 4.2. This implies an increase of NOK 1.6 billion compared with the approved budget for 2020, or a nominal growth of 4 per cent. In fixed prices, the 2021 budget will give a growth in allocations for R&D of around 1 per cent compared with the balanced budget for 2020. As a result of the corona pandemic, however, significantly larger additional allocations were made during 2020.

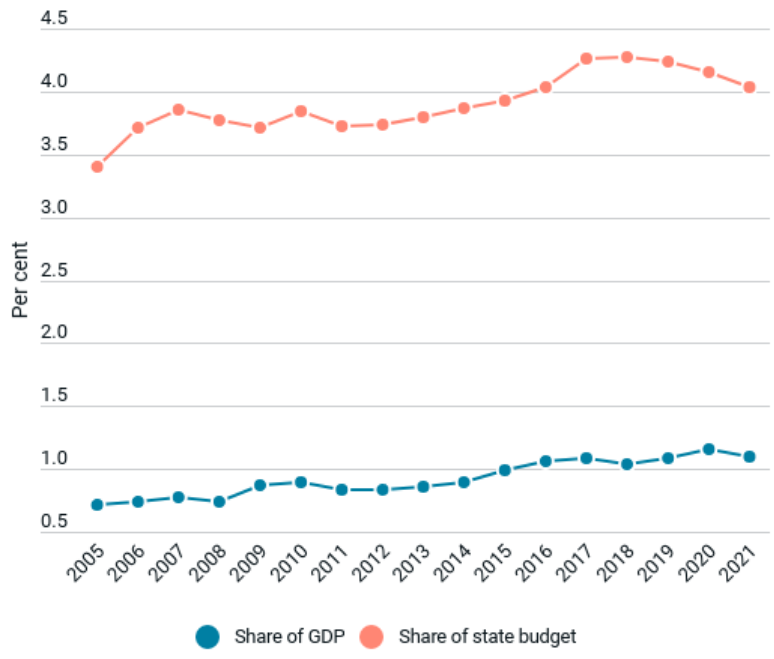
The adopted budgets in the period 2013–2017 had a large and relatively steady increase in allocations for R&D. Annual average real growth in this period was just over 5 per cent. In the last four budgets, growth has levelled off. In fixed prices, R&D appropriations in 2021 are estimated to be only about one percentage point higher than the level of appropriations in 2017.

Small decline in 2021 R&D measured against GDP and total appropriations

R&D appropriations as a share of gross domestic product (GDP) express the relationship between the public investment in R&D and overall value creation. R&D appropriations in the approved state budget for 2021 are estimated at 1.10 per cent of GDP. This is somewhat lower than in 2020, when the share was 1.16 per cent, which was the highest level ever for this indicator. The high share in 2020 is largely due to sharply reduced GDP as a result of the corona crisis, as well as the additional allocations for R&D in extraordinary crisis packages.

The appropriations for R&D are estimated at 4.04 per cent of the 2021 budget's total expenditure when transfers to the Government Pension Fund, and loan transactions are excluded. The share is somewhat lower than in the previous budgets. For this indicator, the 2017 budget is the highest, with 4.27 per cent.

Figure 4.2 Estimated appropriations for R&D from the approved state budget. 2005–2021. Share of gross domestic product (GDP) and share of total appropriations from the central government budget. Per cent.



Source: NIFU, State Budget Analysis Source: NIFU, State Budget Analysis

Large additional allocations in 2020 due to the corona pandemic

In the spring of 2020, the Storting granted large packages of measures in connection with the corona pandemic. Parts of the package of measures also benefited R&D purposes. The total R&D scope of the additional appropriations in 2020 is estimated at NOK 2.4 billion. A significant part of the appropriations concerned business-oriented R&D.

The level of additional appropriations is significantly higher in 2020 than has previously been the case. In most budget years since 2005, the scope of additional allocations for R&D has been modest. Additional appropriations have been more than half a billion kroner twice before. This happened in 2009 because of extra appropriations to combat unemployment and mitigate the effects of the international financial turmoil in the Norwegian economy, and in 2015, primarily as a result of the appropriations for the EU contingent being adjusted upwards in the budget year. The additional appropriations in 2020 amount to more than 6 per cent of the original budget, a share that is more than twice as high as in any other year since 2005.

Grants through the Research Council of Norway

The Norwegian authorities provides significant parts of the allocations for R&D through the Research Council. The purpose of channelling the research funds through the Research Council is to ensure research quality through competition and societal relevance by means of specific initiatives related to thematic areas and societal challenges.

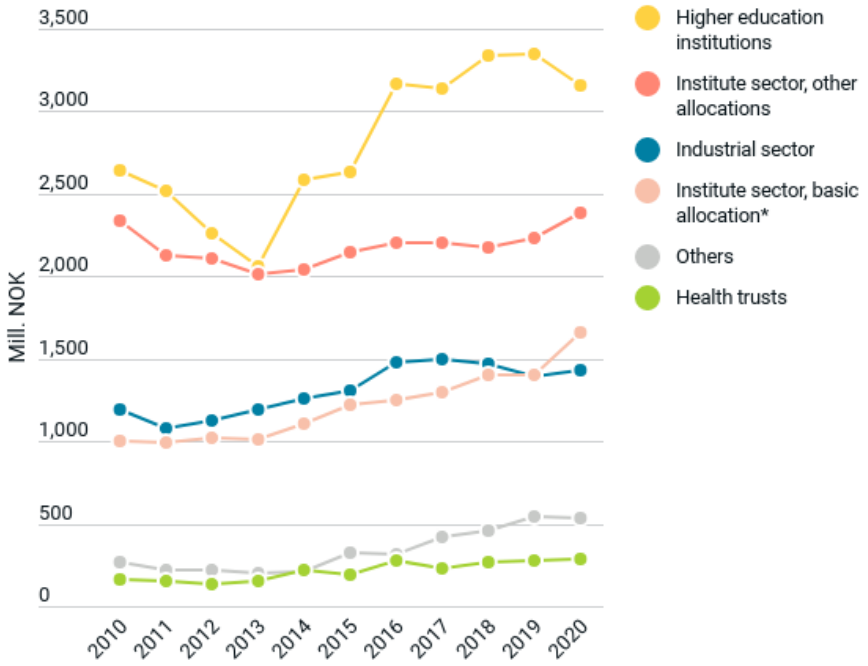
The Research Council allocated more than NOK 10 billion for R&D in 2020

The allocations for R&D from the Research Council in 2020 were NOK 10.4 billion. This is a nominal increase from the previous year of just over 2 per cent. Looking at the increase adjusted for inflation, this resulted in almost zero real growth.

The Research Council allocates R&D funds to actors in the institute sector, at universities and colleges and the business enterprise sector. By comparison, the remaining ones – health trusts and other sectors – receive only marginal shares of the Research Council's grants.

Figure 4.3 shows that the allocations to the department and university and college sector reflected the general allocations from the Research Council up to and including 2019: they decreased in the period from 2010 to 2013, but increased in the following years. In 2020, on the other hand, allocations to the university and college sector have fallen in real terms, while allocations to the institute sector have increased. The distance between the two sectors was in any case smaller in 2020 than in 2013, where the fall for the university and college sector was greater than for the institute sector and was compensated by a steeper increase between 2013 and 2016. The basic grant the institute sector receives from the Research Council may have functioned as a grant buffer. The allocations to the other recipients, such as the business community and the health trusts, have risen somewhat in fixed prices, but have been relatively stable as a percentage of total allocations.

Figure 4.3 The Research Council's allocations by sector. 2010–2020. Fixed 2015 prices.



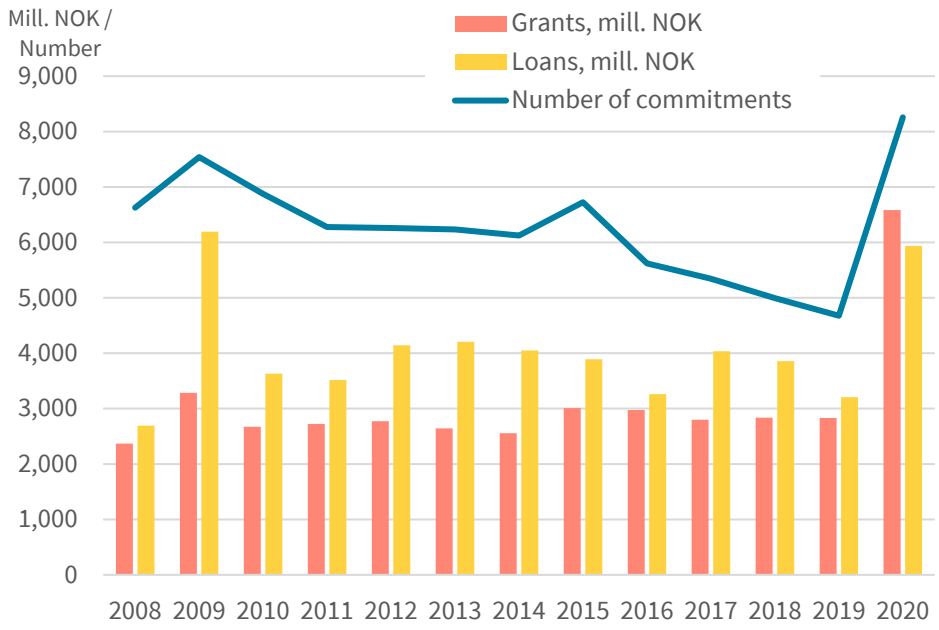
[1] The basic allocation to the institute sector for 2020 includes additional allocations from the package of measures in connection with the corona pandemic.

Source: The Research Council of Norway

Grants through Innovation Norway

Figure 4.4 provides an overview of the number of commitments and the sum of loans and grants from Innovation Norway IN) in the period 2008–2020. If we look at the years from 2008 to 2010, we can see that IN played an active role during the financial crisis. From lending around NOK 2.7 billion in 2008, Innovation Norway increased the lending amount to NOK 6.2 billion in 2009. The grants also increased in the same period from NOK 2.4 to 3.3 billion. Both loans and grants fell back to a more normal level in 2010, and the sum of loans and grants remained relatively stable from 2010 to 2019. In 2020, both loans and grants increased sharply; the sum of the loans reached the same exceptional level as in 2009, while the sum of the grants roughly doubled from the level in 2009. The pandemic crisis in 2020 has thus been met in a different way from the financial crisis in 2009, the increase in numbers being largely driven by the increase in the grants.

Figure 4.4 Number of commitments and loans and grants from Innovation Norway. 2008–2020.



Source: Innovation Norway

Innovation Norway

Innovation Norway (IN) is a state-owned Norwegian special law company founded in 2003 with the aim of increasing innovation in Norwegian enterprises and industry across the country, helping to develop the districts and profiling Norwegian business and Norway as a tourist destination.

Innovation Norway is owned by the Ministry of Trade, Industry and Fisheries and the county municipalities with 51 and 49 per cent, respectively. Innovation Norway is the Norwegian government's official trade representative abroad.

The main goal is that Innovation Norway will trigger business and socio-economically profitable business development and trigger the regions' business opportunities. In addition to the main goal, Innovation Norway has three sub-goals: 1. more good entrepreneurs, 2. more high-growth companies and 3. more innovative business environments.

Throughout 2020, IN received significant extraordinary grants and new assignments to safeguard the business community's innovative power. This included compensation and restructuring funds for industries that were hit hard by the economic consequences of the corona pandemic. IN introduced relief in terms for loan customers with a grace period and interest-free periods to a significant extent. For new innovation and risk loans, the requirements for satisfactory security were significantly reduced.

The tax deduction scheme SkatteFUNN

Since its inception, the SkatteFUNN scheme has experienced both growth and a decline in support. As we can see from Figure 4.5, the scheme started strongly, with around 3,500 new, approved projects and over 5,500 planned, active projects in 2003. Despite this, support for SkatteFUNN fell considerably in the following years. In the period 2006–2012, the number of new, approved projects was less than 2,000 and planned, active projects were around 3,500. This changed after 2012, when the scheme experienced increasing popularity. The number of new, approved projects rose to a peak of 3,656 projects in 2016, and planned, active projects peaked in 2017 with 7,628 projects. In the period from 2016 to 2020, the number of new and active projects has decreased slightly. If we look at total tax deduction, the expenses related to the scheme changed little until 2012. From 2012 to 2018, on the other hand, the expenses increased considerably and in 2018 were more than three times greater than in 2012. This increase was due to both the number of new and active projects. and that the limit for the tax deduction increased. In 2019 and 2020, there has been a slight decrease in the total support through the scheme.

Tax deduction through SkatteFUNN

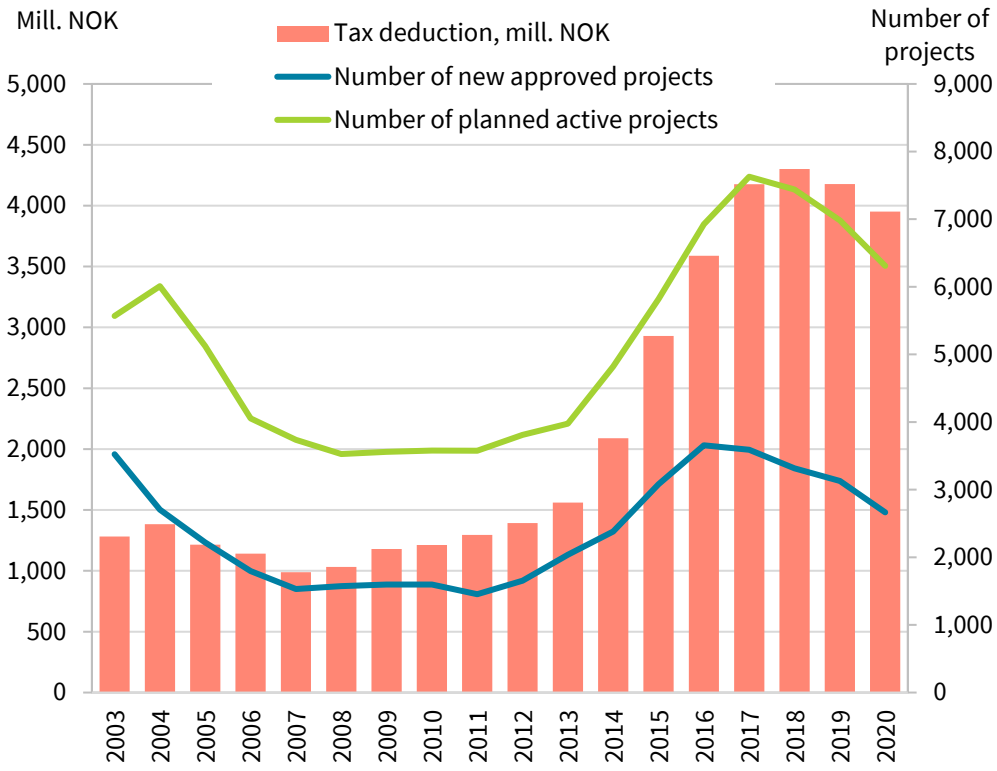
SkatteFUNN is a tax deduction scheme that aims to stimulate increased R&D efforts among Norwegian companies. The scheme is rights-based and means that all companies that want to develop or improve goods, services or production processes through research and development, can apply to have parts of their R&D costs deducted from the tax. The scheme was established in 2002 and has since its inception been expanded with increased deduction options four times (2009, 2014, 2015 and 2016). SkatteFUNN is today the largest single measure among the business-oriented instruments, measured in public costs. The deduction percentage in the tax settlement is currently 19 per cent, while it was previously 20 per cent for small and 18 per cent for medium-sized companies. The Research Council of Norway must approve the R&D project.

New recipients of R&D support

Many applicants in 2020 are relatively "new" (i.e. they have not used the support instruments in the 3-year period before the corona crisis), and relatively many of them came from industries that were historically less R&D-intensive like *tourism, retail, construction, transport and logistics* and *water and waste management*. Most new recipients of support were newly established companies.

Micro-enterprises with 0–4 employees are the largest group that receives funding from Innovation Norway and Siva. This group is also most strongly represented among the users of support from the Research Council, SkatteFUNN and from the EU's research programme H2020. This can be partly explained by the large proportion of enterprises with zero employees in the population of Norwegian enterprises.

Figure 4.5 Tax deduction, new and planned projects under SkatteFUNN. 2003—2020.



Source: The Research Council of Norway

4.2 Norwegian participation in the EU framework programme for research and innovation

International research and innovation collaboration is a key tool for improving Norwegian research, both to achieve higher scientific quality and to make positive contributions to societal and business development. Europe is the most important area for Norwegian collaborative relations, and participation in the EU's framework programme for research and innovation is the largest single measure for the internationalisation of Norwegian research. In this subchapter, we present the main findings for participation in Horizon Europe (2014–2020) and some comparisons with the participation in the Seventh Framework Programme (20017–2013). In January 2021, Horizon Europe started, a continuation of Horizon 2020. Norway has decided to participate in this programme as it has in the previous programmes.

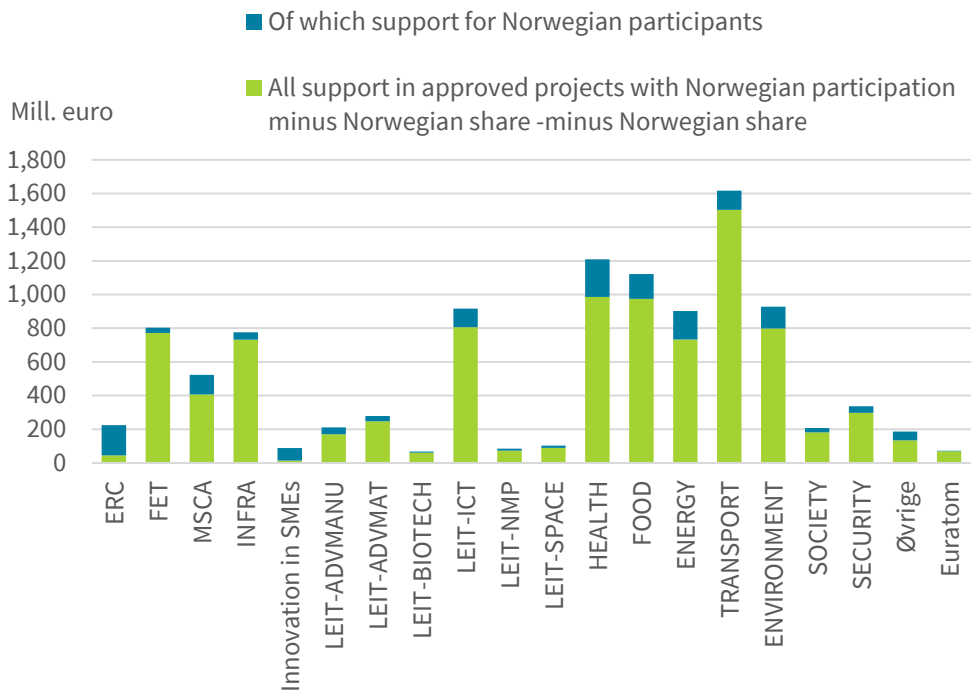
Good Norwegian count in Horizon 2020, especially towards the end of the period

Horizon 2020 started in 2014 and ended in 2020. Horizon 2020 had a budget of almost 75 billion euros and is considered the world's largest research and innovation programme of its kind. Through the Agreement on the European Economic Area (EEA), Norway has since 1994 participated as a full member of the programme. The estimated contingent for Norway's participation in Horizon 2020 is around NOK 16–18 billion. The investment from Norwegian society is thus significant, but Norwegian actors have made good use of the programme, especially in its latter part.

A peak was reached for Norwegian participation in the framework programme in 2021. According to the results as of April, 1.56 billion euros have found their way from Brussels to Norwegian participants. H2020 runs over 7 years, and the accumulated contingent and return will be divided by 7. When the last allocations have been counted, the accumulated return will probably be between NOK 16 and 17 billion, corresponding to an annual return of close to NOK 2.5 billion. In addition, a multiplier effect comes from participation in the collaborative projects.

Norwegian researchers, companies and municipalities have never before competed for more money from the EU within a framework programme. Norwegian players had by April 2021 received almost 2.5 per cent of the funds announced through Horizon 2020. The Norwegian ambition was 2.0 per cent. Norway participates in more than 1,800 approved projects and through them gains access to research and innovation with a total funding of around NOK 100 billion.

Figure 4.6 Total financing in projects with Norwegian participation in Horizon 2020. Mill. euro.



Source: The Research Council of Norway based on the European Commission's database, eCorda. April 2021

Increased competition for funds

The profile of Norwegian participation in the framework programme has changed considerably from the seventh framework programme for the period 2007–2013 (FP7) to Horizon 2020. Competition for budget funds has also increased considerably. In FP7, 23 per cent of all applications were submitted for funding, while the corresponding figure in Horizon 2020 is 12 per cent. The Norwegian success rate has been well above the average for all applications submitted to both FP7 and Horizon 2020.

Norwegian participants have traditionally done best in the thematic parts of the framework programmes and strengthened further in these programmes in Horizon 2020. Overall, Norway is among the countries that have had the highest growth in the return share from FP7 to Horizon 2020.

Increased participation and return for all sectors

In FP7, the institute sector accounted for the largest share of the Norwegian return, while the university and college sector has the largest share in Horizon 2020. All sectors have increased their participation significantly in absolute numbers. This is due to the fact that the budget for Horizon 2020 is larger than for FP7, and that Norway has strengthened its competitiveness with a significant increase in the return share from FP7 to Horizon 2020.

Largest increase in participation from the business community

Relatively speaking, the industrial sector has increased its participation most from FP7 to Horizon 2020. This is mainly due to the introduction of two new project types in Horizon 2020 that are specifically aimed at companies: Innovation Actions and the SME instrument/EIC accelerator. IA finances collaborative projects at a high technology maturity level, where it is assumed that companies play a dominant role in the project consortia.

Government actors and health trusts are more active

In Horizon 2020, public enterprises and health trusts have also increased their participation compared with FP7. In Horizon Europe, it is a clear priority to involve government actors in several projects together with research institutions and the business community, so that knowledge and technology that comes out of the projects can be used more easily.

Larger projects

Each project in Horizon 2020 has on average been larger than in FP7, with higher budgets and more participation. It has also affected Norwegian participation. For collaborative projects with Norwegian participation, the amount allocated per project has almost doubled from FP7 to Horizon 2020. SINTEF and the University of Oslo are the largest Norwegian actors in the EU framework programme. SINTEF is also the Norwegian player with the most coordinator roles.

More collaboration

Cooperation between Norwegian actors from various R&D sectors has increased from FP7 to Horizon 2020, also relatively speaking. This applies to most sectors, but the increase in cooperation for the higher education institutions as well as the industrial sector is particularly high. Also, when it comes to Norway's cooperation with other countries, the picture has changed somewhat. Spain is now Norway's second most important partner country in the projects.

Highest Norwegian return share in climate, environment, bioeconomy, food and energy

Despite the fact that Norway also did well in the thematic programmes in FP7, the return shares under the societal challenges (SC) and industrial leadership (LEIT) in Horizon 2020 are significantly higher than for Cooperation in FP7. This applies to almost all sub-areas under SC and LEIT. It is within climate and environment that the Norwegian return share is by far the highest, as it was in FP7. In Horizon 2020,

Norwegian players have obtained 4.9 per cent of the announced funds in this programme. The return share also remains high in the energy programme by 4.0 per cent, while it has increased sharply in food and bioeconomy in Horizon 2020, where it is now at 4.4 per cent of the announced funds. In the new SME instrument/EIC accelerator, Norwegian companies have also done very well.

Improved results for research excellence

In the programmes within excellence research, where the Norwegian count has previously been weakest, the development has been positive. The Norwegian return share, as well as Norwegian representation in both applications and funded projects, has increased in the European Research Council (ERC) and Marie Skłodowska-Curie activities (MSCA). This is especially true in MSCA, where the Norwegian success rate is also strengthened against the average in this programme.

Only Spain and Belgium have had a larger increase in the return share than Norway

Norway has increased its return share, from 1.69 per cent in FP7 to 2.49 per cent in Horizon 2020. As can be seen in Table 4.1, only Spain and Belgium have had a higher growth in the return share in percentage points. Norway is approaching the results of Denmark and Sweden and has overtaken Finland. Both Finland and Denmark have increased their return share, but less than Norway, while Sweden's return share is lower in Horizon 2020 than in FP7.

Table 4.1 Changes in the return share in the EU framework programmes for research and innovation by selected countries.

		Country	H2020	FP7	Change (percentage points)
	1	Spain	9.4 %	7.3 %	2.16
	2	Belgium	4.9 %	4.0 %	0.91
	3	Norway	2.5 %	1.7 %	0.80
	4	Portugal	1.7 %	1.2 %	0.50
	5	The Netherlands	7.9 %	7.4 %	0.45
	6	Ireland	1.8 %	1.4 %	0.36
	7	Finland	2.2 %	1.9 %	0.31
	8	Greece	2.5 %	2.2 %	0.27
	9	Italy	8.3 %	8.0 %	0.25
	10	Austria	2.9 %	2.7 %	0.24
	12	Denmark	2.6 %	2.4 %	0.23
	30	Sweden	3.4 %	3.8 %	- 0.35

Source: The Research Council of Norway based on the European Commission's database, eCorda. April 2021

Chapter 5: Intellectual assets

The chapter presents intellectual property (IPR) indicators in Norway and internationally. Intellectual property rights are particularly relevant during the development and/or commercialisation of new products and services and have therefore been used as a measure of the results of research and innovation activities over many years.

5.1 Intellectual property rights in Norway

To protect an invention in Norway, you can apply for a patent directly to the Norwegian Patent Office or you can apply for a European patent through the European Patent Office (EPO). When the patent has been validated in the EPO, the holder can have it validated in Norway by the Norwegian Patent Office.

Validation of patents

Validation patents and patent applications are two different indicators. Validation patents are patents that have been granted by the European Patent Office (EPO) in accordance with European guidelines. The EPO is thus responsible for the approval process. The Norwegian Patent Office validates these patents so that they become valid in Norway. When we talk about patent applications, we mean the document that Norwegian and foreign applicants send to the Norwegian Patent Office to start a process that can result in a patent.

Effects of the corona pandemic on intellectual property rights may come later

The figures from the corona pandemic 2020 temporarily show a negative trend for Norwegian applicants. The number of applications for patents, trademarks and design protection has fallen in 2020. The process around a patent protection comes quite late in the life of an invention. In some cases, a design may also need a longer time before an application for protection is submitted.

The process of trademark registration is faster and less expensive than for patents. Figures from Statistics Norway show that several companies were established in the year 2020. A brand can be used to introduce a product or service in the market. Such use could be useful for people starting on their own, for example due to insecure work or lack of work in the corona pandemic. Even a company that has to restructure its production to adapt to a new market can, among other things, receive support for its strategy with trademark protection.

Another way to apply trademarks is when established players want to make innovations in existing products and services visible or register a new name due to a merger or important organisational changes. These latest applications are signs of expansion. During a difficult economic period, many such projects will be postponed. This could lead to a lower number of trademark registrations.

5.2 Patent applications

Fewer patent applications submitted in 2020

In the pandemic year 2020, the Norwegian Patent Office received a total of 1,444 patent applications, 6 per cent fewer than the year before. Both domestic and foreign applicants had lower numbers. For Norwegian applicants, there was a decrease of 6 per cent, and they submitted a total of 834 patent applications. Approximately 83 per cent of all these applications were submitted by Norwegian companies. The rest came from private individuals who are not registered as self-employed. Norwegian companies submitted 8 per cent fewer patent applications in 2020.

About patents and the Patent Cooperation Treaty (PCT)

A patent gives the exclusive right to exploit a concrete solution to a technical problem. Patents are awarded to inventions that constitute a practical solution to a problem, where the solution has a technical character, technical effect and is reproducible. New inventions can be new products, processes or applications. An idea cannot be patented without explaining or showing how it can be implemented in practice.

The purpose of patenting is to stimulate innovation and innovation through a combination of time-limited exclusive rights to inventions and publication of information about these. Obtained patent gives the right to prevent others from exploiting new inventions that provide solutions to a technical problem (business perspective). In return, the invention must be published.

It is expensive to develop a patent, and the willingness to invest in development is assumed to be greater when exclusive rights can be achieved. A patent gives the right to prevent others from exploiting inventions, but it does not necessarily give financial gain. The development of a patent may give a negative return for the applicant. At the same time, the resources that go into developing a patent, the costs of the process from application to award and the cost and resources to protect the patent can go at the expense of resources for innovation and further development of products and services and thus act as a barrier to innovation. These reservations must be considered when using patent data as a source to understand the profile and scope of innovation.

Patent Cooperation Treaty (PCT): is an international patent application scheme. The scheme simplifies filing and investigation if one is to apply for a patent in several countries. Covers 153 countries.

Granted patent: When the patent review and approval process is completed, the patent is granted (announced). The time from filing the application to the patent being approved can vary from two to ten or more years. The complexity of the solution for which patent protection is sought can affect the approval period.

Table 5.1 Number of patent applications by type of application. 2015–2020.

Year	Total number of patent applications	National applications submitted by domestic applicants	National applications submitted by foreign actors	Continued international applications (PCT)	*Of national applications: from Norwegian companies*
2015	1,805	1,122	127	556	*860*
2016	2,062	1,195	121	746	*840*
2017	2,062	1,107	136	819	*807*
2018	1,660	1,016	101	543	*825*
2019	1,531	883	89	559	*752*
2020	1,444	834	99	511	*696*

Source: The Norwegian Patent Office

Foreign players applying for patent protection in Norway will in most cases use an international patent application under the Patent Cooperation Treaty (PCT). The number of applications through this scheme was 9 per cent lower in 2020.

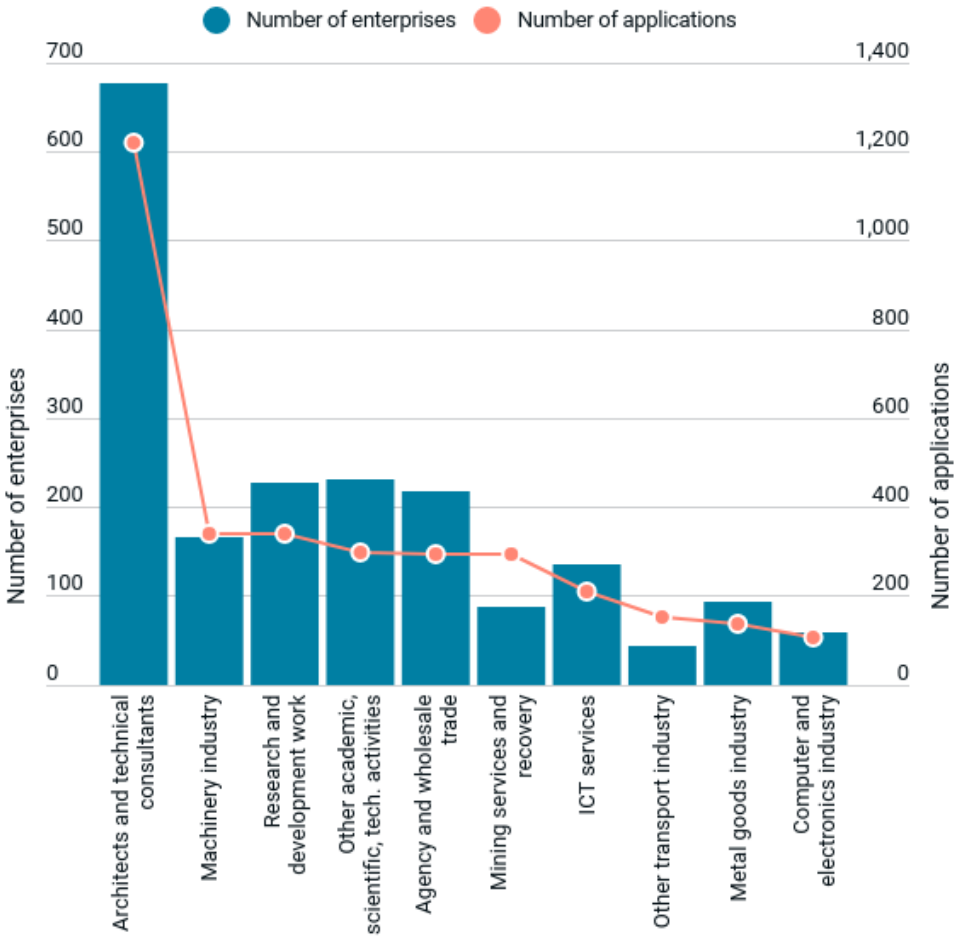
Fewer patent applications in 2020 than in 2015

A direct comparison with 2015 shows that 20 per cent fewer patent applications found their way to the Norwegian Patent Office in 2020, if the number of applications from both Norwegian and foreign actors are counted.

In 2020, there were 511 PCT applications, which was 35 per cent of all patent applications received by the Norwegian Patent Office. When it comes to direct (national) applications from foreign actors, there were 22 per cent fewer applications in 2020 than in 2015, and they accounted for only 7 per cent of the application entry in 2020.

If you work in *technical consulting*, the chances are greater that part of the work is to find solutions that may need an intellectual property right. The enterprises in the industry of *architects and technical consultants* accounted for 25 per cent of the entire domestic application pool; most of the applications came from the sub-group of *technical consultants*. Next come players in the *machinery industry*, which accounted for 7 per cent of all patent applications filed in the six-year period 2015–2020.

Figure 5.1 Patent applications by selected industries. 2015–2020.



Source: Statistics Norway and the Norwegian Patent Office

5.3 Trademark applications

Less demand for trademark applications among Norwegian companies in 2020

Trademark protection is the most used form of intellectual property rights in Norway, both for domestic and foreign applicants. In the pandemic year, the Norwegian Patent Office received 16,660 trademark applications. This was 4 per cent lower than last year's figures. The number of applications among Norwegian applicants was 7 per cent lower than in 2019.

Most applications for trademark registrations submitted to the Norwegian Patent Office by domestic applicants come from Norwegian companies. They accounted for as much as 87 per cent of all trademark applications from Norwegian applicants in 2020. However, there were 8 per cent fewer applications from this group of applicants in 2020 than in 2019.

Foreign applicants mostly use an international registration scheme (the Madrid Protocol) to secure trademark rights in Norway. Through this scheme, there were 5 per cent fewer applications after a record number of 10,275 applications in 2019. The Madrid Protocol is an international agreement that applies to 122 countries and makes it possible to obtain registration of a trademark in several countries based on one international application/registration.

Table 5.2 Number of trademark applications by type of application. 2015–2020.

Year	Total number of trademark applications	National applications submitted by domestic applicants	National applications submitted by foreign actors	International designations in Norway via the Madrid Protocol[1]	*Of national applications: from Norwegian companies*
2015	16,630	4,097	3,007	9,526	*3,710*
2016	15,702	4,265	3,302	8,135	*3,841*
2017	17,307	4,439	3,061	9,807	*4,040*
2018	17,279	4,765	2,799	9,715	*4,161*
2019	17,287	4,168	2,844	10,275	*3,643*
2020	16,660	3,862	3,031	9,767	*3,359*

[1] The Madrid Protocol is an international agreement administered by WIPO (World Intellectual Property Organization) which makes it easier and cheaper to apply for international trademark registration in several countries at the same time. Norway is part of the scheme.

Source: The Norwegian Patent Office

The Norwegian business sector accounted for 89 per cent of all applications for trademark registration sent in Norway in the period 2015–2020. It was *agency and wholesale trade* that applied most for trademark protection in the period 2015–2020, while *retail* is the industry with the second most applications. In addition, there are a good number of applications in *professional, scientific and technical activities* otherwise, an industry that also has many patent applications. *The food and beverage industry* is also a significant group of applicants in terms of trademark protection, but it has few patent applications. There are also several trademark applications from *IT services.*

Design applications in Norway

The Patent Office received 1,279 applications for registration of design in 2020, which was 6 per cent more than the year before. This is due to higher demand from foreign applicants. Design registration is sought to a lesser extent than both patents and trademarks.

National actors sent a total of 236 applications, 3 per cent less than in 2019. In this group are Norwegian companies which in 2020 sent 7 per cent more applications to secure exclusive rights to their designs.

More foreign players applied for design registration in Norway in the period 2015–2020

In total, the number of design applications increased by 5 per cent from 2015 to 2020. Table 5.3 shows a steady growth, except for a decline in 2018. The reason for the growth is applications that are applied in Norway through the international Hague system. In 2020, there were 880 applications via this system, the highest number in the period 2015 to 2020 and an increase of almost 13 per cent since 2015.

Nine out of ten applications for design protection are sent by companies, the remaining 10 per cent by private individuals without company affiliation. Design protection is most sought in the *agencies and wholesale industries*, according to

Figure 5.2. Then follow the groups of *architects and technical consultants* as well as *professional, scientific and technical activities*.

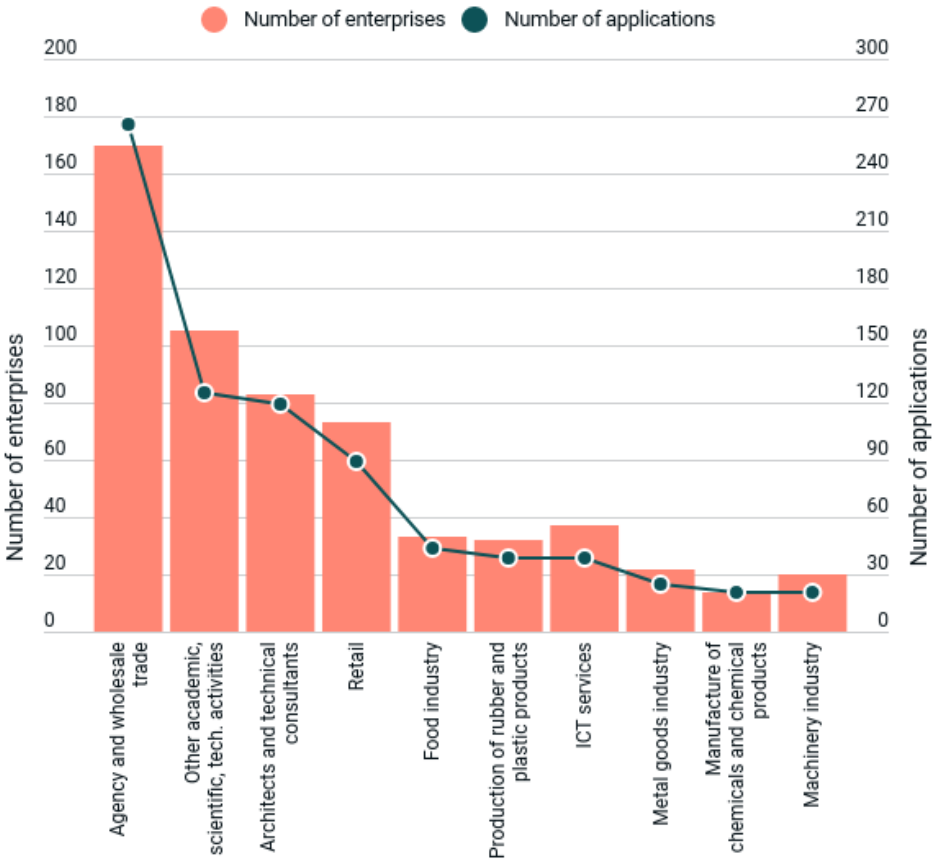
Table 5.3 Number of design applications by type of application. 2015–2020.

Year	Total number of design applications	National applications submitted by domestic applicants	National applications submitted by foreign applicants	International designations in Norway via the Hague Agreement[1]	Of national applications: from Norwegian companies
2015	1,213	250	183	780	230
2016	1,229	240	157	832	185
2017	1,253	242	165	846	219
2018	1,154	242	181	731	210
2019	1,212	244	147	821	200
2020	1,279	236	163	880	213

[1] The Hague System is an international design registration system, a scheme of which Norway is a member. It allows you to apply for design registration in several states at once, with only one application. As of 2015, it was possible to apply in 65 countries. An approved application gives Norwegian citizens and companies the exclusive right to use protected design commercially.

Source: The Norwegian Patent Office

Figure 5.2 Design applications by selected industries. 2015–2020.



Source: Statistics Norway and The Norwegian Patent Office

Development in IPR for Norwegian players in Norway

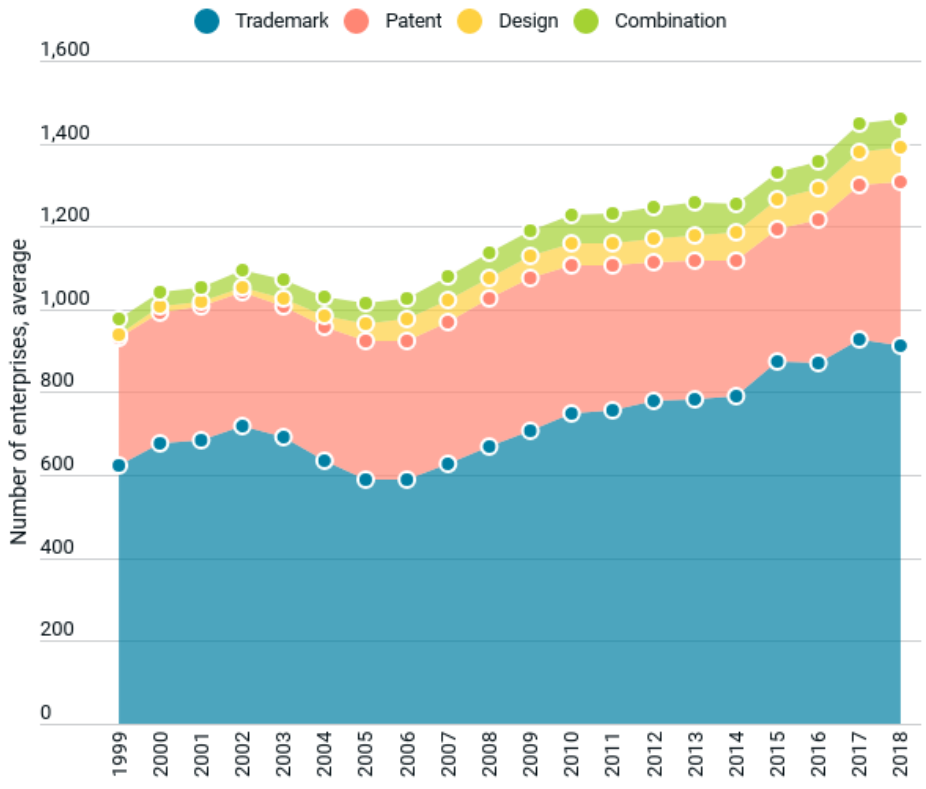
It is fundamental for a long series of analyses that companies that seek IPR protection are linked to company information.

Today, the Norwegian Patent Office largely ensures that received applications are linked to the company in its registers. However, determining the correct organisation number can be challenging. Challenges apply both to links back in time, but also to other registers such as world data (PATSTAT). A unique collaborative project between the Norwegian Patent Office, Statistics Norway and NIFU has in recent years worked on the issue.

The number of companies that are granted IP rights each year is increasing significantly

The population of IPR-active companies has grown in the last 20 years in Norway. In 2018, there were 1,450 Norwegian enterprises in Statistics Norway's enterprise register that applied for and were granted one or more IP rights in Norway. This is an increase of just under 30 per cent compared with 10 years ago and an increase of 50 per cent compared with 20 years ago.

Figure 5.3 Number of IPR-active Norwegian companies per year the right is granted and by type of right. 1999–2018. Current average.



Source: NIFU, based on data from Statistics Norway and the Norwegian Patent Office

By connecting to industry, we see that there are three industries in particular that actively use IP rights. This applies to the three industries that are also traditionally the most research-intensive:

• Manufacturing industry

• Professional, scientific and technical services (knowledge-intensive services)

• Information and communication technology (ICT)

A total of 93,500 different enterprises were active in these industries in the years 1999–2018. Of these, just over 6,000 (6.5 per cent) had applied for and been granted at least one IPR during the 20-year period.

High correlation between R&D and assigned IPR

The companies that are IPR-active also turn out to be largely R&D-active. We see that 62 per cent of the enterprises in the *manufacturing industry* applying for patents are also R&D-active. Patenting enterprises as a share of R&D activity in the other two industries are also high. For the *ICT industry*, this applies to 45 per cent of the enterprises, while in the *knowledge-intensive service industries* this applies to around 35 per cent. Companies that seek combinations of several types of rights (so-called bundles) are R&D-active, especially in *manufacturing industry* and in *knowledge-intensive service industries.*

Chapter 6: Scientific publication

The chapter provides an analysis of Norwegian scientific publication in an international and national comparative perspective. The main sources for the data are the Web of Science and the Cristin database. Adjustments, calculations and analyses of the figures are made by NIFU.

6.1 International development in scientific publishing and citation

China is the world's largest research nation

There are large differences between the countries when it comes to article production. The United States has for a long time been by far the largest research nation globally. But in 2019, China surpassed the United States in publishing volume for the first time. China has further strengthened its position in 2020 and had 540,000 articles measured as article contributions (modified fraction count, see full Norwegian report for explanation). This accounted for 18.3 per cent of the world's scientific production, see table 6.1. The corresponding figures for the USA were 460,000 articles and 15.7 per cent, respectively.

The United Kingdom and India, with 130,000 and 123,000 article contributions, respectively, follow as the next two countries. Norwegian researchers contributed with 22,800 articles in 2020 or 14,800 article contributions. With this, Norway ranks as the world's 33rd largest research nation with a share of 0.50 per cent of the global article production.

Norway number four population-adjusted

Measured in relation to the population, Norway has a 2.77 article contribution per 1,000 inhabitants. On such a scale, Norway is among the countries in the world with the highest publication figures and ranks as fourth in research intensity. Switzerland tops the list with a productivity of 3.21 article contributions per 1,000 inhabitants. This is followed by Denmark with 3.10 per 1,000 inhabitants. Large research nations such as the USA, Great Britain and Germany have significantly lower publication volumes relative to the population than Norway.

Strong growth for some Asian countries

Table 6.1 also shows article production growth in the period 2016–2020 for different countries. The increase in article production in Pakistan and Saudi Arabia is particularly remarkable. In just four years, these countries have almost doubled their publication volume (93 and 89 per cent increase). For Saudi Arabia, the growth is probably related to the fact that the country has made large investments in universities and research laboratories in recent years. China and several other Asian countries (Indonesia and Iran) have also experienced strong growth.

Norway's article production has also increased somewhat during the period. With a growth of 12 per cent Norway ranks as number 16 of the 43 countries shown in the table. Almost all European countries have a lower growth rate than Norway; the exceptions are Spain and Italy with a marginally higher increase.

The change in publication volume will generally reflect changes in resources spent on research during the period, but also that the journal base for the database, i.e. the number of journals included, has grown. Not least, the coverage of magazines published in Latin America and Asia has increased.

Table 6.1 Scientific publication in 2020 in selected countries (over 10,000 article contributions in 2020). Number and per cent.

Country	Number of articles	Number of article contributions	Share of world production[1]	Number per 1,000 capita[2]	Change from 2016 to 2020[3]
Switzerland	44,969	27,507	0.93%	3.21	5%
Denmark	28,179	18,054	0.61%	3.1	4%
Australia	100,932	70,593	2.39%	2.78	8%
Norway	**22,823**	**14,807**	**0.50%**	**2.77**	**12%**
Sweden	40,834	26,095	0.88%	2.54	3%
Singapore	21,413	13,705	0.46%	2.4	-2%
Finland	20,138	13,182	0.45%	2.39	0%
The Netherlands	57,707	38,257	1.29%	2.21	4%
New Zealand	15,830	10,621	0.36%	2.15	8%
Great Britain	187,387	130,375	4.41%	1.95	3%
Canada	103,706	72,785	2.46%	1.94	6%
Austria	25,212	15,909	0.54%	1.79	5%
Belgium	32,539	20,399	0.69%	1.78	0%
Portugal	26,118	18,020	0.61%	1.75	10%
Israel	21,477	15,713	0.53%	1.74	7%
Spain	98,409	74,553	2.52%	1.58	14%
Italy	116,036	87,911	2.97%	1.46	15%
USA	584,161	463,023	15.66%	1.41	2%
South Korea	83,776	71,619	2.42%	1.39	11%
Czech Republic	21,808	14,591	0.49%	1.37	-14%
Germany	156,628	111,471	3.77%	1.34	-1%
Taiwan	35,845	28,164	0.95%	1.19	-4%
Greece	18,142	12,758	0.43%	1.19	6%
France	102,344	70,125	2.37%	1.04	-7%
Poland	49,633	39,097	1.32%	1.02	10%
Japan	112,933	91,852	3.11%	0.73	1%
Saudi Arabia	35,020	23,534	0.80%	0.69	89%
Iran	64,307	56,913	1.92%	0.69	32%
Malaysia	25,714	19,114	0.65%	0.6	1%
Romania	15,753	11,308	0.38%	0.58	-14%
Turkey	55,146	47,218	1.60%	0.57	20%
Chile	15,706	10,753	0.36%	0.56	30%
Russia	82,948	63,923	2.16%	0.44	10%
China	609,568	539,755	18.25%	0.39	44%
Brasil	83,134	70,685	2.39%	0.34	24%
South Africa	25,881	18,404	0.62%	0.32	18%
Argentina	15,288	11,751	0.40%	0.26	9%
Egypt	27,126	19,755	0.67%	0.2	55%
Thailand	15,688	11,818	0.40%	0.19	28%
Mexico	26,355	20,824	0.70%	0.17	24%
Pakistan	27,219	20,451	0.69%	0.09	93%
India	146,694	123,428	4.17%	0.09	17%
Indonesia	21,756	13,925	0.47%	0.05	71%

[1] Share of world production calculated on the basis of the sum of all countries' article contributions.

[2] Number of article contributions in 2020 per 1,000 capita in 2019.

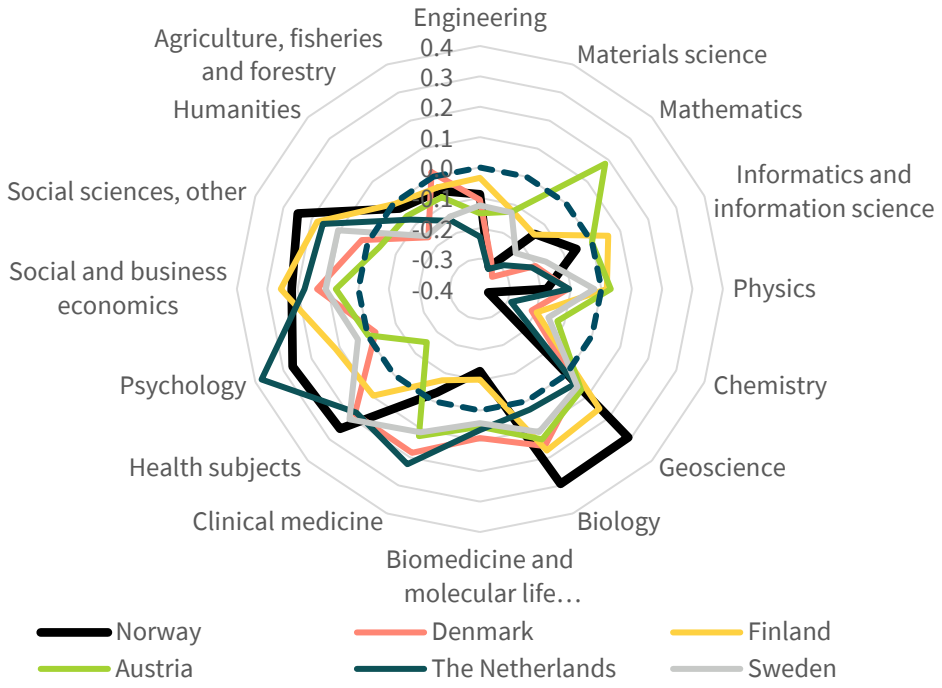
[3] Change in the number of article contributions from 2016 to 2020. The growth in the number of publications is also caused by the expansion of the Web of Science database in the number of indexed journals.

Source: NIFU. Data: Web of Science.

The barometer countries are similar

The analysis shows that the barometer countries have a specialisation profile that differs greatly from the international average. At the same time, they are relatively similar, which is perhaps not so surprising, since the countries were originally selected because of their many similarities with Norway. Roughly speaking, the barometer countries have a high relative activity in the social sciences, health sciences and clinical medicine. Conversely, we find a low relative activity in areas such as chemistry, materials science and engineering. The analysis shows that Norway specialises in geosciences and biology.

Figure 6.1 Relative specialisation index for selected countries (barometer countries) by discipline. 2020.



Source: NIFU. Data: Web of Science.

Relative Specialisation Index (RSI)

The indicator is an expression of whether a country has a higher or lower proportion of publications in a particular field in relation to what is the average for all countries, where RSI = 0. It characterises the internal balance between the fields, but the index does not say anything about production in absolute terms. If RSI> 0, it indicates a relative, positive specialisation (in the form of scientific publication) in the relevant field. Note that the total score for a

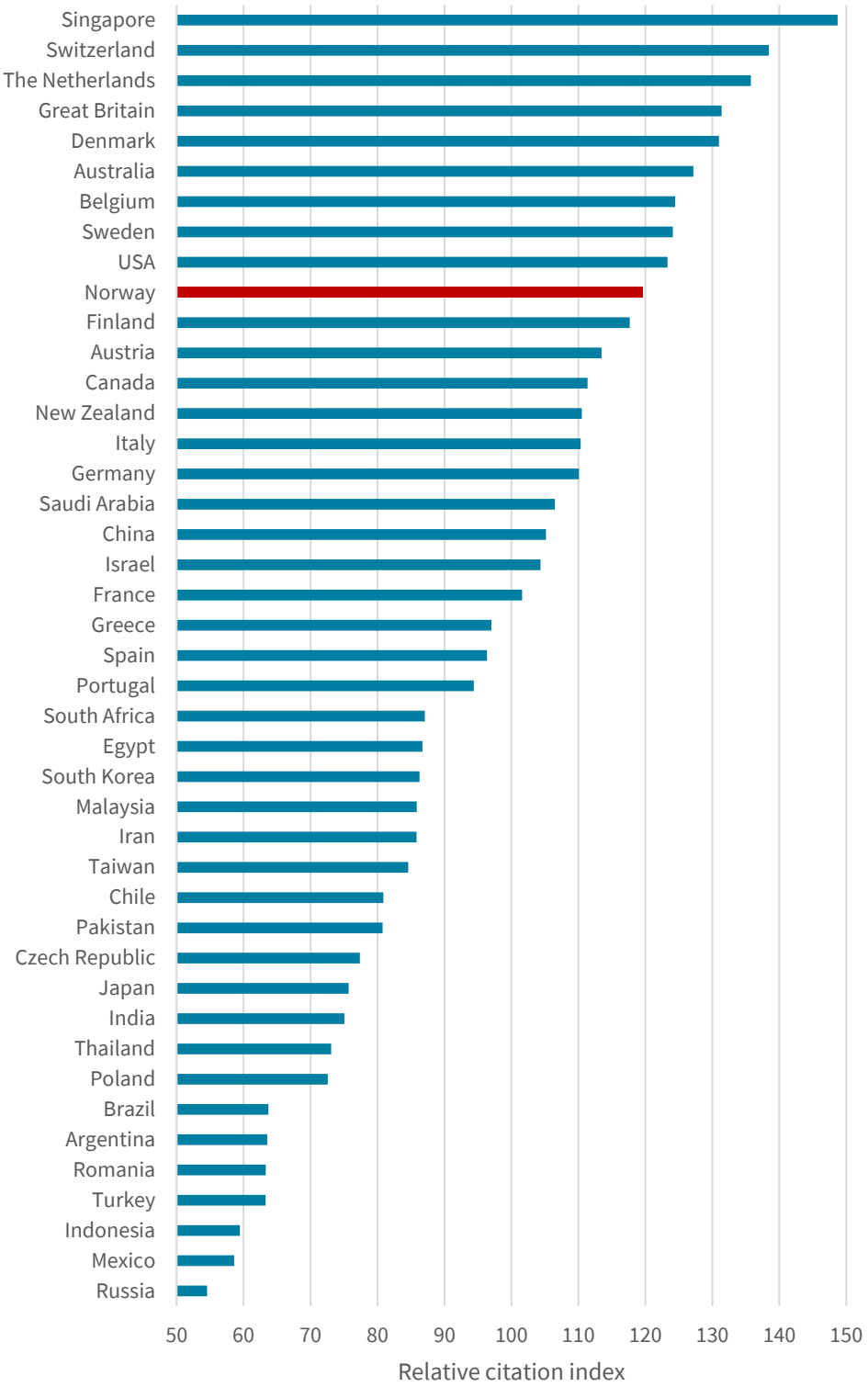
Citation indicators by country

The relative citation index is an expression of the average number of citations per publication. It shows whether a country's publications are more or less cited than the world average, which is normalised to 100.

With a citation index of 120, Norway ranks 10th out of the world's 43 largest nations in terms of publication volume. Compared with the barometer countries, Norway has a citation index roughly in line with Finland (118), lower than the Netherlands (136), Denmark (131) and Sweden (124), but higher than Austria (113).

However, during 2018–2019 Singapore and Switzerland achieved the greatest scientific influence measured by the number of citations. The articles for these countries were quoted 49 and 38 per cent more than the world average, respectively. Publications from non-western countries have the lowest citation frequency. We also see that China with a citation index of 105 scores significantly lower in terms of citation frequency than in terms of publication volume.

Figure 6.2 Relative citation index by selected countries. 2018–2019.[1]



1 Relative citation index for the articles published in the period 2018–2019 and accumulated citations to these publications up to and including 2020. World average = 100.

Source: NIFU. Data: Web of Science.

6.2 Norway's publication profile

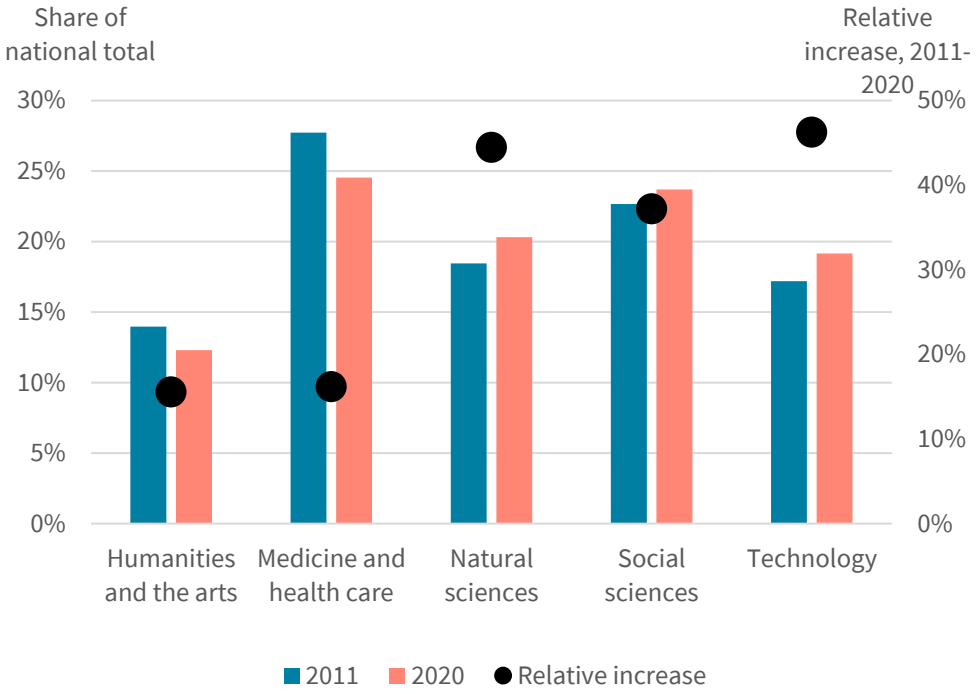
Sectors and institutions

The higher education institutions are responsible for most of the Norwegian scientific publication, but the institute sector and the health trusts are also major contributors. The rest of the public sector and the business enterprise sector contribute relatively little, about 3 and 4 per cent, respectively.

The largest single institution is the University of Oslo, followed by the Norwegian University of Science and Technology (NTNU). Both institutions had over 6,500 publication points in 2020. The University of Bergen follows next, with a publication volume about half as large as at the University of Oslo. UiT – Norway's Arctic University – had just over 2,200 points and is the fourth largest institution. Together, the four old universities contributed to two thirds of the publication in the university and college sector (see table 6.2a).

Of the units in the institute sector, SINTEF AS is the largest with almost 640 publication points, which accounted for 11 per cent of the scientific publication in the institute sector. SINTEF is followed by the National Institute of Public Health, the Institute of Marine Research and the NORCE Norwegian Research Centre with between 400 and 550 points. Of the health trusts, Oslo University Hospital is by far the largest, followed by Haukeland University Hospital and St. Olav's Hospital.

Figure 6.3 Norwegian scientific publication by field of science. Share of national total in 2011 and 2020.[1]



[1] The calculation is based on fractional publication figures (article contributions).

Source: NIFU. Data: Cristin.

Citation indicators

The citation frequency of scientific articles is very skewed. Most articles are little quoted or not quoted at all, while a few achieve an extremely high number of

citations. Over the last decade, there has been a growing interest in using highly cited articles as an indicator in a research policy context. One reason for this is the focus on "top research" or "scientific excellence" internationally.

Table 6.2 Relative citation index and share of articles among the 10 per cent most cited (10th percentile) for the largest[1] institutions, institutes and health trusts in Norway. 2016–2018.

Sector	Institution/institute	Number of articles (WoS)	Share, 10th percentile	Relative citation index
Universities and colleges	University of Oslo	13,536	15%	152
	Norwegian University of Science and Technology	10,919	12%	126
	University of Bergen	7,409	14%	149
	UiT - The Arctic University of Norway	4,287	10%	124
	Norwegian University of Life Sciences	2,605	12%	130
	Oslo Metropolitan University	1,619	9%	108
	University of Stavanger	1,609	12%	126
	University of Agder	1,154	11%	117
	Western Norway University of Applied Sciences	1,133	9%	110
	South-Eastern Norway University of Applied Sciences	746	13%	121
	Norwegian School of Sport Sciences	657	17%	183
	Norwegian Business School	644	16%	146
	Nord University	626	13%	117
	The University Centre in Svalbard	438	9%	105
	NHH Norwegian School of Economics	433	16%	160
	Inland Norway University of Applied Sciences	414	8%	108
	University of South-Eastern Norway	409	9%	112
Institute sector	National Institute of Public Health	1,747	17%	228
	SINTEF	1,404	10%	109
	NORCE Norwegian Research Center AS	1,075	9%	110
	Institute of Marine Research	910	15%	138
	Norwegian Institute of Bioeconomy Research	787	11%	110
	Norwegian Institute for Nature Research	665	15%	155
	SINTEF Energy AS	440	12%	120
	NOFIMA The Norwegian food research institute	417	12%	117
	Norwegian Institute for Water Research	402	16%	143
Health trusts	Oslo University Hospital	5,721	15%	158
	Haukeland University Hospital	2,140	15%	144
	St. Olavs Hospital	1,523	13%	159
	Akershus University Hospital	963	11%	127
	The University Hospital of North Norway	856	12%	138
	Stavanger University Hospital	709	17%	159
	Innlandet Hospital Trust	463	12%	145
	Diakonhjemmet Hospital	403	14%	164

[1] Institutions/institutes with more than 400 articles (WoS) during the period.

Source: NIFU. Data: Cristin/Web of Science.

University of Oslo at the top of the traditional universities

With a citation index of 152, the University of Oslo scores highest of the traditional Norwegian universities. The University of Bergen is marginally below with an index of 149. The proportion of highly cited articles is also almost equal for the two universities (15 and 14 per cent). The Norwegian University of Science and Technology and UiT – Norway's Arctic University, score clearly lower, but at about the same level, with citation indices of 126 and 124, respectively.

In the institute sector, the National Institute of Public Health stands out with a high citation index of 228 and 17 per cent highly quoted articles. Several of the hospitals within the health trusts have high citation levels. At the top we find Diakonhjemmet Hospital, St. Olavs Hospital HF and Stavanger University Hospital with citation indices of about 160.

Field of science

Figure 6.4 shows how Norway's scientific publication was distributed by fields of science in 2011 and 2020. The analysis includes all scientific publication registered in Cristin (NVI publications). This means that the business community is not included in the figures.

Medicine and health care is the largest field of science and accounted for 25 per cent of the publications in 2020. The humanities and the arts is the smallest field, with a share of 12 per cent. All fields have had a clear growth in the publication volume from 2011 to 2020. The growth has been greatest for technology, natural sciences and social sciences (46–37 per cent), while the humanities and medicine and health care were significantly lower (16 per cent).

The higher education institutions contributes to a total of 96 per cent of the scientific publications in the humanities. The sector's share is lowest in medicine and health care with 58 per cent. The figures for social sciences, technology and natural sciences are 84, 78 and 73 per cent, respectively.

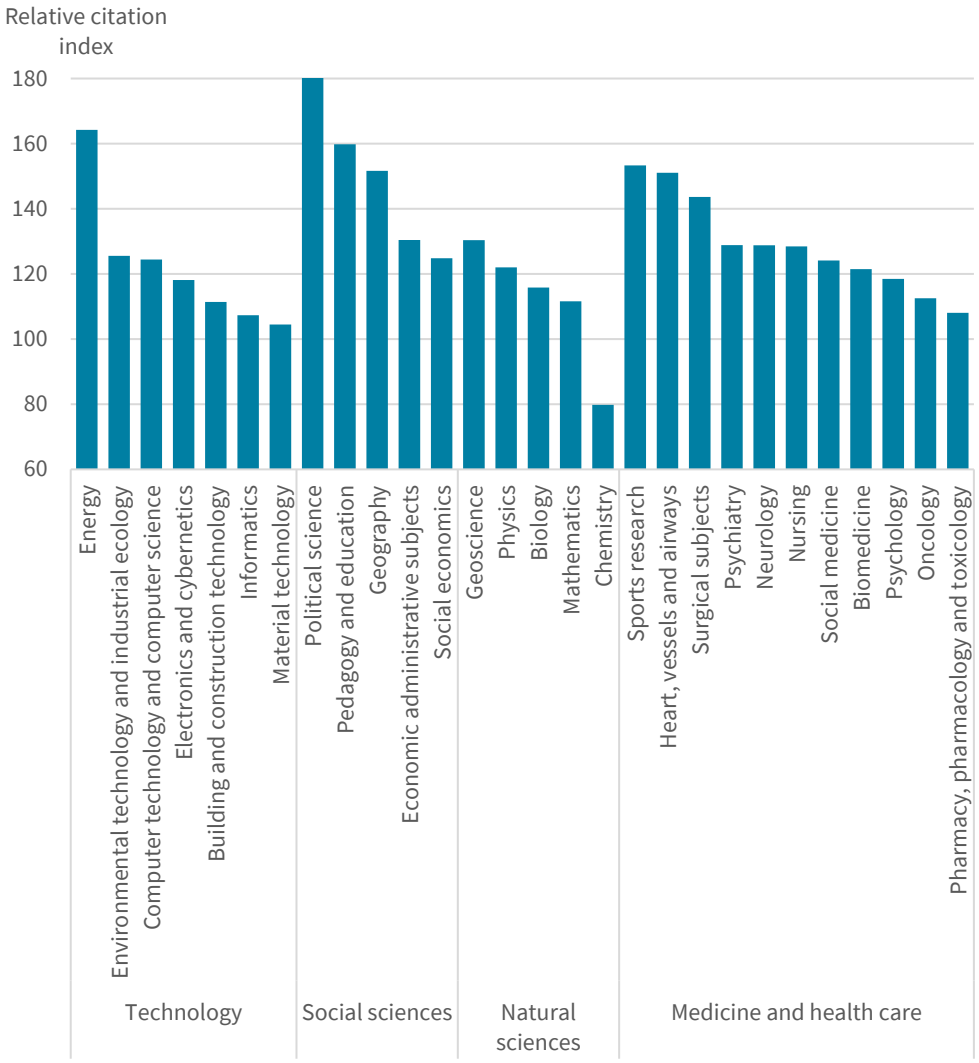
The institute sector's share is highest in natural sciences and technology and engineering with 23 and 21 per cent, respectively, and lowest in the humanities with 4 per cent. The health trusts contribute to 34 per cent of the scientific publications within medicine and health care, while the proportions are naturally very low in the other subject areas.

Social sciences and medical and health sciences most cited

In the period 2016–2018, the articles in the social sciences and medicine and health care achieved the highest relative citation indices. On average, the articles were cited 38 and 34 per cent more than the world average, respectively. The citation index for natural sciences was 116 and for technology and engineering 118. In the case of social sciences, however, it should be added that only a relatively small proportion of the publications are covered by the database (primarily articles in international journals, while other publications, such as books and Norwegian journals, are not included). A similar restriction applies to an even greater extent to the humanities and the arts.

There are also big differences within the different fields of science. Figure 6.4 shows the citation index for the largest individual disciplines measured in publication volume (more than 500 journal articles in the period) for the articles published in the period 2016–2018.

Figure 6.4 Relative citation index by selected disciplines.[1] 2016–2018.



[1] Disciplines with more than 500 articles during the period.

Source: NIFU. Data: Web of Science.

The proportion of women's participation has increased over time

The proportion of women's participation in publications has increased slowly over time. In 2011, 39 per cent of the publishing researchers were women. During the nine-year period, the share has thus increased by six percentage points to 45 per cent. However, women's share of publication points is lower than men's, but has increased from 32 per cent to 36 per cent in the same period.

The difference in the proportions between publishing researchers and publication points implies that women on average publish less than their male colleagues. Part of the explanation is that there are relatively more women in the younger age groups where the publication frequency is lower for both men and women. Furthermore, the proportion of women among professors is relatively low, and this group has the highest productivity.

Large individual variations

Publication at the individual level is very skewed. A small proportion of researchers are extremely productive, while many publish little. The average figures for the number of publication points per person are therefore strongly affected by this skewed distribution.

The analysis shows that the 10 per cent most productive researchers in total contributed to as much as 43 per cent of the publication points in Norway in 2020. There are significantly more men than women in this group of highly publishing researchers (7 per cent of women and 13 per cent of men, which constitutes a female share of 31 per cent).

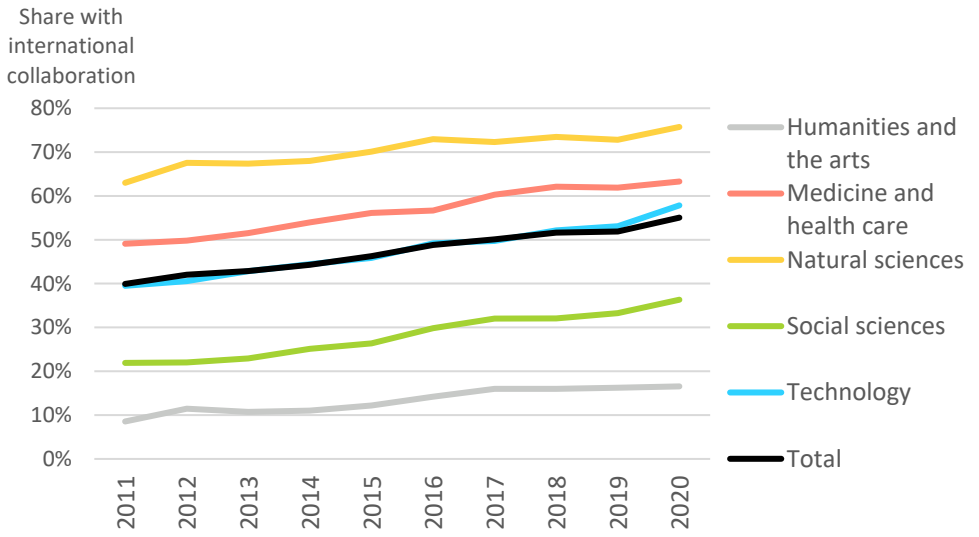
6.3 Collaboration in scientific publishing

A well-established way of measuring research collaboration is to look at scientific publications that have co-authors in various institutions and countries.

International collaboration

Figure 6.5 shows the development in international collaboration for the period 2011–2020 per field of sciences and in total. During this nine-year period, the share of publications with foreign co-authorship has increased from 40 per cent to 55 per cent for Norway as a whole (all fields of science combined).

Figure 6.5 Proportion of Norwegian publications with international collaboration by field of science. 2011–2020.

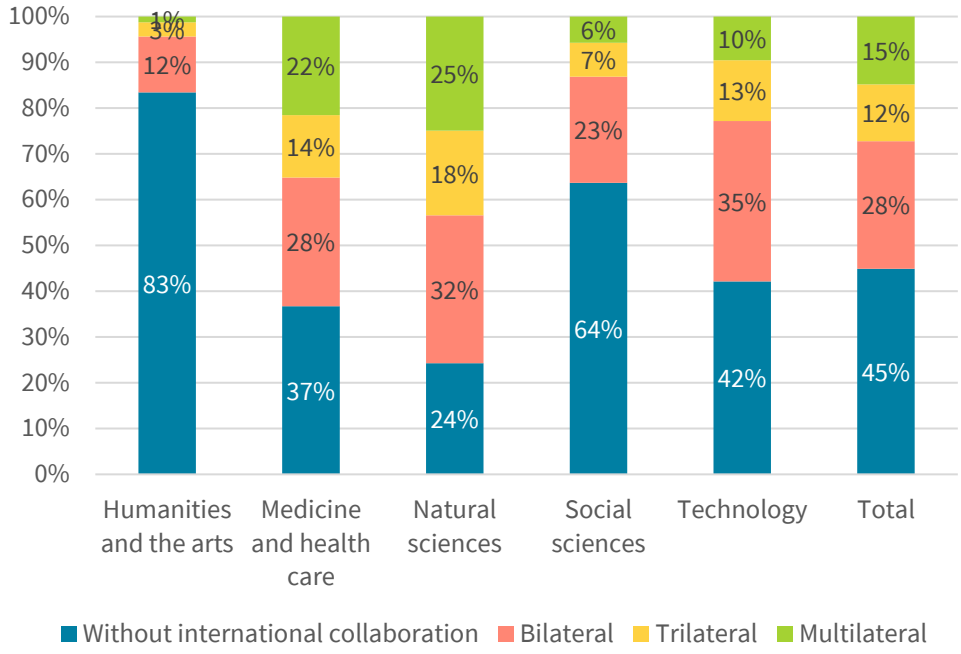


Source: NIFU. Data: Cristin.

Most bilateral international collaboration

In total, 55 per cent of all publications had co-authors from other institutions or other countries. About 28 per cent involved co-operation with another country (bilateral co-operation), 12 per cent with two other countries (trilateral co-operation) and 15 per cent with three or more other countries (multilateral co-operation). Bilateral co-operation thus accounts for about a quarter, but the scope of multilateral co-operation is also significant. Multilateral cooperation is particularly widespread in the natural sciences and medicine and health care, but hardly occurs in the humanities and the arts and social sciences.

Figure 6.6 Norwegian publications by different types of international cooperation. 2020.



Source: NIFU. Data: Cristin.

The United States and the United Kingdom are the largest partners

Researchers from the USA have the most frequent publication collaboration with Norwegian researchers. In total, 17 per cent of the articles with bilateral and trilateral collaboration had authors from the United States. Collaboration with the United Kingdom, Sweden and Germany is also extensive, with 13, 11 and 9 per cent respectively. Of the Nordic countries, we see that Norway has much closer collaboration with Sweden and Denmark than with Finland.

Large variations in the scope of international cooperation

Figures at institutional and departmental level show that there are significant differences in the degree of international collaboration measured through co-authorship. Of the four largest universities, the University of Bergen has the highest proportion of publications with international collaboration in 2020 (59 per cent). The other three universities have shares of 55–56 per cent.

Of the other institutions, the University Centre on Svalbard has the highest proportion of international collaboration, with a share of as much as 80 per cent. The proportion is also high for the Norwegian University of Life Sciences (NMBU) and the Norwegian School of Sport Sciences (NIH), with 63 and 65 per cent, respectively. Of the other institutions, the proportion is lowest at VID University College and OsloMet – the metropolitan university, with 21 and 27 per cent, respectively.

Overall, the institute sector has a profile with a slightly higher element of international cooperation than the higher education sector. Some institutes, especially the Institute of Marine Research, the Norwegian Institute for Nature

Research and the Norwegian Institute for Bioeconomy Research (NIBIO), have a significant scope of international research collaboration (66–72 per cent).

For publications by the university hospitals and other health trusts, 59 per cent had co-authors from foreign institutions.

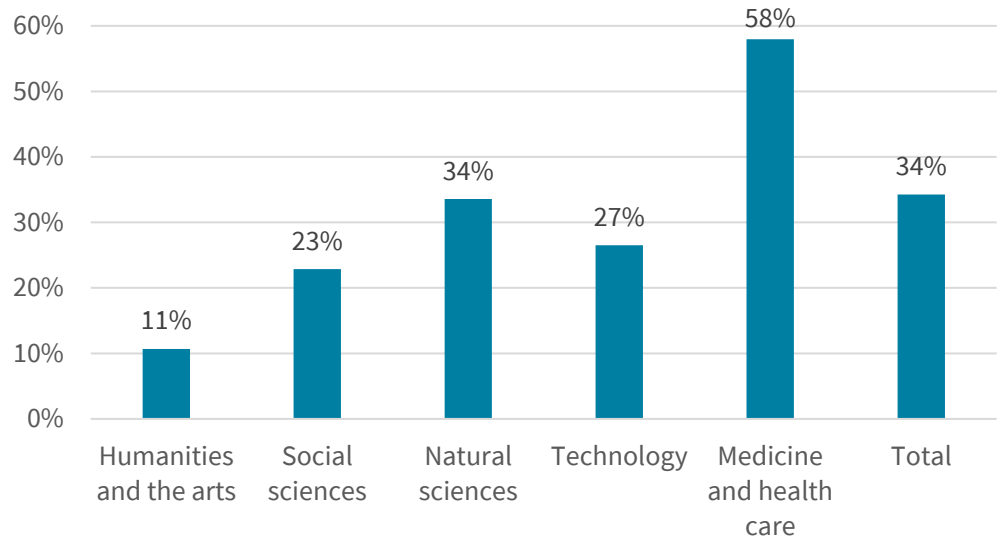
The degree of international collaboration will be influenced by the profile of the institutions. A large element of the humanities and the arts and social sciences will probably give lower ratios, since the importance of such collaboration is less in these fields of science. This is an important explanation for the institutional differences.

National collaboration

In addition to international cooperation, there is also significant national cooperation in research. There is most national collaboration within medicine and health care, where approximately 6 out of 10 publications involve such collaboration, see Figure 6.7. The lowest proportion of collaboration is in the humanities and the arts, where 11 per cent of the publications have authors associated with various Norwegian institutions. Within the social sciences, collaboration is twice as frequent as in the humanities, but the proportion is still only 23 per cent. At the same time, it appears that every third publication in natural sciences and technology is written in collaboration with other Norwegian institutions.

The high level of collaboration in medicine and health care reflects the close link especially between the medical faculties and the affiliated university hospitals. Furthermore, "divided" positions are widespread, for example when a chief physician at a university hospital is also a professor II at a university.

Figure 6.7 Proportion of publications with institutional collaboration for Cristin-institutions by field of science. 2020.



Source: NIFU. Data: Cristin.

Chapter 7: Innovation in Norway and Europe

Business innovation has been measured systematically and compared internationally since the early 1990s. The use of the concept of innovation has gradually developed to cover more industries than just manufacturing industries. In addition, the public sector also collects data on innovation activity for its underlying units. Innovation is defined as the utilisation of something new; a technology, a product, a service or something else. Innovation is therefore considered a key indicator of development and implicit improvement.

This chapter presents results from the Norwegian innovation survey of business and industry, which is conducted every two years. The chapter also discusses innovation in the public sector, about which more systematic information is constantly being obtained. Finally, a comparison of Norway in an international perspective (i.e. European Innovation Scoreboard) is included.

International definition of innovation

Innovation: A product or business process, or a combination of the two, that is new or improved, that differs significantly from the enterprise's previous products or business processes. An innovation does not have to be new to the market or developed by the enterprise itself.

Product innovation: A new or improved product or service, which is significantly different from the enterprise's previous products or services and which has been made available on the market. Changes in design that are exclusively of an aesthetic nature are not covered.

Innovation in business processes: A new or improved business process, for one or more operational functions, which differs significantly from the enterprise's previous processes and which has been implemented/put into use in the enterprise. Includes both development and production of goods/services and other organisational and marketing processes.

The international guidelines for innovation statistics are given in the fourth edition of the so-called "Oslo-manual" published by OECD/Eurostat (2018). The Norwegian survey is part of the EU's Community Innovation Survey, CIS.

7.1 Innovation in Norwegian business, 2018–2020

Small changes in innovation activity

Overall, there have been small changes in the business sector's innovation activity from the period 2016–2018 to the period 2018–2020. However, a closer look at the totals, in combination with specific follow-up questions about the corona pandemic, shows a more nuanced picture. COVID-19 has led to clear changes in how Norwegian companies innovate in the face of changed conditions.

Fifty-eight per cent of Norwegian enterprises that were included in the survey on innovation in the industrial sector introduced one or more innovations during the three-year period from 2018 to 2020. This is one percentage point higher than for

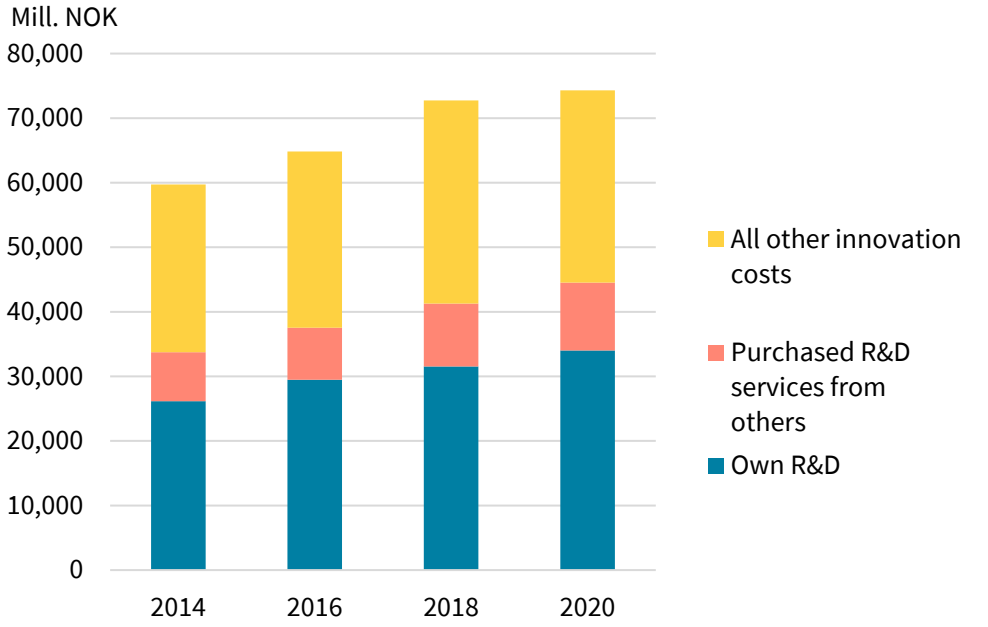
the period 2016–2018. 38 per cent introduced product innovation, 28 per cent had innovation in goods and 25 per cent in services, while 48 per cent had innovation in business processes. If we consider the uncertainty in the survey, the proportion of innovators remains unchanged for all types of innovation. A further 5 per cent of the enterprises carried out activities with the intention of innovating, but without this leading to the introduction of any innovations in the enterprise during the period.

A moderate increase in innovation investment

The total innovation costs are estimated at NOK 74.3 billion in 2020 (Figure 7.1). This growth mainly follows the trend from previous surveys. However, the large growth from 2016 to 2018 is due to the fact that from 2018 a new revision of the Oslo manual has been used as the basis for the data collection. This switch led to, among other things, inclusion of more types of innovation than before, such as innovation in organisational and market business processes.

Own research and experimental development (R&D) constituted by far the largest investment, with about NOK 34 billion, followed by other personnel costs for innovation of NOK 15 billion. The companies invested NOK 10.5 billion in the purchase of R&D services from others and a total of NOK 12.5 billion in operating equipment and capital goods for use in the innovation activities. Other costs, which include costs for market introduction of innovations, amounted to NOK 2.2 billion.

Figure 7.1 Total innovation investments by type of costs. 2014–2020. Mill. NOK.



Source: Statistics Norway, Innovation survey

Innovation investments are unequally distributed

Most enterprises report relatively small amounts, while some have very large costs for their innovation development. Statistics show that companies' R&D costs are relatively constant over time. However, innovation investments are not as stable.

The life of products on the market will vary, and large investments each year will not necessarily be repeated the following year.

It is also the case that many companies are not able to separate innovation costs from other costs and investments. Generally, innovation costs are not listed as independent posts in the companies' accounts and annual reports. Many companies will therefore necessarily have to use discretion when answering the survey.

However, the trend in the reported innovation investments has been relatively stable over several periods, which is a strength for the survey's ability to measure the total scope of business and industry's innovation investments.

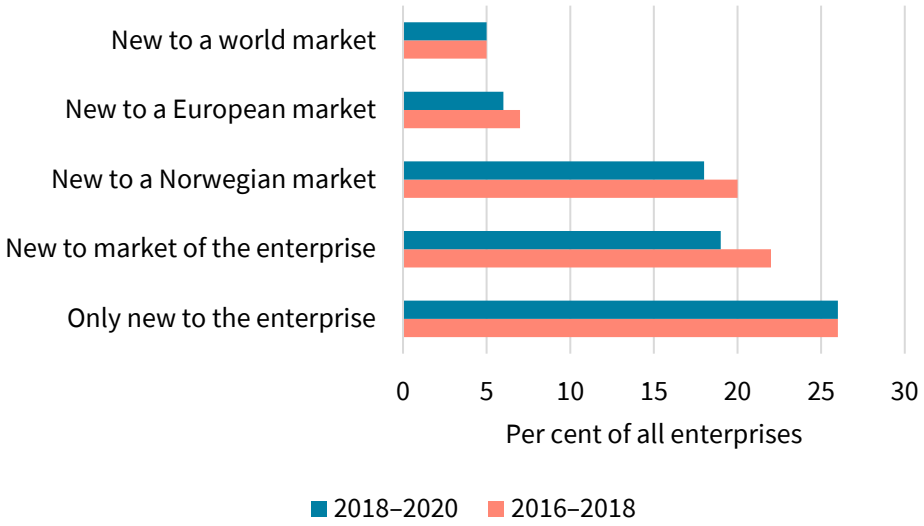
The Industrial sector develops its own innovations

As in previous surveys, the enterprises mainly state that they have developed at least one of their own innovations themselves. This applies to both goods, services and business processes. In total, 87 per cent of the innovators said that at least one of their innovations had been developed by the enterprise alone or in collaboration with other companies or organisations. Only 13 per cent introduced only innovations that had been developed mainly by copying from other companies or innovations that had been fully developed by others.

Decline for product innovation to the new marked

The decline in the share of enterprises with product innovation is due to fewer enterprises introducing goods or services that were new to the enterprise's market. The share of enterprises that introduced products that were only new to the enterprise is unchanged, compared with the previous survey (Figure 7.2).

Figure 7.2 Product innovations according to the novelty of the innovations. 2016–2018 and 2018–2020.



Source: Statistics Norway, Innovation survey

More collaboration in innovation

A total of 44 per cent of the enterprises with innovation activity collaborated with other enterprises or other organisations/institutions on either R&D or other

innovation activities during the period. This is an increase of 5 percentage points in the previous survey.

26 per cent of the innovation-active enterprises collaborated on R&D, while 32 per cent collaborated on other innovation activities, an increase from 23 and 28 per cent respectively. In absolute figures, this implies a nearly ten per cent increase in the number of enterprises with such collaboration, and that as many as 28 per cent of the enterprises covered by the survey collaborated on either R&D or innovation activity.

Permanent changes because of the pandemic

For all types of innovation, an overwhelming majority, a total of 93 per cent, answer that one or more of the innovations that have been introduced because of the pandemic will be continued in the enterprise, even after a normal situation has been restored.

Seventeen per cent of all enterprises, 30 per cent of innovators, have introduced innovations as a direct result of the corona pandemic. 9 per cent have introduced new products, 5 per cent in goods and 6 per cent in services, while 14 per cent have adopted new business processes. At the same time, 7 per cent of the enterprises have interrupted, postponed or completed innovation activity, without this resulting in an innovation.

The fact that the pandemic has affected innovation activity in various ways in the enterprises also reflects the innovation costs. About three out of five companies with innovation activity say that the situation around COVID-19 has not affected their investments or efforts for innovation in 2020, measured in direct costs. Of the remaining, about as many respond that they have increased their innovation investments compared to what they otherwise would have been, as those who say that the innovation costs have been lower than in a normal situation. For the industrial sector as a whole, 11 per cent of the enterprises have increased their innovation investments as a result of the pandemic, while 13 per cent reduced them in 2020.

Another clear difference from the previous innovation survey and a likely pandemic effect is that a significantly larger proportion of enterprises report receiving direct public support, excluding SkatteFUNN (tax deduction), from local, regional, national or EU authorities or government-run organisations. EU support has been reported unchanged, while support from authorities or institutions in Norway has increased considerably. This is not unexpected as several policy instruments in the Norwegian innovation system have received increased transfers and special allocations as a result of the pandemic.

Differences between innovators and non-innovators

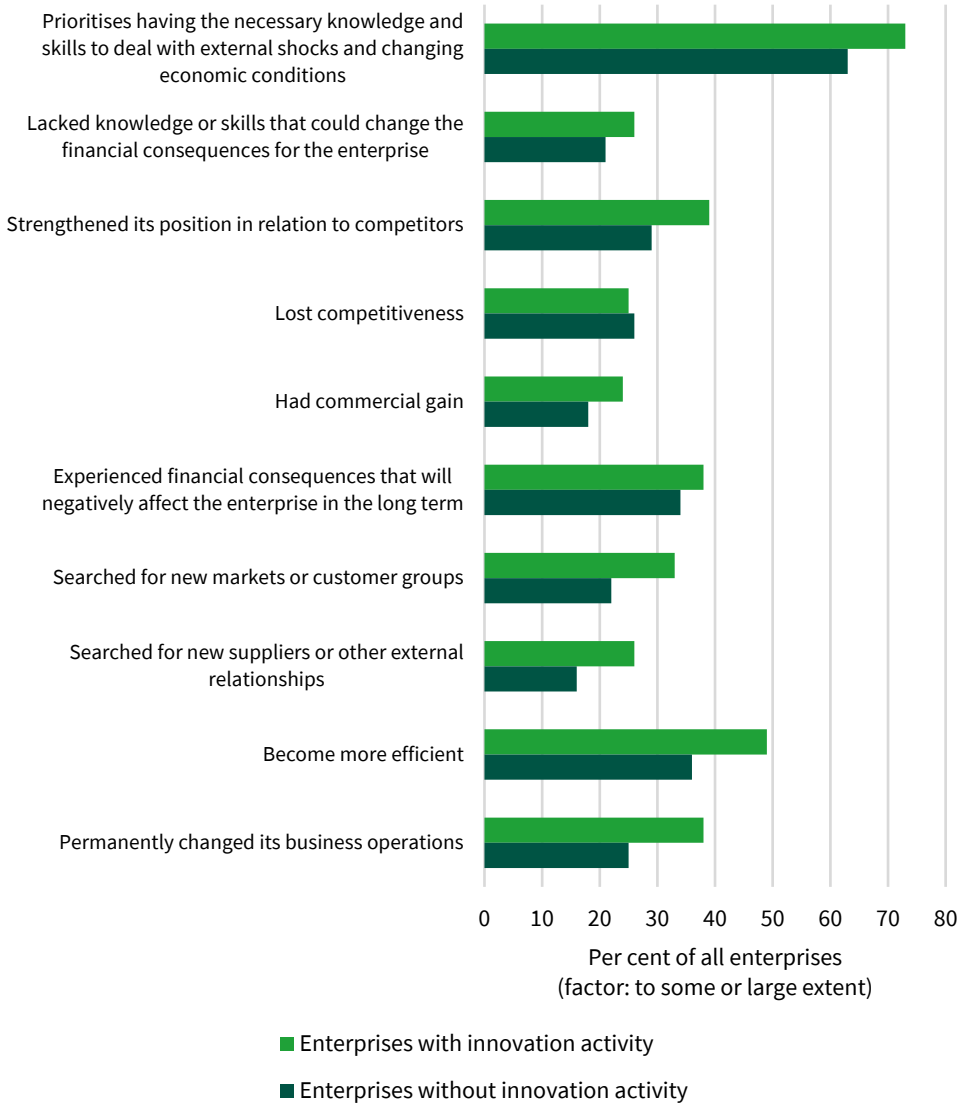
All enterprises, both innovators and non-innovators, have also been asked to state whether they have experienced several direct consequences/effects of the situation around COVID-19 and about their own capacity to handle external shocks and changed economic conditions (Figure 7.3).

The innovators report more effects as applicable to a large extent or to some extent than the non-innovators. Only “lost competitiveness” is experienced by a larger

proportion of non-innovators. They also respond, except for "long-term economic consequences", more often that the effects apply to a large extent.

It is likely that some of these differences are due to an awareness gap between innovators and non-innovators. For example, it is not obvious that innovators to a greater extent lacked knowledge that affected the economic consequences for the enterprise, but innovators may be able to realise to a greater extent that they lacked such knowledge. Likewise, it is known from previous innovation surveys that the more innovative an enterprise is, the greater the probability that they are aware of what hinders or further limits their own innovation activity. This effect can also be clearly seen in the present study, although it is somewhat weaker than before.

Figure 7.3 Effects of the situation around COVID-19. 2018–2020.



Source: Statistics Norway, Innovation survey

Innovations with positive environmental impact

The Norwegian Innovation Survey for 2018–2020 included for the first time questions about whether the enterprises had introduced innovations with a positive environmental effect, or green innovations, and if these are expected to

be continued in upcoming surveys as well. Innovative companies were asked to state whether any of their innovations have had a positive environmental impact, and if so, whether this effect was significant. The enterprises were also asked to indicate the positive environmental effects, based on a number of fixed and two open categories. The survey also distinguished positive environmental effects that have been realised within the enterprise, and environmental effects that arise for customers or end users when the product is used or consumed.

What is innovation with a positive environmental effect?

An innovation has a positive environmental effect if it has a positive – or less negative – impact on the environment in relation to the company's previous products or business processes, or in relation to other products already available on the market. The positive environmental effect can be either the main purpose of the innovation or a by-product of other characteristics or purposes of innovation. The positive environmental effect of the innovation can occur either in the production of an item or service, when a process is put into use or when a product is consumed, consumed or used by the end user. The user may here be individuals, other enterprises, organisations or public authorities.

Large industrial enterprises have a high share of green innovation

Industrial enterprises are most likely to introduce green innovations, and the proportion of green innovators increases with the size of the enterprises. It is also in manufacturing that the largest share of green innovations is reported to have had a significant positive environmental impact.

Most often green innovations in business processes

When it comes to the type of innovation, innovation in business processes is most often reported to have had an environmental advantage. This may be, for example, in connection with the actual production of goods or services, but also distribution and logistics or changed packaging fall under the criteria for innovation in business processes. 19 per cent of enterprises report having innovation in business processes with a positive environmental effect, while the figures for goods and services are both 10 per cent.

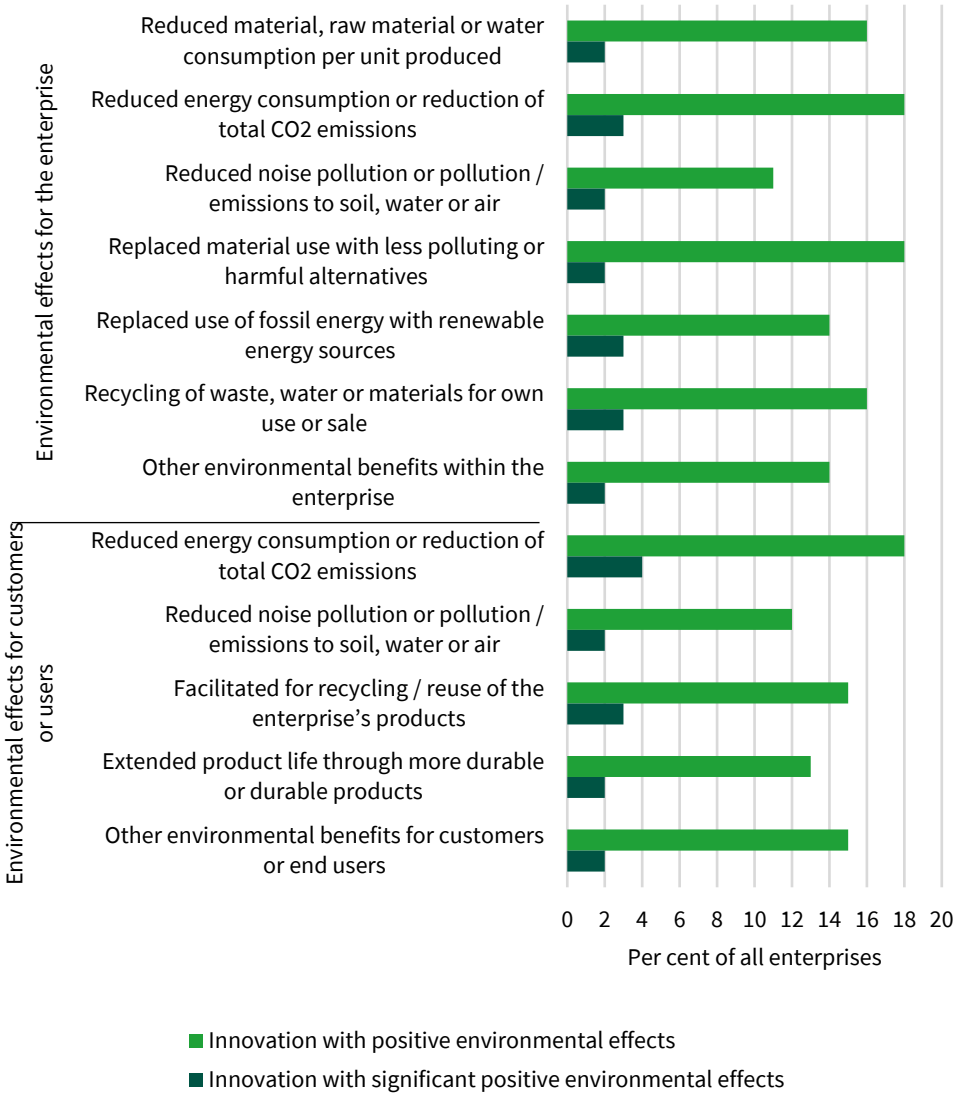
No single positive environmental effect stands out

None of the specified environmental effects clearly stand out from the others when you see all Norwegian enterprises. Between 12 and 18 per cent of enterprises report innovations with positive environmental impacts, and between 2 and 4 per cent report innovations with a significant positive environmental impact (all environmental effects). This means that some significant positive environmental effects occur because of innovations, twice as often as others, but overall, the figures are relatively small.

There are differences between the industries, both in the presence of green innovators and in the distribution between the different environmental benefits. However, with such a low frequency of significant environmental effects, it is

difficult to draw conclusions about relationships or patterns in the results based on aggregated figures. Hopefully, future analysis with several periods or other approaches to this data can contribute to increased knowledge, both about how the business sector innovates and about the framework conditions that lead to green innovations.

Figure 7.4 Innovations with positive environmental impact, by environmental effect. 2018–2020.



Source: Statistics Norway, Innovation survey

7.2 Innovation in the public sector

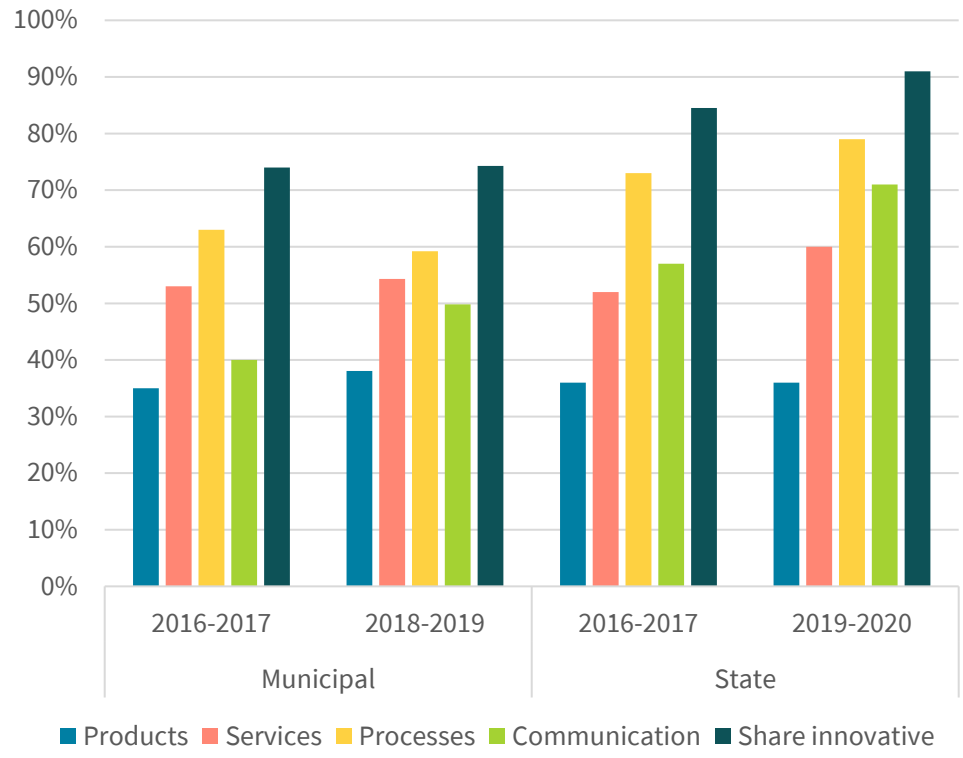
Innovation in the public sector has been a set of concepts in public strategies for a ten-year period in Norway. Nevertheless, it is only in the last couple of years that the strategies have become visible on the public agenda.

Increased innovation during the pandemic

The Figure 7.5 compares the degree of innovation in the last two measurements for the municipal and central government sectors, respectively. The survey for the municipal sector covers 2016–2017 and 2018–2019, while the state sector covers

2016–2017 and 2019–2020. The latest survey for the government sector thus includes the pandemic, which is worth noting. The chart shows a relatively stable picture of the degree of innovation in the Norwegian public sector. However, we see that innovation in the categories services, processes and communication, increases in the government sector in the two measurements. There is little doubt that this is due to the pandemic and that new digital solutions have been developed and implemented.

Figure 7.5 Proportion of innovative units and types of innovation in the municipal sector in Norway. 2018–2019.



Source: KS and the Norwegian Digitalisation Agency

Own budget is the most important source of funding for public innovation

Own funds are the main source of funding for public innovation. In the municipal sector, 60 per cent of the respondents answer that the latest innovation is self-financed. For the general government sector, the same share is 54 per cent. The two second largest sources of funding in the municipal sector are special grants in the municipality or county municipality and public support schemes, for 17 and 11 per cent of the respondents, respectively. External programmes and private funds are the least widespread. Only 4 per cent of the respondents funded innovation with external contributions, and 1 per cent with private funds.

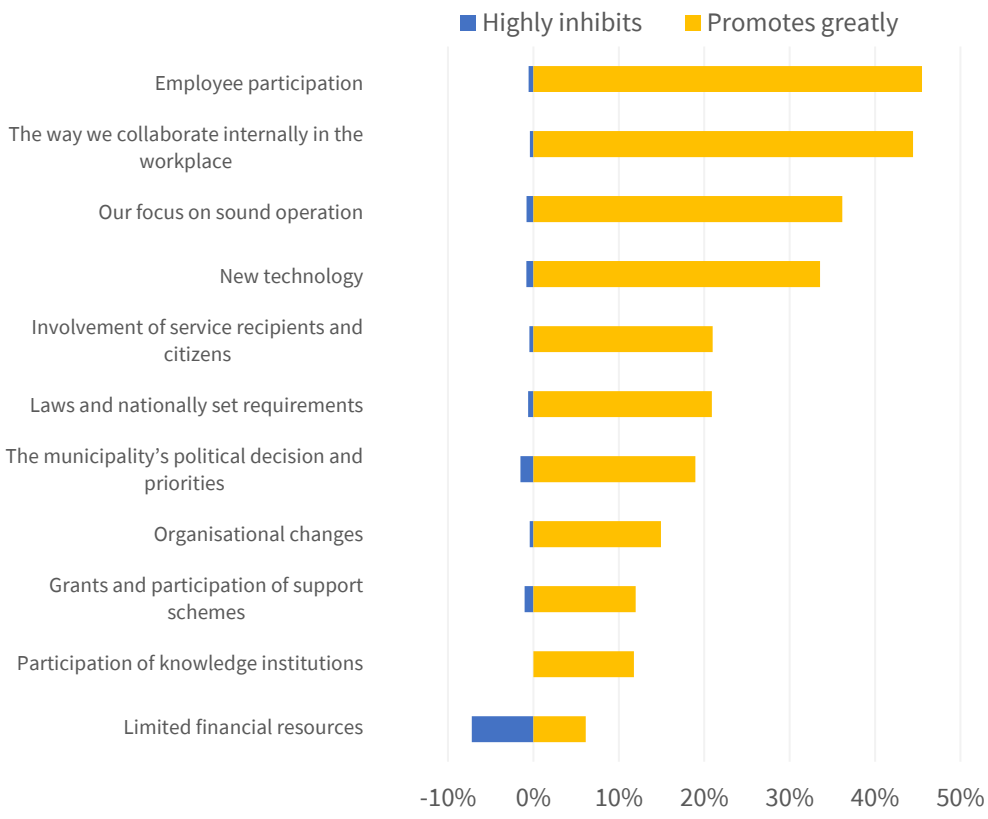
New technology and new colleagues drive innovation, but limited budgets hamper

There is agreement between municipalities and state enterprises that most factors promoted the latest innovation more than they inhibited it. At the same time, there are differences in how municipal and state units emphasise different factors. Here

we present the factors that greatly promoted innovation, and those that were largely perceived as inhibiting.

Among municipal units, there is the highest support for the role of employees and internal cooperation being the most important factors in promoting the latest innovation. This is stated by around 45 per cent of the respondents. It is then stated that focus on new technology and sound operation of the municipality are also important factors that stimulate innovation. Other significant external factors include residents and laws and nationally-stipulated requirements. Both categories were stated by 21 per cent of the respondents.

Figure 7.6 Factors that greatly promoted and hampered innovation in the municipal sector. 2018–2019.



Source: KS

Although state-owned enterprises also highlight internal factors, the majority place the most emphasis on new technology. The share who believes that it was new technology that promoted innovation to the greatest extent is 43 per cent. This is followed by employees and internal decisions and priorities, stated by 36 and 35 per cent of the respondents, respectively.

As mentioned earlier, many respondents answer that different factors are more promoting innovation than inhibiting. However, there is one factor that stands out. Most respondents in both the municipal and state sectors state economic challenges as the biggest barrier to innovation, at 7 and 15 per cent, respectively.

Another obstacle to innovation in the municipal sector is the municipalities' political decisions and priorities. This is stated by 2 per cent of the respondents.

7.3 International comparisons of innovation

Norway's position on international innovation surveys drops to 11th position

With a decline from ninth to eleventh place on the European Innovation Scoreboard 2021, Norway remains a strong innovator, just below the group of innovation-leading countries. All the Nordic countries except Iceland and Norway are classified as innovation leaders in the same ranking.

Norway ranks among the top 3 in international co-publishing, innovative SMEs that collaborate with others, and numbers employed in knowledge-intensive industries. At the same time, Norway scores weaker on intellectual assets (trademark and design applications), venture capital, and innovation expenses other than R&D, and sales of medium- and high-tech export goods and innovative products. As in previous years, we do not find Norway at the forefront of innovation measurements. The country is not among the top ten countries on the Global Innovation Index (GII), the German Indicator Report, the Bloomberg Index or the World Bank's Human Capital Index (HCI).

Norway, number 8 in the World Happiness report

After being ranked number one in the World Happiness Report in 2017, Norway's ranking has dropped to eighth place in 2021. In the UN's Human Development Report, however, Norway scores again at the top. Both reports, which are supported by the UN, focus on new ways of measuring happiness and well-being. In this year's edition of the latter report, Norway is among the countries that score highly due to low deaths because of the corona pandemic. Norway was also the lowest when it came to the inhabitants' fear of being infected with COVID-19.

European Innovation Scoreboard

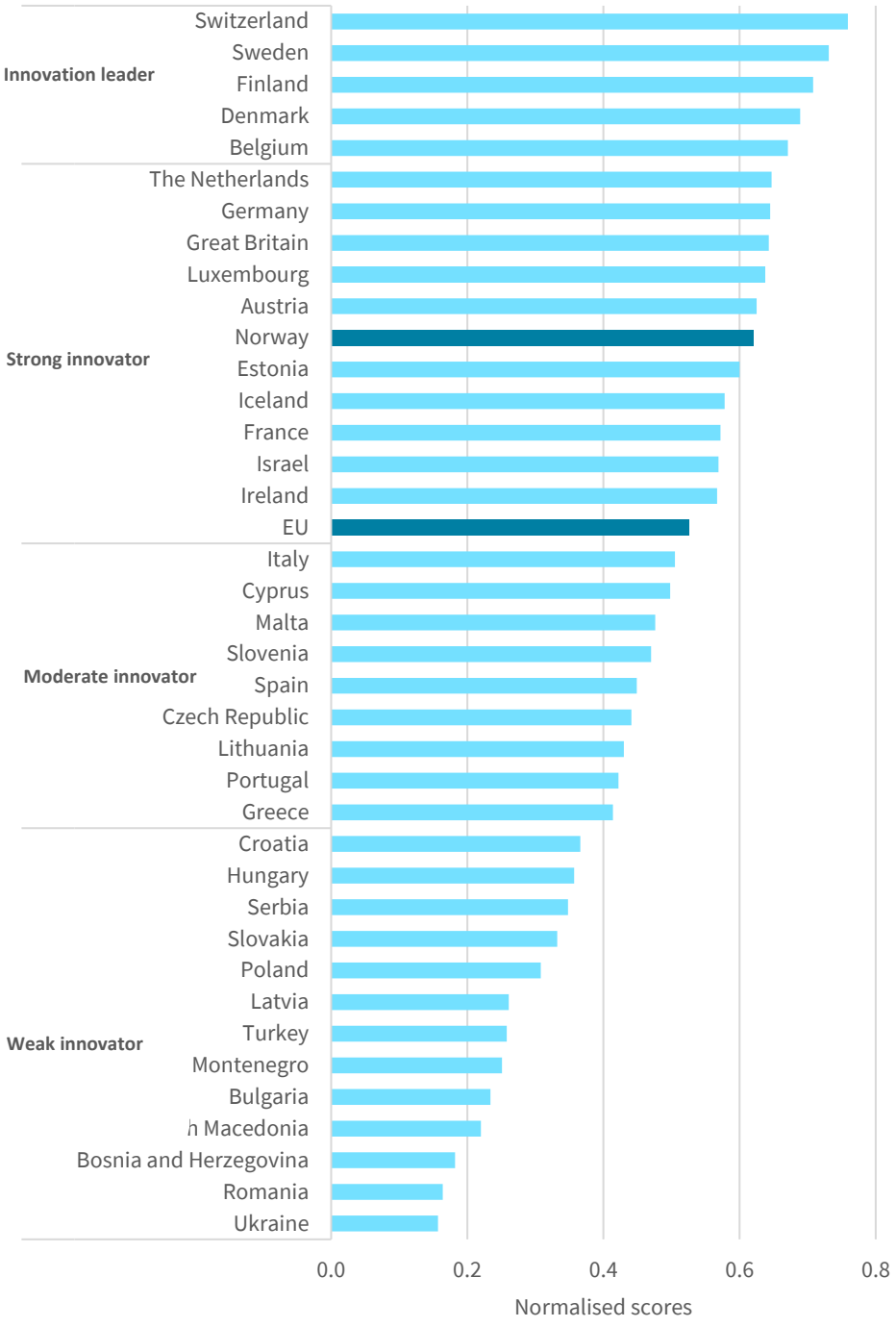
Since 2001, the European Commission has published an annual overview of key indicators of innovation in European countries, the so-called European Innovation Scoreboard (EIS). In 2021, the ranking covers a total of 37 countries inside and outside the EU and includes 32 indicators. The purpose is to provide a broad picture of innovation ability, framework conditions and results of innovation. The reference year for various indicators in this year's edition varies from 2016 to 2020. It is not yet possible to estimate the effect of COVID-19 based on figures in this year's report.

New countries among Innovation Leaders in the composite index for 2021

In the ranking from 2021, we find the same countries that topped the list in 2020: Switzerland, Sweden, Finland and Denmark, with Belgium as a new member in 2021. They form a group of "innovation leaders" and score well above the EU average. The Netherlands and Luxembourg, which belonged to the group of innovation leaders in the previous edition, end up among "strong innovators", the next group. This includes countries with the collective index slightly higher or approximately equal to the EU average. Norway retains its place in this group, as No. 11. Among other countries are Germany, Great Britain, Luxembourg, Austria, Iceland, etc. The other groups of countries are referred to as "moderate

innovators" and "modest innovators", respectively. A ranking of all EU countries, Norway and several countries outside the EU is presented in the figure below.

Figure 7.7 The countries' position in the European Innovation Scoreboard (EIS) 2021 according to summary index.



Source: European Innovation Scoreboard 2021

Appendix

Sector of performance	Total	Industry		Government		Other national sources	Foreign sources	
		Total	Of which: Oil companies	Total	Of which: The Research Council of Norway		Total	Of which: EU
Industrial sector	**35,408**	27,900	-	1,498	787	1,992	4,018	307
Institute sector	**15,088**	2,532	439	10,760	3,742	504	1,292	517
Higher education sector	**26,335**	618	-	23,618	3,907	1,090	1,009	678
Total	**76,831**	**31,050**	**439**	**35,876**	**8,436**	**3,586**	**6,319**	**1,502**

Table 1: Total R&D expenditure in Norway by sector of performance and source of funds. 2019. Mill. NOK.

Source: NIFU and Statistics Norway, R&D statistics.

Field of science	Total	Industrial sector	Institute sector	Higher education sector
Humanities and the arts	2,399	-	432	1,968
Social sciences	8,288	-	2,106	6,182
Natural sciences	7,110	-	2,789	4,320
Engineering and technology	7,777	-	4,945	2,832
Medical and health sciences	9,838	-	1,905	7,933
Agricultural sciences	2,798	-	2,388	410
Not elsewhere classified	33,164	33,164	-	-
Total	**71,374**	**33,164**	**14,564**	**23,645**

Table 2: Current expenditure on R&D by sector of performance and field of science. 2019. Mill. NOK.

Source: NIFU and Statistics Norway, R&D statistics

Sector of performance		Total	Basic research	Applied research	Experimental development
Institute sector	Million NOK	14,564	2,086	9,769	2,709
	Per cent	100	14	67	19
Higher education sector	Million NOK	23,646	9,292	11,315	3,039
	Per cent	100	44	43	13
Industrial sector	Million NOK	33,164	1,388	6,009	25,768
	Per cent	100	4	18	78
Total	**Million NOK**	**71,374**	**12,766**	**27,092**	**31,516**
	Per cent	**100**	**18**	**38**	**44**

Table 3: Current expenditure on R&D by type of R&D and sector of performance. 2019. Mill. NOK and per cent.

Source: NIFU and Statistics Norway, R&D statistics

	All sectors			Industrial sector[3]			Institute sector			Higher education sector		
Year	Total	Current expend.	Invest-ments	Total	Current expend.	Invest-ments	Total	Current expend.	Invest-ments	Total	Current expend.	Invest-ments
1970	891	774	117	276	256	20	329	295	34	286	223	63
1972	1,236	1,094	142	355	335	20	459	417	42	421	342	79
1974	1,633	1,467	166	479	434	44	630	579	51	525	454	71
1977	2,716	2,356	360	850	747	103	959	860	99	907	749	158
1979	3,265	2,952	313	1,026	942	85	1,230	1,135	95	1,009	876	133
1981	4,268	3,865	402	1,334	1,210	125	1,713	1,570	144	1,220	1,086	134
1983	5,765	5,207	557	1,886	1,738	149	2,405	2,142	262	1,474	1,328	146
1985	8,203	7,362	841	3,574	3,249	325	2,826	2,494	333	1,802	1,619	183
1987	10,319	9,216	1,103	4,548	4,037	512	3,605	3,232	373	2,166	1,947	219
1989	11,662	10,314	1,348	4,590	4,057	534	4,300	3,839	461	2,771	2,418	354
1991	12,744	11,285	1,459	4,980	4,463	517	4,405	4,024	381	3,359	2,798	561
1993	14,336	12,668	1,668	5,631	4,907	724	4,811	4,338	472	3,894	3,422	471
1995[4]	15,970	14,389	1,581	7,341	6,438	903	4,491	4,272	219	4,139	3,680	459
1997	18,244	16,485	1,759	8,572	7,742	830	4,827	4,519	308	4,846	4,225	621
1999	20,346	18,441	1,905	9,540	8,772	768	4,987	4,753	234	5,819	4,916	903
2001	24,469	22,305	2,164	12,614	11,348	1,265	5,582	5,337	244	6,274	5,619	655
2003	27,246	24,813	2,432	13,391	12,077	1,314	6,360	6,075	285	7,495	6,661	834
2004	27,553	25,280	2,272	12,708	11,736	972	6,620	6,320	300	8,225	7,225	1,000
2005	29,515	27,443	2,072	13,512	12,591	920	6,907	6,661	246	9,096	8,190	906
2006	32,275	29,845	2,430	14,735	13,615	1,120	7,650	7,350	300	9,890	8,880	1,010
2007	36,788	33,956	2,832	16,755	15,482	1,274	8,310	7,942	368	11,723	10,532	1,190
2008	40,545	37,354	3,191	18,295	16,929	1,366	9,267	8,812	454	12,984	11,613	1,371
2009[5]	41,884	39,062	2,823	18,202	17,180	1,022	10,262	9,794	468	13,420	12,087	1,333
2010	42,759	40,000	2,759	18,514	17,264	1,250	10,415	10,051	364	13,830	12,685	1,145
2011	45,440	42,578	2,863	20,066	18,532	1,533	11,115	10,657	458	14,259	13,388	872
2012	48,044	45,140	2,903	21,176	19,718	1,458	11,828	11,238	590	15,039	14,184	855
2013	50,748	47,818	2,930	22,557	21,059	1,498	12,190	11,689	501	16,001	15,070	932
2014	53,867	50,895	2,972	24,802	23,336	1,466	12,345	11,911	434	16,720	15,648	1,072
2015	60,209	56,087	4,122	27,782	26,034	1,748	13,718	12,812	906	18,709	17,241	1,468
2016	63,345	59,299	4,046	29,489	27,689	1,800	13,220	12,738	482	20,636	18,872	1,764
2017	69,176	64,543	4,633	31,990	30,319	1,671	13,864	13,124	740	23,322	21,100	2,222
2018	72,777	66,935	5,842	32,748	30,546	2,202	14,828	13,686	1,142	25,201	22,702	2,499
2019	76,830	71,374	5,456	35,408	33,164	2,244	15,088	14,564	523	26,335	23,645	2,689
2020*	78,374	72,723	5,651	36,966	34,544	2,422	15,000	14,480	520	26,408	23,699	2,709

Table 4: R&D expenditure in Norway by sector of performance and type of cost. 1970–2020.* Mill. NOK. Current prices.

*Preliminary figures. Source: NIFU and Statistics Norway, R&D statistics

[3] Due to new information from important R&D units in the industrial sector, R&D statistics from 2001 till 2007 have been corrected.

[4] Data from 1995 is not directly comparable with the previous years due to an extension in the data coverage in the Industrial sector, as well as the transfer of state commercial enterprises from the institute sector to the Industrial sector.

[5] In 2009 some research units were reclassified, mainly from the higher education sector to the institute sector.

Year	All sectors			Industrial sector[1]			Institute sector			Higher education sector		
	Total	Researchers[2]		Total	Researchers[2]		Total	Researchers[2]		Total	Researchers[2]	
		Total	Women (%)		Total	Women (%)		Total	Women (%)		Total	Women (%)
1974	21,820	9,756	..	5,152	1,419	..	7,599	3,286	9	9,069	5,051	12
1977	23,952	10,818	..	5,851	1,688	..	8,108	3,517	9	9,993	5,613	14
1979	25,154	11,851	..	6,402	2,017	..	8,605	3,982	9	10,147	5,852	14
1981	26,297	12,939	..	6,473	2,316	..	9,138	4,376	12	10,686	6,247	15
1983	27,930	14,002	..	7,254	2,909	..	9,793	4,663	11	10,883	6,430	16
1985	30,979	15,923	..	10,041	4,475	..	9,818	4,792	13	11,120	6,656	18
1987	31,898	18,128	..	10,332	5,897	..	10,077	5,343	16	11,489	6,888	19
1989	32,871	19,515	18	9,734	5,861	13	10,639	5,882	19	12,498	7,772	22
1991	31,473	20,118	20	8,634	5,671	14	10,094	5,909	20	12,745	8,538	24
1993	33,979	21,879	22	9,402	6,192	16	10,514	6,339	24	14,063	9,348	25
1995[3]	40,915	26,712	24	12,631	8,012	15	10,092	6,048	26	18,192	12,652	29
1997	43,972	30,280	26	14,326	10,377	17	9,998	6,118	28	19,648	13,785	32
1999	43,893	30,994	28	14,545	10,710	19	9,279	5,920	29	20,069	14,364	34
2001	48,394	34,549	29	17,995	13,308	19	9,285	6,077	31	21,114	15,164	36
2003	50,728	35,307	29	19,356	12,741	17	9,411	6,350	32	21,961	16,216	38
2005	53,845	36,570	32	20,215	11,999	19	9,425	6,484	34	24,205	18,087	39
2007	59,156	41,347	34	21,464	14,068	20	10,618	7,467	37	27,074	19,812	42
2008	62,675	43,715	34	23,472	15,412	20	11,111	7,713	38	28,092	20,590	43
2009[4]	64,126	44,762	35	23,468	15,249	21	11,716	8,198	39	28,942	21,315	44
2010	63,876	44,774	36	22,939	14,854	21	11,854	8,277	40	29,083	21,643	44
2011	64,717	45,578	36	23,317	15,332	22	12,106	8,434	41	29,294	21,812	45
2012	66,085	46,747	40	24,730	16,460	31	12,079	8,386	41	29,276	21,901	46
2013	68,204	47,795	36	25,324	16,667	19	12,297	8,540	42	30,583	22,588	47
2014	71,947	50,024	37	28,153	18,180	22	12,265	8,440	42	31,529	23,404	47
2015	76,557	52,181	37	31,068	19,236	22	12,323	8,341	43	33,166	24,604	48
2016	80,684	54,601	38	33,495	20,729	22	12,241	8,334	43	34,948	25,538	48
2017	85,335	57,934	38	36,087	22,451	23	12,582	8,390	44	36,666	27,093	49
2018	86,610	59,629	39	36,796	23,135	24	12,895	8,651	44	36,919	27,843	50
2019	89,864	61,657	39	38,848	24,166	23	13,061	8,670	45	37,955	28,821	50

Table 5: R&D personnel (head count) in Norway by sector of performance and gender. 1974–2019.

[1] Due to new information from important R&D units in the industrial sector, R&D statistics from 2001 till 2007 have been corrected.

[2] Personnel with a higher education degree (ISCED-level 5A and 6). Only academic staff are included in the higher education sector.

[3] Data from 1995 are not directly comparable with the previous years due to an extension in the data coverage in the Industrial sector, as well as the transfer of state commercial enterprises from the Institute sector to the Industrial sector.

[4] In 2009 some research units were reclassified, mainly from the higher education sector to the institute sector.

Source: NIFU and Statistics Norway, R&D statistics

Year	All sectors			Industrial sector[1]			Institute sector			Higher education sector		
	Total	Researchers[2]	Others	Total	Researchers[2]	Others	Total	Researchers[2]	Others	Total	Researchers[2]	Others
1970	9,857	4,317	5,540	3,067	867	2,200	3,820	1,663	2,157	2,970	1,787	1,183
1974	12,459	5,630	6,829	3,460	1,011	2,449	5,007	2,309	2,698	3,992	2,310	1,682
1977	13,860	6,358	7,502	4,003	1,202	2,801	5,333	2,556	2,777	4,524	2,600	1,924
1979	14,810	7,112	7,698	4,390	1,390	3,000	5,638	2,906	2,732	4,782	2,816	1,966
1981	15,025	7,548	7,477	4,201	1,524	2,677	5,885	3,125	2,760	4,939	2,899	2,040
1983	16,188	8,350	7,838	4,409	1,821	2,588	6,801	3,544	3,257	4,978	2,985	1,993
1985	19,036	9,767	9,269	6,687	2,995	3,692	7,095	3,605	3,490	5,254	3,167	2,087
1987	20,140	11,557	8,583	7,187	4,102	3,085	7,619	4,181	3,438	5,334	3,274	2,060
1989	20,471	12,256	8,215	6,579	3,862	2,717	8,108	4,725	3,383	5,784	3,669	2,115
1991	20,530	13,570	6,960	6,747	4,599	2,148	7,810	4,817	2,993	5,973	4,154	1,819
1993	22,166	14,803	7,363	7,482	5,021	2,461	8,026	5,045	2,981	6,658	4,737	1,921
1995[3]	24,003	15,964	8,039	9,437	6,169	3,268	7,611	4,802	2,809	6,955	4,993	1,962
1997	24,935	17,520	7,415	10,410	7,662	2,748	7,463	4,767	2,696	7,062	5,091	1,971
1999	25,444	18,319	7,125	10,995	8,080	2,915	7,136	4,718	2,418	7,313	5,521	1,792
2001	26,745	19,714	7,031	12,273	9,321	2,952	6,988	4,723	2,265	7,484	5,670	1,814
2003	28,546	20,581	7,965	13,390	9,368	4,022	7,238	4,962	2,276	7,918	6,251	1,667
2004	29,150	20,735	8,415	13,430	8,915	4,515	7,220	5,020	2,200	8,500	6,800	1,700
2005	29,984	21,216	8,768	13,288	8,617	4,671	7,276	5,088	2,188	9,420	7,511	1,909
2006	31,251	22,600	8,651	13,881	9,530	4,351	7,500	5,200	2,300	9,870	7,870	2,000
2007	33,655	24,369	9,286	14,848	10,372	4,476	7,796	5,523	2,273	11,011	8,474	2,537
2008	35,502	25,593	9,909	15,996	11,027	4,969	8,165	5,796	2,369	11,341	8,770	2,571
2009[4]	36,091	26,273	9,818	15,673	10,783	4,890	8,763	6,328	2,435	11,655	9,162	2,493
2010	36,121	26,450	9,671	15,321	10,622	4,699	8,832	6,360	2,472	11,968	9,468	2,500
2011	36,950	27,228	9,722	15,545	10,925	4,620	9,123	6,543	2,580	12,282	9,760	2,522
2012	37,707	27,841	9,866	16,062	11,375	4,687	9,232	6,611	2,621	12,413	9,855	2,558
2013	38,534	28,311	10,223	16,371	11,508	4,863	9,449	6,749	2,700	12,714	10,054	2,660
2014	40,418	29,379	11,039	18,053	12,426	5,627	9,355	6,657	2,698	13,010	10,296	2,714
2015	42,409	30,632	11,777	19,087	13,000	6,087	9,370	6,656	2,714	13,952	10,976	2,976
2016	43,918	31,913	12,005	19,616	13,396	6,220	9,365	6,722	2,643	14,937	11,795	3,142
2017	46,235	33,622	12,613	21,205	14,432	6,773	9,355	6,652	2,703	15,675	12,538	3,137
2018	46,602	34,333	12,268	20,979	14,598	6,382	9,385	6,685	2,700	16,237	13,051	3,187
2019	48,722	35,897	12,825	22,178	15,322	6,856	9,587	6,739	2,848	16,957	13,836	3,121
2020*	50,553	37,476	13,077	23,140	16,316	6,824	9,670	6,800	2,870	17,743	14,360	3,383

Table 6: R&D personnel (FTE) in Norway by sector of performance. 1970–2020.*

*Preliminary figures. Source: NIFU/Statistics Norway, R&D statistics

[1] Due to new information from important R&D units, R&D statistics from 2001 till 2007 have been corrected.

[2] Personnel with a higher education degree (ISCED-level 5A and 6). In the higher education sector only academic staff are included.

[3] Data from 1995 are not directly comparable with the previous years due to an extension in the data coverage in the Industrial sector, as well as the transfer of state commercial enterprises from the Institute sector to the Industrial sector.

[4] In 2009 some research units were reclassified, mainly from the higher education sector to the institute sector.

Science & Technology Indicators for Norway 2021

Since 1997 a national report of research and innovation indicators for Norway has been published regularly and annually since 2009. This is an English version of the 2021 report, consisting of selected parts of the full Norwegian report. Data and analysis are based upon the results from the national statistical survey on resources devoted to research and experimental development (R&D) and Innovation survey as well as other statistics and studies. Time-series and international data are also included.

The purpose of the report is to present an overall description for non-Norwegian readers of Norway's performance and activity within science, technology and innovation. The data and analysis are structured around seven chapters: the first chapter focuses on R&D in the Norwegian system. The second chapter describes Norwegian R&D in an international context. Chapter 3 presents human resources in research and innovation, while chapter 4 presents public instruments for support of R&D and innovation. Chapter 5 includes indicators for intellectual property rights, while Chapter 6 presents bibliometric indicators of the Norwegian publication and citation profile. In chapter 7 data on innovation in the Norwegian industrial sector and public sector are presented.

The title and reference for the original report in Norwegian is: Det norske forsknings- og innovasjonssystemet – statistikk og indikatorer 2021, (978-82-12-03903-2 (pdf) and is published at the web page of the Research Council of Norway https://www.forskningsradet.no/indikatorrapporten/. The report is the result of a collaboration between NIFU, Statistics Norway and the Research Council of Norway, where NIFU has had the main editorial responsibility. Editors of the original report in Norwegian were Espen Solberg and Kaja Wendt, with Mona Nedberg Østby as editorial secretary. All of the above are from NIFU. Other members of the editorial committee were Svein Olav Nås and Tom Skyrud from the Research Council of Norway, Erik Fjærli, Kristine Langhoff and Lars Wilhelmsen from Statistics Norway, Knut Senneseth from Innovation Norway, Beate Rotefoss from SIVA, Magnus Otto Rønningen from the University of Oslo and Michael Spjelkavik Mark from NIFU.

The English version has been prepared by a team at NIFU: Kaja Wendt, Mona Nedberg Østby, Ekaterina Denisova, Kristoffer Rørstad and Frøydis Sæbø Steine. Chris Allinson at Allinson Editorial has proofread the report.

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