Report on Science & Technology Indicators for Norway

2011

Human Resources

Research and Development

Technology

Innovation

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Foreword

This new English edition of the Indicator Report provides the most up-to-date data available on research and innovation activity in Norway adapted to an international audience. The report brings together wide-ranging indicators relevant to the development and use of knowledge and research, thereby serving as an important reference point. As well as providing an overview of available data in this important area it presents recent analyses, discussions and explores methodological challenges about how such information is collected and used. Pure data from innovation and research statistics are not sufficient to give us the whole picture - the data must be put into the right context. We hope that the Indicator Report provides a valuable contribution to a real understanding of these complex issues.

There is no obvious way to agree on what an appropriate level of activity in research and innovation should be, or on what kind of results we should expect from it. Financial models or other models provide no concrete answers to these questions. The pragmatic solution to the problem involves acknowledging two things: trends need to be assessed over time and results from any given sector, region or country need to be considered in comparison with others. These considerations have led to a new structure from this year‘s edition of the report with a separate chapter focusing on Norway’s position relative to the rest of the world. The report follows up with a more detailed presentation of the various sectors of the Norwegian R&D and innovation system and its development, followed by a chapter with focus on regional comparisons and challenges.

Policy is formulated continually, but annual budget decisions remain of central importance. For this reason, the Norwegian edition is since 2010 published on an annual basis. This will provide the most immediate possible access to robust information about significant developments in this area, to support ongoing assessment. The same considerations apply in explaining the increasing popularity of the internet version of the report. The internet version provides information in downloadable formats, with more detail than the printed version can contain. Tables and figures in the internet edition are also updated regularly throughout the year, as new data becomes available. An overview of the contemporary situation is also provided in the annual publishing calendar («årshjulet»). The complete report is also downloadable as a PDF. So, stay up-to-date via:
http://www.forskningsradet.no/indikatorrapporten.

This report has been produced through cooperation between NIFU, Statistics Norway (SSB) and the Research Council of Norway. Where necessary it also draws in additional expert input and comment, and this year’s edition includes NIBR’s contributions to the regional chapter. The editorial committee included members from Innovation Norway and the Norwegian Association of Higher Education Institutions (UHR). I wish to thank the editors and all the contributors for their efforts towards this fast-paced and comprehensive work. To the readers and those who use the report, I hope you find the report useful and interesting, and would like to invite your feedback; an ongoing dialogue with those who use this report will help us make this source of information for research and innovation policy even better next year.

Arvid Hallén
Director General
The Research Council of Norway

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Introduction

This document presents a selection of science and technology (S&T) indicators from Norway. This abridged English report is based on the more comprehensive Norwegian text, and is designed to provide useful information and perspectives on a range of S&T issues. It aims to provide relevant and useful information for foreign audiences, who may not be familiar with the Norwegian S&T environment. It complements the full version which can be found online (in Norwegian).

This report is the latest of a regular series which goes back to 1997, although it also draws on certain measurements and indicators with a much longer history. It continues the serie's original aim of presenting a wide range of relevant statistics and indicators and of ensuring their ongoing development. Statistics on the resources devoted to research and experimental development (R&D) in Norway, in terms of expenditure and personnel, have been compiled since 1963. Those relating to patents, bibliometric analyses and advanced technology have been included since the 1980s. Innovation studies were first introduced in the 1990s.

The full-length Norwegian report presents a larger set of indicators and commentary, divided into international, national and regional sections. It also includes a separate section with detailed tables. The contributions of the authors from the original Norwegian report have been adapted in this abridged version to include more dicsussion and information on important features about the Norwegian research and innovation system. The highlights sections and tables on key indicators are taken directly from the original version of the report and may therefore include some topics which are not included in the text of this abridged version.

This English version of the report's structure should make it easy to find information across the wide range of topics covered. The report opens with an overview of the Key Indicators presented, before a brief presentation of the Norwegian innovation system. Chapter 1 introduces recent economic developments and then presents the main results from R&D surveys based on international data from both UNESCO and the OECD; this chapter also includes results from the 2008 Innovation survey, and presents comparisons over time and between countries, for statistics on students, doctoral degrees, bibliometrics and patents. Chapter 2 draws on national R&D statitics for the three research-performing sectors in Norway: the industrial sector, the institute sector and the higher education sector. Employment statistics and education statistics are also included in order to establish the human resources availble in the country for science and technology. Chapter 2 also includes data on Norwegian participation in the EU Framwork Programme. Chapter 3 presents regional indicators for R&D and innovation.

Not all sections of the original report are included here. The original Norwegian report also includes supplementary details on the Norwegian research and innovation system in a number of "fact boxes" and more short comment pieces from experts in "focus boxes" that are not included here. Similarly, full references do not feature in this abridged report, but these can be found in the Norwegian report, available on Internet: http://www.forskningsradet.no/

Currency rates

As of 2009 (year average):
1 Euro = 8.7 NOK (Norwegian kroner)
1 US$ = 6.3 NOK

As of September 2011:
1 Euro = 7.7 NOK
1 US$ = 5.6 NOK

The Norwegian innovation system

Norway is a small open economy, with just under 5 million inhabitants, that relies heavily on a sophisticated exploitation of several significant natural resources. The Norwegian gross domestic product (GDP) exceeded $55 000 per person in 2010, when measured in constant US dollars.[1] Only four other countries had a higher standard of living. When measured in terms of labour productivity or output per hour worked, Norway ranked second among the most advanced industrial economies, appearing just below Luxembourg. When petroleum activities and ocean transport are excluded, labour productivity was 20 per cent lower but *mainland* Norway appeared just below the USA, the Netherlands and Belgium and was above all other countries where these data are available. Natural resources, innovation, skills, and participation in international research networks were key factors that enhance the performance of Norwegian enterprises.

Flows of technology and knowledge among people, enterprises and organizations define the national innovation system. A complex set of relationships among actors in the system that includes the government, public and private research institutes, universities and enterprises, underlie these flows. The national innovation system also includes the institutional arrangements that provide procedures that facilitate the creation, use and diffusion of new technologies. It also includes the education system, which helps facilitate learning and the creation of new competencies.

There are three distinct layers of enterprises in the Norwegian innovation system:[2] one with small scale enterprises operating with little knowledge accumulation, one with large scale enterprises that are knowledge intensive and rely on collaborative learning, and a third one with small R&D intensive enterprises that rely on collaborative learning with other enterprises and research organizations and likely to operate within global innovation networks. While the different layers are not unique to Norway, this diversity intersects with a specific economic specialization that is related to natural resources. Although relatively large-scale centralized enterprises dominate the economy, offshore petroleum activities have attracted many knowledge-intensive enterprises as well as research organizations.

In the Norwegian innovation system the business enterprise sector carries out almost 52 per cent of Norwegian R&D activity. Traditional industrial activities related to the extraction of raw materials and natural resources (petroleum and natural gas, fish, wood), and to their industrial processing into bulk products and semi-finished goods make up a large share of the Norwegian economy. These industries are less R&D intensive than industries such as pharmaceuticals and ICT, which partly explain why R&D expenditures make up only 1.8 per cent of GDP. When petroleum activities and ocean transport are excluded from GDP, the percentage share of R&D increases to just above the OECD average of 2.3 per cent. There has been broad political agreement that efforts should be made to foster more R&D intensive, knowledge-intensive manufacturing industries and services and in energy technologies, exploiting both renewable and non-renewable sources.

An interesting facet of the Norwegian innovation system is that about 25 per cent of R&D activity is done by independent research organizations, which are formally outside the education system. Historically, these research institutes were established in the Post World War II period as a complement to the universities and were intended to focus on developing specific kinds of knowledge. Many of these organizations began in the public sector, but then became private foundations although most continue to depend on public funding[3]. The remaining third of R&D activity is carried out by the higher education sector. Norway has 8 universities, 6 specialised universities and 25 university colleges. These organizations fund R&D mainly through ordinary budgets, but obtain additional funding for programmes and equipment, mainly from the Research Council.

Governance of the Norwegian innovation system involves many different ministerial bodies, advisory structures and a range of different actors, all concerned with the making and steering of policy and its implementation. The figure on the inside front cover

[1] Purchasing power parity. The Conference Board Total Economy Database, September 2011.

[2] Olav Wicken 2009. The Historical Evolution of a National Innovation System in Norway in J. Fagerberg, D. Mowery, and B. Verspagen, eds., *Innovation, Path Dependency, and Policy: The Norwegian Case*, Oxford University Press, pp 33-60.

[3] In international comparisons the institutes that mainly serve the industrial sector (branch institutes and task-oriented industry institutes) are included in the business enterprise sector according to OECD guidelines.

provides an overview of the various government, public and private actors. The Norwegian Parliament, or *Stortinget*, is the highest political authority for policy debate, legislation and control. While Norway has no single forum focusing solely on science, innovation and technology (STI) policy issues, three Standing Committees of the *Stortinget* deal with these issues directly: (1) Education, Research and Church Affairs; (2) Business and Industry; and (3) Energy and Environment. Policy priorities and relevant appropriations are nevertheless made at the level of the ministries. Three Government Ministries are central in STI funding and policy: (1) Education and Research (KD); (1) Trade and Industry (NHD); and (3) Local Government and Regional Development (KRD). Other ministries also consider STI policy important to their portfolio as the figure illustrates. Several higher-level initiatives have been made in recent years to integrate policy areas to a greater degree across traditional ministerial mandates.

Four agencies have the main responsibility for implementing STI policies: (1) The Research Council of Norway (RCN); (2) Innovation Norway (IN); (3) The Industrial Development Corporation of Norway (SIVA); and (4) The Norwegian Design Council (NDC). The Ministry of Education and Research (KD) administers the RCN, which has the overall responsibility for the promotion of basic and applied research within all scientific and technological areas. Innovation Norway was funded in 2004 and the objective of this state-owned enterprise is to promote private- and socio-economic profitable business development throughout the country, and to release the commercial opportunities of the districts and regions by encouraging innovation, internationalization and image-building. SIVA is a public network organisation that aims to develop strong regional and local industrial clusters through ownership in infrastructure, investment and knowledge networks as well as innovation centres. NDC promotes the use of design as a strategic tool for innovation. Finally also Norwegian counties have their own responsibility for industrial policy and Innovation policy, they are part-owner of Innovation Norway and manage the regional research funds.

The first Norwegian White Paper on innovation policy, titled, *An Innovative and Sustainable Norway* (White Paper No 7) was published in 2008. It was the first comprehensive innovation policy document intended for discussion in the Norwegian Parliament. The White Paper emphasised that an idea or invention does not become an innovation until it becomes a practical application, making it crucial to consider factors that may facilitate the transition from invention to innovation, including lack of critical resources, knowledge, international networks or complementary innovations. The main objectives of Norwegian innovation policy agenda are to: (1) establish better conditions for small and medium sized enterprises; (2) strengthen education and research; and (3) create a more innovative public sector. The White Paper emphasises the role and potential for improvement in education and competence building at all levels, from primary education to higher education, including vocational education and training and lifelong learning. Collaboration between education institutions and enterprises as well as entrepreneurship in education is also emphasised, in particular in higher education. About 22 per cent of the Norwegian population between 18 and 69 are in education and training programmes in 2010, which is more than 50 per cent higher than the EU average, according to Eurostat.

The last White paper of the Norwegian Ministry of Local Government and Regional Development *(Local growth and Hope for the Future*, White paper No. 25 2008–2009) also had innovation policy implications. One main objective of the report was to enable municipal authorities and local communities to make use of local resources and to strengthen local growth. The Norwegian government's objective is that all people shall have real freedom in their choice of where they live.

The 2009 White Paper on research policy, titled, *Climate for Research* (Report to the Storting No. 30 2008–2009) emphasized the continued need to increase R&D expenditures and the role of public finance in facilitating this process. Nine policy objectives are proposed in the White paper, five strategic goals that concern global challenges, social challenges, health and medical issues, knowledge based industry, and research priorities, and four overarching goals that concern high quality, increased internationalization of Norwegian research, more cooperation and efficient use of research funding. The main research priorities become those of the RCN and include food, marine, maritime, tourism, energy, environment, biotechnology, ICT and new materials (nanotechnology).

Key indicators

The following two tables present a set of key indicators. The intention is to introduce essential trends of Norwegian research and innovation in a concise form. The first table shows main trends in Norway. The second table compares the status of Norway to that of the other Nordic countries, the EU, and the OECD. See also the indicators in the appendix of this report.

Key indicators for R&D and innovation in Norway in 2003, 2005, 2007, 2008 og 2009

	2003	2005	2007	2008	2009
Resources for R&D and innovation					
R&D expenditure as a percentage of GDP	1.71	1.52	1.62	1.61	1.81
R&D expenditure per capita in constant 2009 prices (NOK)	7 410	7 550	8 530	8 810	8 675
R&D expenditure funded by government as a percentage of total R&D expenditure	40	43	45	..	46
R&D expenditure funded by industry as a percentage of total R&D expenditure	52	48	45	..	43
R&D expenditure in the higher education sector as a percentage of total R&D expenditure	28	31	32	32	32
Human resources					
Percentage of the population with higher education	31	33	34	36	..
R&D full time equivalents per 1 000 capita	6.4	6.6	7.2	7.5	7.5
R&D full-time equivalents per qualified researcher/scientist per 1 000 capita	4.6	4.7	5.3	5.5	5.5
Percentage doctoral degree holders among qualified researchers/scientists	24	27	27	28	30
Percentage women among qualified researchers/scientists	30	32	33	34	35
Cooperation in R&D and innovation					
Extramural R&D expenditure compared to intramural R&D expenditure in the industrial sector (%)	26	30	28	29	28
Companies involved in cooperation on R&D as a percentage of all R&D companies	46	52	39	..	39
Companies involved in cooperation on innovation as a percentage of all innovative companies	..	37[1]	39[2]	38[3]	..
Articles in international scientific journals co-authored by Norwegian and foreign researchers as a percentage of all articles by Norwegian researchers[3]	50	50	54	53	56
Results of R&D and innovation					
Percentage innovative companies in the business enterprise sector	25	26[1]	25[2]	27[3]	..
Percentage of turnover of new or substancially altered products in the industrial sector		5.9[1]	6.1[2]	4.5[3]	..
Number of articles in international scientific journals per 100 000 capita[3]	125	147	157	186	194
Number of patent applications to the European Patent Organization per million capita[4]	75	105	98	96	..

[1] 2004.
[2] 2006.
[3] Does not include enterprises with 10–19 employees in Construction and Transportation and storage.
[4] By inventor address and by application date, European applications only (EP-A).

Source: NIFU, Statistics Norway, OECD, Eurostat

Key indicators for R&D and innovation in last available year with comparable data in Norway, Sweden, Denmark, Finland, EU and OECD

	Year	Norway	Sweden	Denmark	Finland	EU15	OECD
Resources for R&D and innovation							
R&D expenditure as a percentage of GDP	2009	1.81	3.62	3.02	3.96	2.05	2.33[1]
R&D expenditure per capita (NOK)	2009	8 675	11 890	10 070	12 360	6 275	6 905[1]
R&D expenditure funded by the government as a percentage of total R&D expenditure	2009	47	27	28	24	34[1]	28[1]
R&D expenditure funded by the business enterprise sector as a percentage of total R&D expenditure	2009	44	59	60	68	55[1]	641
R&D expenditure in the higher education sector as a percentage of total R&D expenditure	2009	32	25	30	19	24[1]	17[1]
Human resources							
Percentage of the population with higher education	2008	36	32	33	36	25[2]	28
R&D full time equivalents per 1 000 capita	2009	7.5	8.2	10.4	10.5	5.6	..
R&D full time equivalents per qualified researcher/scientist per 1 000 capita	2009	5.4	5.0	6.4	7.7	3.4	3.5[3]
Cooperation in R&D and innovation							
Companies involved in cooperation on innovation as a percentage of all innovative companies	2008	35	40	57	37	34[4]	..
Companies involved in cooperation on innovation as a percentage of innovative companies in manufacturing and mining	2008	42	40	56	40	32[4]	..
Results of R&D and innovation							
Percentage of innovative companies in the business enterprise sector	2008	30	42	39	43	33[4]	..
Percentage of innovative companies in manufacturing and mining	2008	30	46	41	49	37[4]	..
Percentage of turnover of new or substancially altered products in the business enterprise sector	2008	3.3	9.2	7.8	11.4	13.3[4]	..
Percentage of turnover of new or substancially altered products in Manufacturing or Mining	2008	14.6	18.7	20.4	25.8	23.0[4]	..
Number of articles in international scientific journals per 100 000 capita	2010	194	214	214	185	98	73
Number of patent applications to the European Patent Organization per million capita[5]	2008	96	292	235	234	111	95

[1] 2008.
[2] EU 19.
[3] 2007.
[4] EU 27.
[5] By inventor address and by application date, European applications only (EP-A).

Source: NIFU, Statistics Norway, OECD, Eurostat