

**OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2004
COUNTRY RESPONSE TO POLICY QUESTIONNAIRE**

NORWAY

1. General framework and trends in science, technology, and innovation policy

The Norwegian Government is preparing a new White Paper on research. It will be presented early in 2005 and the process is in an initial phase. Quality, R&D based innovation, the Norwegian institute sector and international S&T co-operation are among the aspects that will be discussed in the new White Paper.

There are several reasons for presenting a new White Paper on research. Current Norwegian research policy is to a large extent based on goals and priorities established in the White Paper presented in 1999. Most of the policy initiatives launched in the last White Paper have now been implemented. For instance:

- A Research and Innovation Fund has been established, the annual yield from the fund is NOK 1,9 bill.
- 13 Centers of Excellence have been established,
- The Research Council of Norway has been evaluated
- The funding target (to reach the OECD –average by 2005) and present research priorities have to be reassessed.

Norwegian national research priorities today are long term basic research and four thematic priority areas: Marine research, Information and Communication technology, Medical and Health research and Research in the Intersection between Energy and the Environment.

In addition special funding is provided for functional genomics and materials technology. It is time to discuss whether all or some of these should be continued or whether new priorities should be proposed.

Plan for a Comprehensive Innovation policy

In October 2003, The Norwegian Government launched a Plan for a Comprehensive Innovation Policy titled “From Idea to Value”. The vision is for Norway to be one of the most innovative countries in the world, where resourceful and creative enterprises are given opportunities for developing profitable businesses. Furthermore, Norway shall be in the lead internationally in important areas, in terms of knowledge, technology and wealth creation.

The objective of the Government’s innovation policy is to facilitate increased wealth creation across the country, in order to achieve overarching welfare policy objectives. Increased wealth creation requires increased innovation on the part of Norwegian industry, and the Government has defined five main policy areas:

- General conditions for trade and industry

- Knowledge and competency
- Research, development and commercialisation
- Entrepreneurship
- Electronic and physical infrastructure

The fact that these areas are interrelated calls for a comprehensive approach to innovation policy. The Government has appointed a special Government Committee responsible for developing and coordinating policy at the national level. An important aspect of the plan is to improve mechanisms for dialogue between administrative levels within the public sector, between the public and the business sector, and between research and innovation communities.

See <http://www.dep.no/archive/nhdvedlegg/01/10/fromi033.pdf>

As a follow-up of the Innovation Policy Plan, the Government in February 2004 launched an initiative called "Innovation 2010". This initiative aims to activate and stimulate national, regional, and local actors in the public and the private sectors. Several regional projects have been initiated in order to identify opportunities and obstacles for regional innovation.

Innovation Norway

As of 1 January 2004 the new state owned company *Innovation Norway* is a result of the merger of the following four organisations: The Norwegian Tourist Board, the Norwegian Trade Council, the Regional Development Fund, (SND) and the Government Consultative Office for Inventors, (SVO).

(For information about Innovation Norway see <http://www.ntr.no/templates/Page.aspx?id=45053>)

Innovation Norway shall promote nationwide industrial development. It provides different financial support mechanisms such as loans and grants, information and advisory services as well as measures for internationalisation and promotion of Norwegian industry abroad. Innovation Norway will be working with the development of skills, knowledge and networks needed to increase innovation in of Norwegian companies.

A new Research Council of Norway

Approximately 30 percent of public funds for R&D is channelled through the Research Council of Norway (RCN). The RCN was established in 1993 as a merger of five existing research councils. The RCN has been subject to an extensive international evaluation. In 2002, the Government concluded that the existing model with one research council should be continued, but with extensive organisational changes.

(For information about the RCN see: <http://www.forskningsradet.no/>)

As of 01.09.03, the RCN is organised by function into three divisions, Division for Science, Division for Innovation and Division for Strategic Priorities. The new organisation acknowledges that research activities have different objectives and that different customers have different demands and needs. The reorganisation and the new structure shall secure

better co-ordination across disciplines and linking basic and applied research. The RCN shall be more customer oriented, maintaining an open dialogue with external stakeholders.

The Research Council of Norway

Division for Science – main roles

- Serve research institutions
- Contribute to the development of basic research in general
- Contribute to the development of multi- and cross-disciplinary research
- Influence the general conditions for Norwegian R & D institutions

Division for innovation – main roles

- Serve businesses
- Contribute to the development of R & D activities and innovation in trade and industry on national and regional levels
- Innovation in public services

Division for Strategic priorities

- Serve the public sector
- Provide necessary research-basis for policy development
- Large-scale research programmes

New legislation

On 1 May 2003, a new Design Act entered into force, transposing the EU Design Directive into Norwegian law and bringing about several amendments of the old Act to make it more user-friendly. The maximum period available for design protection was raised from 15 to 25 years. Several new types of visible aspects of products and services were made available for design protection, i.a. elements of user interfaces on computers, etc.

In December 2003, the Norwegian Parliament voted to transpose the EU Patent Directive into national law, mainly by amending the Patent Act. The main thrust of the adopted amendments is to make it clear that, in principle, biotechnological inventions are patentable in Norway like any other type of inventions, albeit with certain exceptions and special rules. This is meant to be, among other things, a positive political signal vis à vis industry that the Government welcomes the development of a biotech industry sector in Norway, as long as the technology that is implemented is ethically sound.

2. Public sector research and public research organizations

The Quality Reform

Since Norwegian universities and university colleges have undergone a reform process to improve quality in higher education and research, and to meet Norway's obligation to achieve the aims of the Bologna Process. The Quality Reform covers both public (state) and private institutions of higher education,

A new Act regulating all (public and private) Norwegian universities and colleges will be presented to parliament in 2004, replacing the Act regulating the state owned institutions and the one regulating the private institutions. (For further information about the reform see <http://www.dep.no/archive/ufdvedlegg/01/02/thequ067.pdf>)

A New funding model for higher education institutions

The Government has given priority to the implementation of the Quality reform resulting in growing budgets for higher education institutions.

A new result-oriented funding model for higher education institutions was introduced in the budget year 2002, based on the institutions' performance in year 2000. In the new model, state allocations to the institutions consist of a basic component (60%), an educational component (25%),

and a research component (15%). Over time, there will be variations between the components and between the institutions from year to year.

Performance measures for the educational and research components are included in the model. The educational component is based on the production of completed student credits, graduate production (scheduled to begin in 2005) and the number of international exchange students (in + out).

The research component consists of one part redistributed on the basis of performance and one part related to quality and strategic considerations. Regarding the performance related part of the research component, redistribution between universities is based on degree production, specified by level (Ph.D., Master), funding from research co-operation within the EU and from the Research Council of Norway. The number of higher academic positions (professors etc.) is also included. This last component is also included for university colleges in addition to credit production and external cooperation.

From the year 2006, scientific publications will be included in the research component for the universities and the university colleges.

Institutional autonomy

According to the Quality Reform, the individual higher education institution may choose its own organisational structure. Each institution may adapt its structure to suit its own distinctive character as well as its particular tasks and challenges.

Universities and university colleges have been granted increased autonomy when it comes to introducing and abolishing courses and study programmes. The universities may decide which disciplines, subjects and subject combinations they wish to offer as a basis for the various degrees. This also applies to the specialised university institutions, the university colleges and the colleges of art.

Quality assurance

The Norwegian Agency for Quality Assurance in Education (NOKUT) was established on 1 January 2003. The agency's role is to be an independent state body monitoring the quality of Norway's higher education institutions by means of accreditation and evaluation. NOKUT's accreditation and evaluation processes are also designed to support the institutions in their own quality assurance and development. (For more information about NOKUT see <http://www.nokut.no/sw410.asp>)

3. Government support for private-sector R&D and innovation

Tax treatment of business R&D

In 2002 the Government introduced a tax deduction scheme ("Skattefunn") for R&D expenditures in small and medium sized enterprises, defined as companies with less than a 100 employees.

From the year 2003, the scheme was redefined to include all enterprises that are subject to Norwegian taxation. For enterprises with more than 250 employees, 18% of the R&D-expenses related to an approved project may be deducted in tax. For smaller enterprises (less than 250 employees), 20% deduction is allowed. The scheme has a certain SME-profile, since there is a limit to the amount that may be deducted. The limit is NOK 4 million (per year) for R&D projects conducted by the enterprise itself and NOK 8 million for projects where the enterprise collaborates with an approved R&D institution.

In 2002, 2600 applications were accepted. In 2003, the number of accepted applications was 3600. The total effects on tax revenues for 2004 is estimated at NOK 1,5 billion, which is NOK 600 mill more than the estimate for 2003. It should be emphasised that there are some uncertainty concerning these estimates, especially due to the recent changes in the scheme.

(For more information about Skattefunn see: <http://www.skattefunn.no/>)

4. Enhancing collaboration and networking among innovating organisations

Recently two major changes were made in the Norwegian legislation to enhance the collaboration between universities and colleges and industry. In 2002 changes were made in the Act on Universities and Colleges to introduce new responsibilities for universities and colleges to cooperate with industry, and to work actively for the dissemination and use of their research results, for industrial purposes. On 1 January 2003, new legislation entered into force, amending the Act on the Ownership to Inventions made by Employees, by repealing the so-called exception for teachers. Thereby, rules on ownership to inventions made by researchers employed at universities and state colleges, in principle became the same as for employees in other establishments, with only a few exceptions still remaining (see below). Main elements of the changes were:

- Researchers must notify the institution, without undue delay, of any research result or invention that may be assumed to be patentable.
- Universities and colleges may, if they so wish, take possession of the right to commercial exploitation of patentable inventions made by their employees.
- In order to secure researchers' possibility for open dissemination of their research results an exception is made to the general provisions of the Act. The new exception entails that teachers and scientific personnel in full or part-time posts at universities and colleges shall have a statutory right to freely publish their research results even when this may prevent the institution from exploiting an invention commercially. If the publication right is not taken advantage of within a year after the institutions is notified of the invention, the institution may take possession of the right to the invention.
- Any economic benefit accruing from the exploitation are to be divided fairly between the mother institution, the individual that have made the invention and the research group or institute involved. 1/3 of the benefit to each of these parties is suggested as a reasonable starting point for negotiations.

The new legislation provides a reasonable balance of rights and responsibilities for researchers and institutions, and facilitates the organization of work on commercial exploitation of inventions at universities and colleges. The researchers will receive assistance from the institutions in their work on exploitation of an invention, thereby enabling them to concentrate more on research and teaching. The institution must, for its part, organise an apparatus to safeguard the rights of both the researchers and the institution and ensure that inventions are patented and made available to commerce and industry.

So far, the new legislation seems to have stimulated the universities and colleges to closer collaboration with industry and has among other things led to the establishment of Technology Transfer Offices (TTO's) at some of the larger institutions.

(For example see TTO at University of Oslo: <http://birkeland.uio.no/english.html>)

5. Human resources for S&T

The Norwegian government places great emphasis on this topic. A national strategy with a comprehensive overview of measures with government funding was presented in January 2003. The strategy was launched as a response to the need for a comprehensive approach. Several dedicated

actors have taken a number of valuable, but separate initiatives over the years, but these initiatives have not been seen as pieces of the same puzzle.

It is important that several actors in society are willing to shoulder their share of responsibility concerning recruitment to science and technology. When priority is assigned to science subjects at government level, it is desirable and necessary that municipalities and local authorities also become aware of their responsibility as school-owners and business-developers, and assign priority to what will generate future benefits. The national strategy will be available in English in early March

Policy initiatives/aims:

- A National Centre for Contact with the Business Community on MST subjects, called RENATE was established in 2003. Its mandate is to establish contact between education institutions and the business community in order to assure the recruitment of students studying science, mathematics and technology; to increase the participation of women; and attend to the business community's needs for competence in the MST fields. Its work includes network building, national and regional arrangements (e.g. Engineer's Day), and recruitment campaigns.
- For the last 3 years, the Ministry has given the universities extra financial support for science equipment. This extra support is most important for the MST related institutes, and up-to-date equipment can be important for increasing the recruitment of Ph.D. students.
- The general teacher education programme was changed a few years ago, and mathematics is now a compulsory subject for all teacher education students. Mathematics represents a unit of ½ year which is 25 per cent of the total compulsory subjects in the Norwegian teacher education.
- In 2003, some universities started new education programmes for teachers in mathematics and sciences. These programmes are 5-year integrated master studies, and the candidates will be qualified to teach mathematics and sciences in upper secondary schools.
- In 2003, the Ministry of Education and Research offered an education grant for teachers who want to upgrade their education in mathematics. This grant scheme has proved to be very popular, and only 51 per cent of the teachers who applied for the grant received a positive answer. From 2004 this grant will be distributed by local authorities.
- Improving statistics describing the number and participation of students in science and technology education. Teacher education is particularly important.
- Distributing information concerning knowledge, interests and attitudes among pupils and students. TIMSS, PISA and ROSE are projects which contribute with valuable information in this respect.
- Increasing the number of lessons given in mathematics in primary education. This work will be presented by the Ministry in a white paper during the spring of 2004. The same white paper will also present actions to improve counselling in schools so that careers in science and technology are perceived as attractive options.
- Increasing the recruitment to undergraduate studies in engineering (Bachelor in Engineering), the ministry is funding 40 one year classes (each with at least 30 students) with a vocational secondary education background. The initiative has an annual budget of €4,7 million. These classes are organised by the same university colleges that also offer engineering studies. The syllabus consists of mathematics and science, as well as foreign and native language at the level of the last year of secondary education. Many university colleges recruit as much as half of their engineering students from these so-called pre-courses for engineering.

- Evaluating pre-courses and other qualifying courses given prior to regular courses in science and technology in colleges and universities.
- Further developing existing websites presenting science and technology.
- Evaluating science and mathematics in primary and secondary school in connection with the development of new curricula.
- Encouraging local testing of new ways of organising science and mathematics teaching at individual schools.
- Developing new forms of evaluation and examinations.
- National tests in mathematics will be given in the 4th and 10th grade.
- Organising a group of demonstration teachers in mathematics. These excellent teachers will share their methods and experiences with other teachers.
- Promoting participation in science competitions for students.
- Special actions will be taken to increase the recruitment of girls to science and mathematics in higher education.
- A web-based program for further education in science will be offered to teachers from the autumn of 2004.
- A film-based information package presenting good teaching practises at primary level will be developed during 2004.
- Scholarships for journalists who want to strengthen their science knowledge, and for researchers who want to work as journalists will be established.
- A number of events will be organised during 2005 – The World Year of Physics.
- A number of arrangements for children and young people will be held in connection with the award of the second Abel prize in mathematics which will take place in May 2004.
- A scheme for writing off student loans in order to increase the recruitment of students taking teacher education in sciences, mathematics and technology is being planned.

Recent statistics

Table 1. Graduates in science and engineering by discipline and gender

Year	1991/92			1992/93			1993/94			1994/95		
	M	W	T	M	W	T	M	W	T	M	W	T
Fields of education												
Science, Mathematics and Computing (ISC 4)	901	412	1313	874	427	1301	1021	471	1492	1042	439	1481
Life sciences (ISC 42)	136	150	286	131	143	274	125	161	286	142	155	297
Physical sciences (ISC 44)	191	111	302	206	131	337	223	136	359	244	143	387
Mathematics and statistics (ISC 46)	28	8	36	25	16	41	23	9	32	28	16	44
Computing (ISC 48)	546	143	689	512	137	649	650	165	815	628	125	753
Engineering, Manufacturing and Construction (ISC 5)	2408	603	3011	2483	696	3179	2682	678	3360	2459	636	3095
Engineering and engineering trades (ISC 52)	1860	395	2255	1941	414	2355	2131	424	2555	1986	379	2365
Manufacturing and processing (ISC 54)	14	23	37	15	36	51	16	31	47	22	56	78
Architecture and building (ISC 58)	534	185	719	527	246	773	535	223	758	451	201	652
Total: Graduates in Science and Technology	3309	1015	4324	3357	1123	4480	3703	1149	4852	3501	1075	4576

Source: Statistics Norway (the numbers has not been published before). M=men, W=women, T=total.

Year	1995/96			1996/97			1997/98			1998/99		
	M	W	T	M	W	T	M	W	T	M	W	T

Fields of education												
Science, Mathematics and Computing (ISC 4)	1197	536	1733	1258	524	1782	1245	531	1776	1377	588	1965
Life sciences (ISC 42)	166	213	379	181	228	409	181	224	405	152	209	361
Physical sciences (ISC 44)	257	166	423	217	155	372	274	162	436	243	135	378
Mathematics and statistics (ISC 46)	29	13	42	55	24	79	67	17	84	43	10	53
Computing (ISC 48)	745	144	889	805	117	922	723	128	851	939	234	1173
Engineering, Manufacturing and Construction (ISC 5)	2614	705	3319	1603	444	2047	2036	540	2576	1942	553	2495
Engineering and engineering trades (ISC 52)	2133	480	2613	1247	230	1477	1625	355	1980	1520	363	1883
Manufacturing and processing (ISC 54)	31	63	94	27	68	95	23	58	81	20	42	62
Architecture and building (ISC 58)	450	162	612	329	146	475	388	127	515	402	148	550
Total: Graduates in Science and Technology	3811	1241	5052	2861	968	3829	3281	1071	4352	3319	1141	4460

Source: Statistics Norway (the numbers has not been published before). M=men, W=women, T=total.

Year	1999/2000			2000/01			2001/02		
	M	W	T	M	W	T	M	W	T
Fields of education									
Science, Mathematics and Computing (ISC 4)	1717	758	2475	1871	793	2664	1625	773	2398
Life sciences (ISC 42)	130	196	326	155	189	344	107	182	289
Physical sciences (ISC 44)	246	121	367	240	124	364	176	108	284
Mathematics and statistics (ISC 46)	59	11	70	37	18	55	30	13	43
Computing (ISC 48)	1282	430	1712	1439	462	1901	1312	470	1782
Engineering, Manufacturing and Construction (ISC 5)	1788	530	2318	1992	512	2504	1729	467	2196
Engineering and engineering trades (ISC 52)	1385	322	1707	1502	345	1847	1295	293	1588
Manufacturing and processing (ISC 54)	13	43	56	15	28	43	13	30	43
Architecture and building (ISC 58)	390	165	555	475	139	614	421	144	565
Total: Graduates in Science and Technology	3505	1288	4793	3863	1305	5168	3354	1240	4594

Source: Statistics Norway (the numbers has not been published before). M=men, W=women, T=total

Field/gender	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
<u>Humanities</u>															
Women	5	1	5	2	4	5	5	6	8	8	10	7	13	10	10
Men	13	11	13	6	14	12	11	16	22	16	11	25	12	28	30
All	18	12	18	8	18	17	16	22	30	24	21	32	25	38	40
<u>Social science</u>															
Women	1	1	-	3	1	-	3	2	4	5	8	14	16	14	3
Men	8	5	8	16	12	8	24	21	23	20	35	30	43	47	5
All	9	6	8	19	13	8	27	23	27	25	43	44	59	61	8
<u>Natural science</u>															
Women	1	3	8	6	6	11	13	16	13	11	19	30	30	29	4
Men	26	28	48	39	46	43	37	50	54	58	90	84	103	107	10
All	27	31	56	45	52	54	50	66	67	69	109	114	133	136	14
<u>Technology</u>															
Women	1	3	4	5	1	5	2	4	3	7	2	5	9	19	2
Men	57	48	43	44	41	49	44	48	42	78	94	70	83	106	9
All	58	51	47	49	42	54	46	52	45	85	96	75	92	125	12
<u>Medical science</u>															
Women	10	4	3	9	11	8	16	12	21	18	18	32	18	35	3
Men	49	42	45	60	63	59	58	55	73	84	72	74	79	57	7
All	59	46	48	69	74	67	74	67	94	102	90	106	97	92	11
<u>Agriculture and Veterinary science</u>															
Women	1	3	-	1	2	6	10	6	7	9	8	15	8	18	1
Men	15	24	17	16	23	14	29	17	27	24	26	29	25	21	3
All	16	27	17	17	25	20	39	23	34	33	34	44	33	39	4
Total	187	173	194	207	224	220	252	253	297	338	393	415	439	491	55

Source: The Doctoral Degree Register/NIFU

See <http://www.nifu.no/doktor/doktorgrader/startpage.html>

Postgraduate research training

Norway is increasing its expenditure on postgraduate research training. The goal is to increase the number of Ph.D. degrees awarded from 700 to 1100 degrees (total for all disciplines) yearly by 2010. The Government has therefore been increasing the number of publicly funded research student positions (full stipends) by 900 since the year 2000 to an estimated total of 4100 fellowship positions today, including privately funded stipends. According to plan, another 1000 fellowships will be added, reaching a total of 5100 positions by the end of 2007.

Research training in Norway was evaluated by an international panel of experts in 2002. One main finding was that time-to-degree is more than twice as long as the allotted three or four years. Only about half of the research-training students graduate with a Ph.D. within 6.5 years. Universities have now reorganised their Ph.D. programs to meet the challenges that were identified. The Government is expecting that time-to-degree will decrease as a result of the many new measures taken.

According to plan, the Government will allocate about a 1000 new research student fellowships to universities and university colleges over the next three years. Higher education institutions in Norway have extensive autonomy and consequently decide themselves the distribution of fellowships among disciplines. It is thus not the Government, but the higher education institutions themselves that must assure a sufficient number of students and graduates in science and technology. However, research training in technology is a priority of the Government. The Government will therefore reward those institutions that train the most Ph.D. graduates in technology (as measured by the throughput of their Ph.D. programs) by awarding them a larger share of the new research student fellowships.

6. Policies to boost innovation in the service sector

The service sector (public and private services) are responsible for more than half of all value creation in Norway. Increasing R&D based innovation is a main challenge for the service sector.

The Norwegian Government has adopted a policy of caution as regards state involvement in the market for value added services. As a result, outsourcing of public tasks to private sector actors has increased, and production of advanced services had an increase. Further development is being considered.

Perhaps somewhat contradictory to the relative importance of the service sector in the Norwegian economy, there are few public measures directly aiming at service-providing enterprises. These enterprises will, however, to a large extent be encompassed by more general measures in the field of innovation and research. Many Norwegian programmes are based on a systemic approach to innovation processes. Service providers are an integral part of such processes. Innovation Norway's ARENA-programme for instance aims at increasing value creation in regional business communities by stimulating co-operation and networks among enterprises, R&D institutions, and public authorities, without restrictions concerning branches.

The customised (user-driven) programmes in the Research Council of Norway do target specific trade and industry sectors, and will encompass service-providing enterprises to a varying degree. The 8-year programme PULS is a relatively new research programme, and focuses exclusively on services, commerce, and logistics. The programme aims at networking and collaboration, and offers financial support to research projects dealing with innovation processes and development of knowledge-based products and services. Use of ICT in the provision of services constitutes about 75 percent of the programme.

A process initiated recently by the Research Council of Norway aims at developing a more comprehensive picture of the participation of service-providing enterprises in research and innovation programmes, not least in programmes not specifically targeted at the service sector.

In the field of ICT, the Government has also taken initiatives related to the establishment of electronic market places and the fostering of more Public Key Infrastructure (PKI-) solutions, both important to the provision of services. Also, work has been initiated with the aim of securing a more transparent regulation of the transfer of public data (maps, meteorological data etc.) for private sector commercial use, in line with EU-regulation in this area.

In the area of standards, a new organisation has been established – Standards Norway. The new organisation has been assigned with the task of working out standards in Norway also in the field of services.

(For more information about Standards Norway see <http://www.standard.no/imaker.exe>)