



ERAWATCH Country Report 2009

Analysis of policy mixes to foster R&D investment
and to contribute to the ERA

Norway

Lisa Scordato and Egil Kallerud



EUR 23976 EN/24 - 2009

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JRC 53714
EUR 23976 EN/24
ISBN 978-92-79-13331-2
ISSN 1018-5593
DOI 10.2791/ 24584

Luxembourg: Office for Official Publications of the European Communities

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Printed in Spain

ERAWATCH COUNTRY REPORT 2009: Norway

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investment and to contribute to the ERA

ERAWATCH Network – NIFU STEP Norwegian research institute for
studies in innovation, research, and education

Lisa Scordato and Egil Kallerud

Acknowledgements and further information:

This analytical country report is one of 33 reports for EU Member and Associated States prepared as part of ERAWATCH. ERAWATCH is a joint initiative of the European Commission's Directorates General for Research and Joint Research Centre. For further information on ERAWATCH see <http://cordis.europa.eu/erawatch>. The analytical framework and the structure have been developed by the Institute for Prospective Technological Studies of the European Commission's Joint Research Centre (JRC-IPTS) in collaboration with DG-RTD and the ERAWATCH Network.

The report has been produced by the ERAWATCH Network (<http://www.erawatch-network.eu/>) in the framework of the specific contract on ERAWATCH Policy Mix Country Reports 2009 commissioned by JRC-IPTS. It makes use of information provided in the ERAWATCH Research Inventory with support of the ERAWATCH Network.

In particular, it has benefited from comments and suggestions of Paul Cunningham, who reviewed the draft report. The contributions and comments of Amrie Landwehr from JRC-IPTS are also gratefully acknowledged.

The report is only published in electronic format and available on the ERAWATCH website: <http://cordis.europa.eu/erawatch>. Comments on this report are welcome and should be addressed to Mariana Chioncel (Mariana.Chioncel@ec.europa.eu).

Executive Summary

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country. This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

In Norway the R&D intensity (measured as percentage of GDP) stood at 1.65 per cent in 2007, an increase compared with 1.52 per cent for 2006. For comparison, the share of GDP was 1.83 in the EU countries in 2007. The low indicators of the Norwegian performance may be seen as reflecting the specific structure of the Norwegian economy. Hence, comparisons made by normalising against GDP tend to show Norway in a relatively lower position compared to countries whose economies are less resource based (OECD 2008).

In 2007, €2.2b or 46 per cent of total R&D expenditure was performed by private companies, an increase of €0.2b compared with 2006. Norwegian BERD in 2007 stood at 0.77 per cent of GDP. According to Statistics Norway this corresponds to an increase of 15 per cent in nominal value, or 11 per cent in fixed prices, which is markedly higher than within the EU and the other Nordic countries. The service industry now makes up 42 per cent of total R&D. Enterprises with 10-49 employees had a 9 per cent increase in R&D expenditure, and make up 24 per cent of total R&D in 2007 (Statistics Norway).

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Insufficient political and public support of R&D as political priority	Opportunities for linking R&D to new priorities (clean energy, Carbon Capture and Storage (CCS), health). Risks of persistent/increasing political short-termism.
The strong sector based research funding system generates challenges regarding the coordination of research assignments.	Risk of failing overall and long-term commitment to R&D in Government. Opportunities for strong R&D-focussed policies within sectors (e.g., energy, health, defence). Opportunities exist for stronger coordination (in particular, energy/environment, presently on the agenda). Unexploited opportunities for coordinated implementation by the Research Council, including through collaboration with Innovation Norway and SIVA.
Relatively low absorption capacity of business enterprise sector	Opportunities in insufficiently recognised and targeted potential for increasing R&D in traditional industrial sectors. Strengthen the capability of research institutes to cooperate with firms. Risk of too weak competitive pressure on firms (cfr OECD).
Low business R&D expenditure due to structural barriers (few large R&D intensive firms, high share of industries with low R&D intensity, small share of R&D intensive industries)	Opportunities for growth of R&D intensive firms, in particular in services; stronger focus on new innovative firms. Strengthen the R&D tax credit scheme (SkatteFUNN). Risks of R&D cuts in large firms with high R&D activity

For a small open economy like Norway, collaboration in international research and participation in the ERA is of central importance.

Following the adoption of the 3 per cent Barcelona target, issues of skills and human resources for research have received more attention. Examples of policy instruments in this context are the introduction of an industry PhD scheme in 2008. The relatively low level of private funded R&D is of particular concern for Norwegian policy makers and has been the target for policy instruments such as the R&D tax credit scheme. Recent statistics indicate that the private funding of R&D increased remarkably in 2007. By international comparison, business expenditures of R&D are still low. The low level of private R&D investments can be explained by the industrial structure of the Norwegian economy, as characterised by smaller share of R&D intensive industries than the OECD average.

The Norwegian business sector R&D is strongly concentrated in a few companies and sectors. The larger part of business R&D is moreover constituted by *development* and not of research. In Norway the 20 largest firms account for 25 per cent of business intramural R&D. As many as 80 per cent of all companies report not having any R&D activities. Five per cent of all companies account for 85 per cent of all intramural R&D, while 95 per cent of R&D in the business sector is performed in 10 per cent of the companies (Kallerud and Spilling 2008).

Policy makers also see great opportunities for knowledge users to increase their access to international knowledge through participation in the European Research Area. This has been specifically addressed in several policy and strategy documents during 2007 and 2008.

Policies for skills and life-long learning are high on the government's agenda but insufficient strategies to lift education in S&T studies could be seen as a risk in achieving policy goals.

In light of more recent developments it can be concluded that unstable global macro-economic conditions may impact the research and innovation budgets of firms. Furthermore, inertia in shifting the economy towards a knowledge based society can also be seen as a potential barrier to private R&D investments.

As a response to the current financial crisis, the government has increased funding to several research and innovation related instruments and is orienting research spending towards more environmental friendly sectors. The attention towards energy and climate related research is strengthened, with particular emphasis on offshore wind and Carbon Capture and Storage (CCS). These developments therefore contribute to expand the research system.

The development of the ERA was extensively discussed in the government's latest White Paper on research policy, and efforts to "strengthen collaboration between national and international priorities" are explicitly supported, "possibly on the ERA-NET model". A new white paper on research policy will be presented later this year, and the government has already announced it will discuss how to increase the added value from public financed research, further development of international cooperation, and follow up of national priorities.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • High on the government's agenda with regard to several aspects. 	<ul style="list-style-type: none"> • Anglo-American PhD degree system • Uptake of the European charter for researchers and the Code of conduct for the recruitment of researchers • National committee to promote gender equality in science • Gender equality dimension in funding announcements • Participation in EU research mobility programmes, such as EURAXESS and Marie Curie grants. • Financing opportunities specifically designed for attracting foreign researchers exist under the RCN
Governance of research infrastructures	<ul style="list-style-type: none"> • Strategic importance, new roadmap in 2008. 	<ul style="list-style-type: none"> • National policy engagement in the ESFRI (European Strategy Forum for Research Infrastructure) process • Participation in Nordic research infrastructures
Autonomy of research institutions	<ul style="list-style-type: none"> • High importance, and emphasised in the latest reform of higher education and research (2003) 	<ul style="list-style-type: none"> • Reform of the higher education and research (Quality Reform) • New and more performance based system for institutional core funding • Greater institutional autonomy in financial matters • Move towards managerialist approach in internal management structures in universities
Opening up of national research programmes	<ul style="list-style-type: none"> • Not particularly emphasised in policy documents and in actual implementation. 	<ul style="list-style-type: none"> • High levels of participation in ERA-Nets • Participation to national R&D programmes is not open to non-nationals without having an affiliation to a Norwegian organisation.

Official policy strongly emphasizes Norway's orientation towards and commitment to the ERA conception, as seen in i.a. the strong role assumed by Norway in the Bologna process and its literal adoption of the Barcelona target as national target.

ERA plays a key role in Norwegian research policy, and it is also emphasised that, for Norway, research collaboration within the context of the EU is an important part of Norwegian foreign policy in relation to the EU. It is a key priority in Norwegian research policy that national participation in European research programmes should be facilitated and extended.

The main challenges for the national R&D system in relation to ERA include further opening up of national research programmes and to increase the share of private R&D spending. A major challenge hence exists in relation to the realisation of the objective to reach the 3 per cent Barcelona target.

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1 Introduction

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Hence, a central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of the efforts in increasing R&D investments and improving the performance of national research systems.

The main objective of the report is to characterise and assess the evolution of the national policy mixes in the perspective of the national goals for R&D investments, and for the contribution to the realisation of the European Research Area, as associate country.

This report is building on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

In this report we characterise and assess the performance of the national research system and national research policies. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain is guided by a set of generic "challenges", common to all research systems, which unravel possible bottlenecks, system failures and market failures a research system has to cope with. The main elements of and results from this analysis are presented in Chapter 2, while in the Annex, the reader can find a more detailed account of this exercise.

The need for an effective research policy, appropriately co-ordinated with education, innovation, and other types of policies, is also widely recognised. Therefore, we focus on the following two analytical issues:

- The assessment of the national policy mixes for the achievement of national R&D investment goals set. Particular attention is paid to policies fostering private R&D and addressing barriers (Chapter 3).
- The assessment of national policies contributing to the realisation of the European Research Area, as associate country (Chapter 4).

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Norway is a small open economy with a population of 4.6 million. In international comparisons Norway has a very strong economic performance with a GDP per capita 1.8 times higher than the EU average. The oil and gas sector provides a solid contribution to this macroeconomic success. According to Statistics Norway the R&D intensity (measured as percentage of GDP) stood at 1.65 per cent in 2007, an increase compared with 1.52 per cent for 2006. For comparison, the share of GDP

was 1.83 in the EU countries in 2007. The relatively low R&D share of GDP is primarily due to a high increase in Norwegian GDP, driven to a large extent by high oil prices ([INNO-Policy TrendChart, 2008](#)). Moreover, if compared with its Nordic neighbours, Norway is the country that spends the smallest proportion of GDP on R&D. If normalised by population rather than by GDP the rate is still lower than the other Nordic countries but increasing (OECD 2008).

The low indicators of the Norwegian performance may be seen as reflecting the specific structure of the Norwegian economy. Hence, comparisons made by normalising against GDP tend to show Norway in a relatively lower position compared to countries whose economies are less resource based (OECD 2008).

Main actors and institutions in research governance

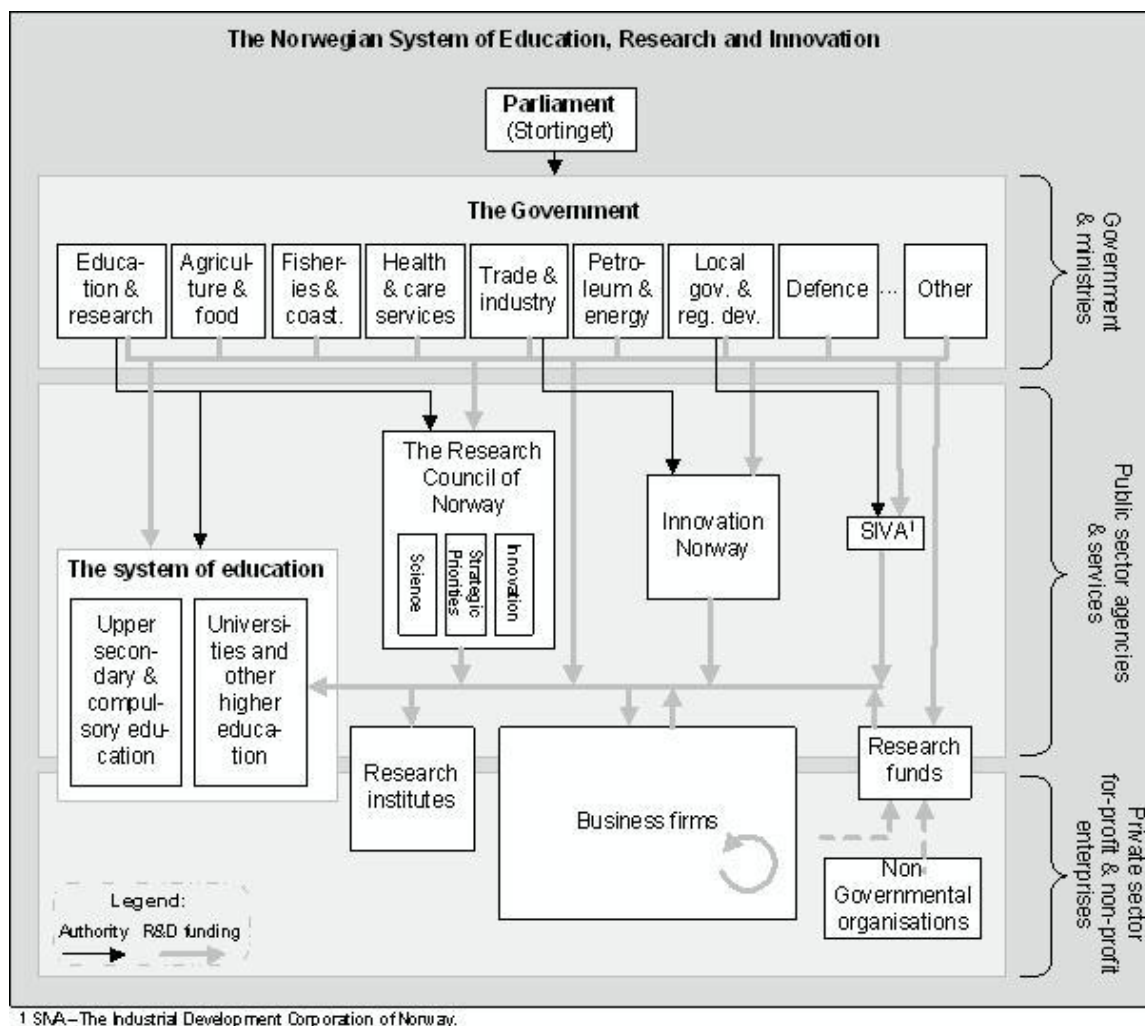
At government level, the Ministry of Research and Education has the main responsibility for coordinating the overall research policy and is the largest source of government research funds. Several other ministries have large research portfolios and each ministry is responsible for research related to its own sector in society. In addition to the Ministry of Research and Education, the main ministries funding research are: the Ministry of Trade and Industry, the Ministry of Health and Care Services, the Ministry of Oil and Energy, Ministry of the Environment, the Ministry of Agriculture and Food and the Ministry of Fisheries and Coastal Affairs. The ministries with the largest research portfolios are also standing members of the Government's Research Board (*Regjeringens forskningsutvalg*), which coordinates overall R&D policy under the lead of the Minister of Research and Higher Education. The Board has limited authority, and the strongly sectorised funding structure research generates challenges regarding the coordination of research assignments (OECD 2008).

The Research Council of Norway (RCN) is the only operational research policy agency in Norway. In addition to funding research, RCN has the mandate to advise the government about research policy and to create communication and coordination arenas for actors of research, industry and government. The Council had a budget of €0.7b (NOK5.6b) in 2007. Another important organisation for policy advice is the Norwegian Association of Higher Education Institutions. Other actors which provide policy advice are the Confederation of Norwegian Business and Industry (NHO), the Norwegian Confederation of Trade Unions (LO) and Tekna, the Norwegian Society of Chartered Technical and Scientific Professionals.

Innovation Norway and SIVA are the main public institutions that provide support for innovation, and are in part of their portfolio involved in industrial R&D. Innovation Norway is owned by the Ministry of Trade and Industry and provides programmes and services with the objective of promoting innovation at regional and national level, in mainly small and medium size companies. SIVA (the Company for Industrial Growth) is involved in the provision of science parks, incubators and services to developing companies and venture capital to mainly start up firms.

An overview of the governance structure of the Norwegian research system is presented in figure 1.

Figure 1: Overview of the governance structure of Norway's research system



Source: NIFU STEP

The institutional role of the regions in research governance

Norway is a unitary state divided into 19 county administrations (*Fylke*). The county councils together with the municipalities form the regional governance system in Norway. The government and the parliament (*Storting*) are politically responsible for formulating objectives and establishing the framework for Norwegian research activities. Initiatives have however been taken by some country authorities to develop research and innovation policies of their own.

In late October 2008 the government presented a proposal for regional administrative reform to be made effective from 2010. According to the proposal, the regional administrative structure is to remain the same but with a wider set of policy tools at their disposal. Among the proposals are to set up new regional research funds, that will receive a government contribution of €722,195m (NOK6b). The counties will also be responsible for selecting board members to university colleges in the region.

Main research performer groups

In 2007, €2.2b or 46% of total R&D expenditure was performed by private companies, an increase of €0.2b compared with 2006. Norwegian BERD in 2007 stood at 0.77% of GDP. According to Statistics Norway this corresponds to an increase of 15 per cent in nominal value, or 11 per cent in fixed prices, which is

markedly higher than within the EU and the other Nordic countries. The service industry now makes up 42 per cent of total R&D. Enterprises with 10-49 employees had a 9 per cent increase in R&D expenditure, and make up 24 per cent of total R&D in 2007 (Statistics Norway).

The R&D performed in higher education institutions (HEIs) and research institutes respectively were €1.4b and €1b in 2007. The HEI sector's expenditure on R&D (HERD) in 2006 was €1.270b.

About one third of R&D in research institutes is related to the business sector (BERD) category. The extramural business R&D is to a large extent performed by private technical and industry-oriented research institutes, such as SINTEF, Rogalandsforskning, the Institute for Energy Technology (IFE), etc.

Industry is the largest research performer and funder. Its share at 46% is, however, relatively low. The low level of private funded and performed research can be explained by the lack of large R&D intensive companies. The largest private R&D performer in Norway is the state owned petroleum company, StatoilHydro.

Norway has a relatively large institute sector. The strategic responsibility for the institute sectors has traditionally been within the ministries, but in recent years there has been an increasing shift to delegate the responsibility directly to the Research Council of Norway (RCN).

The seven universities perform the largest part (83% in 2007) of research in the HEI sector. A large part of the funding for HEI research is the core funding channelled directly from the Ministry of Education and Research, but funds are also provided from project funding through the RCN. For a number of years the universities have had the opportunity to establish independent companies for performing commissioned research.

The universities are:

- University of Oslo
- University of Bergen
- University of Tromsø
- Norwegian University of Science and Technology (NTNU)
- University of Stavanger
- University of Life Sciences in Ås
- University of Agder

In addition, there are 26 university colleges, where approximately 10% of the HEI R&D is performed. A smaller amount (about 6%) of research is performed in the five public university institutions (vitenskaplige høyskoler), specialising in veterinary medicine, architecture, physical education and sports, music and economics and business administration.

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the methodological approach of the ERAWATCH Analytical Country Reports 2008 which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant

domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The complete analysis of the research system can be found in the Annex.

When assessing the strengths and potentials of the Norwegian research system it is important to take into account the economic profile of Norway, which has been shaped by the dominant role played by natural resources such as oil and gas, fish and minerals in the Norwegian economy. The development of petroleum related industrial activities in engineering and services have had a particularly strong imprint on the economic and R&D specialisation patterns of Norway. The so called "Norwegian puzzle", i.e. that Norway underperforms against traditional innovation indicators despite its very high economic performance, has been debated intensively. A recent OECD review of the Norwegian innovation system argues that the low business R&D expenditure can largely be explained by the industrial structure of the Norwegian economy, as characterised by a smaller share of R&D intensive industries than the OECD average. Moreover, non-R&D based innovation, such as innovation in the service sector may also partly explain the high performance in productivity.

The OECD points to the need to restructure the Norwegian economy towards other knowledge-based activities which can sustain growth even after oil and gas production has peaked. In this context, the Barcelona type of quantitative target based on GDP is "unfair", considering the economy and specialisation pattern of Norway, and misconceives the issue as a short-term issue of R&D investment, and not as a long-term issue of innovation and economic policy. The inevitable failure to achieve such a quantitative target in the short term may in fact damage the credibility of Norwegian R&D policy.

In terms of resource mobilisation, a key strength is the establishment of the Research Fund from the proceeds of the Pension Fund (state income from petroleum activities). The Fund has to some extent contributed to provide larger funding to cross sectoral and thematic research priorities. However, as the fund has increasingly become part of the normal budget structure, concerns are being raised about the narrowing scope for long term strategic policy making. A weakness that remains, despite reforms targeting the strategic and performance levels of the research system is the entrenched sectorised system at the governmental level of R&D funding and policy making. New regional research funds will be established in 2010. The funds are expected to raise the research performance in the regions.

In the private sector, particular areas of strength include the cooperation between the private enterprise sector and the research institutes. Hence, about one third of R&D in research institutes is related to the business sector (BERD). Nevertheless, the relatively low research intensity of business R&D is a cause for concern, in particular in a long-term structural perspective. R&D performed in the private of private sector is strongly concentrated in a small number of companies.

The Norwegian Government's enterprise policy has in recent years increasingly focused on facilitating start up firms' access to finance. National seed capital schemes have been implemented and now provide risk capital for new, knowledge based firms.

The challenge to increase the low number of S&T graduates has been an area of focus for the government over several years and continues to be a central issue in

policy debates and documents. The declining number of research personnel in industry is also a cause for concern.

The quality of knowledge production by the Norwegian science base is improving and may be counted as one of the strengths of the Norwegian research system. Research quality has been and continues to be a core issue for R&D policy makers. According to a recent announcement by the Norwegian Minister of Research and Education, research quality will be a main issue in the new research white paper announced for the spring 2009.

Transfer of knowledge production supported by the TTOs, science parks and incubators is increasingly growing in policy importance. The number of firms cooperating with the public research infrastructure, especially research institutes, is at a very high level and above OECD average. A remaining weakness is the relatively low absorption capacity of small firms.

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	The justification to invest in research reflects the need, based on broad political consensus to restructure towards more knowledge-intensive industries. New White Paper on research in April 2009.
	Securing long term investment in research	Adoption of the 3 per cent Barcelona target. The strong sector based research funding system generates challenges regarding the coordination of research assignments.
	Dealing with barriers to private R&D investment	The R&D intensity of the Norwegian economy is low in particular the private sector. The tax credit scheme (SkatteFUNN) was introduced in 2002 to mainly stimulate private R&D investments.
	Providing qualified human resources	The number of new S&E graduates is well below the EU average. Measures have been targeting scientific and technological subjects in secondary education. Human resource policies will be discussed in the white paper on research 2009.
Knowledge demand	Identifying the drivers of knowledge demand	Well established policy instruments to stimulate knowledge demand (see for example the tax credit scheme for R&D).
	Co-ordination and channelling knowledge demands	A number of measures are in place to support coordination of knowledge demand (under the RCN and Innovation Norway). The government wants to increase the funding of these programmes.
	Monitoring of demand fulfilment	Fairly extensive use and openness of both evaluations and indicators in the policy-making process. Reports are openly published, and have become subject to extensive policy awareness and debate. Evaluations are typically done by international peer panels.
Knowledge production	Ensuring quality and excellence of knowledge production	Research quality is high in international comparisons. The establishment of a scheme for centres of excellence (NCE) has been introduced to sustain the quality of research.
	Ensuring exploitability of knowledge	Measures are in place to enhance commercialisation of research. The programme for Commercialisation of R&D results (FORNY) and TTOs are central measures in this context.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Above OECD average of firm cooperation with public research organisations. Following new regulations universities have set up TTOs. Industry PhD scheme is intended to facilitate cooperation.
	Profiting from international knowledge	It is a key priority that national participation in EU research programmes should be facilitated and extended. A strategy to make Norwegian participation in ERA more proactive was published by the government last year.
	Enhancing absorptive capacity of knowledge users	Lifelong learning is a policy priority. Several policy instruments are set up to enhance absorptive capacity of SMEs.

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to national goals goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

A new White Paper on Research will be presented by the red-green coalition government this year. It has been announced that the White Paper will contain proposals on improved quality and framework conditions for recruitment of researchers and infrastructure. It will also discuss how to increase the added value from public financed research, further development of international cooperation, and follow up of national priorities. During recent years the debate on research policy in Norway has been very much coloured by the negative progress on reaching the 3 per cent target. Many have argued that the target is unrealistic for a country like Norway with high general GDP, very low unemployment and strong performance of Norwegian firms in established industries. The new white paper will also discuss and propose additional, more concrete and realistic targets.

In the National Budget for 2009 the government proposes to increase the total funding for research and development (R&D) with €2m (NOK1.6b) to around €2.5b (NOK19.7b). This represents a real terms increase of around 4 per cent compared to 2008. The growth in 2009 corresponds to a slightly higher annual average growth in research funding compared to previous years since 2000. There will be a significant increase in funding for research in renewable energy and climate and carbon capture and storage (CCS) technology. In the same time, the funding for petroleum related research is reduced. New funds for regional R&D will be established with a total funding of €75m (NOK6b). The government also proposes creating 200 new research positions, comprising a mixture of funded research posts, post-docs and company-sponsored PhDs. As for previous years the increase in funding for health related research continues over the next year.

To mitigate the effects of the international economic crisis, the Norwegian government presented on 26th January a national financial rescue package. A sizable part of the package consists of investments to stimulate research and innovation in trade and industry. The R&D contract schemes (IFU/OFU) under Innovation Norway are to be strengthened by €7m. Budgets for the programme under the Research Council of Norway for user driven research based innovation (BIA) increased by

€8m. The recently implemented industry PhD scheme will benefit from additional €5m. The maximum level of support under the tax reduction scheme (SkatteFUNN), was raised in the rescue package, despite the fact that the innovation White Paper had stated one month earlier that the scheme would continue unchanged.

Eight new Centres for Environment-friendly Energy Research (CEER) have recently been established. At a conference in February 2009 eight new centres were awarded the status of CEER. The Centres seek to develop expertise and promote innovation through focus on long-term research in selected areas of environment-friendly energy, transport and CO₂ management in close cooperation between prominent research communities and users. The scheme also seeks to enhance technology transfer, internationalisation and researcher training. The Research Council of Norway is responsible for selection and follow-up of the centres. The centres will have a duration of up to eight years and have a total budget of €12.2m (NOK120m) to be distributed from the RCN to the eight centres.

The eight research centres awarded are:

- Research Centre for Offshore Wind Technology - SINTEF Energy research
- The Norwegian Research Centre for Solar Cell Technology – Institute for Energy Technology
- Bioenergy Innovation Centre (CenBio) – Norwegian University of Life Sciences (UMB)
- Centre for Environmental Design of Renewable Energy - SINTEF Energy research
- The research Centre on Zero Emission Buildings – Norwegian University of Science and Technology (NTNU)
- BIGCCS Centre - International CCS Research Centre - SINTEF Energy research
- Norwegian Centre for Offshore Wind Energy – Christian Michelsen Research (CMR)
- Subsurface CO₂ storage - Critical Elements and Superior Strategy – Christian Michelsen Research (CMR)

In its latest white paper on innovation policy (December 2008), the government declared its intention to increase research investments in the public sector. Among the proposed initiatives are to:

- Extend the duration of the demand-driven innovation and business development in the health sector to ten years, and to extend it to include research-based innovation;
- Increase competency on how public procurements can contribute to innovation and simplify the use of R&D contracts for public procurers;
- Strengthen the public R&D contract scheme, with a particular focus on the promotion of innovation in the social care sector.

The Norwegian Government's enterprise policy has, in recent years, increasingly focused on facilitating access to finance by start up firms. Part of this policy is the newly established State Investment Fund (Investinor AS) with a capital of €275m to support early stage companies with growth potential. Targeted sectors are environment, energy, tourism, marine and maritime sectors. A new measure was introduced by Innovation Norway in February 2008. The measure is called NewGrowth ("Ny Vekst") and was set up to support new small and medium size firms

with growth potential. The budget for 2008 is €5m allocated from the Ministry of Local Government and Regional Development of which €4.4m goes directly to the County Councils. Companies from all sectors can apply for funding under the scheme.

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	<ul style="list-style-type: none"> • New White paper on Innovation in December 2008. • New White Paper on Research in 2009
Securing long term investments in research	<ul style="list-style-type: none"> • Reduced importance of the 3 per cent Barcelona target. • Strategic policy for better access to EU Research funding • New regional research funds • Intensified public funding to green energy technology, in particular CCS and off- shore wind energy • New centres for environmental friendly research • Increase in funding for health related research
Dealing with uncertain returns and other barriers	<ul style="list-style-type: none"> • New measures are introduced to support innovative start-ups • New state investment fund for early stage companies • Reduced administrative burdens for companies
Providing qualified human resources	<ul style="list-style-type: none"> • Increased funding for the industry PhD- scheme • Increased number of research positions

2.3.2 Knowledge demand

A policy driver of knowledge demand in Norway, as mentioned previously, is the need to restructure the economy, to be able to respond to challenges of an increasingly ageing population and the expected downturn of oil production, seen as future threats to what is now a well functioning welfare system.

The global demand for clean carbon technologies is increasing. High potential is therefore seen to lie in the opportunities to exploit more effectively world class knowledge in the oil sector for developing cutting-edge technology for Carbon Capture and Storage (CCS). The 2008 white paper on innovation emphasizes the importance of developing new energy technologies, where CCS and off-shore wind energy are identified as of particularly high strategic significance.

As mentioned several policy instruments for knowledge demand are strengthened to counteract the effects of the financial crisis. These instruments include the BIA scheme, the IFU/OFU contracts and the tax credit scheme. The maximum deductible support amounts under the latter were raised in the rescue package from late January, from €0.4m to €0.55m for intramural R&D and from €0.8m to €1.1m for extramural R&D expenses.

In the white paper on Innovation policy, the government states that Innovation Norway and SIVA, two of the three main innovation policy authorities in Norway, will be evaluated in the near future.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	<ul style="list-style-type: none"> Increased funding of green energy technology, especially for offshore wind energy and CCS Increased funding of public sector research, especially within the health sector
Co-ordinating and channelling knowledge demands	<ul style="list-style-type: none"> The main programmes BIA, IFU/OFU receives increased funding. Maximum deductible support amounts under the tax credit scheme are raised
Monitoring demand fulfilment	<ul style="list-style-type: none"> Government decision to evaluate Innovation Norway and SIVA in 2009

2.3.3 Knowledge production

A recent policy change with regard to knowledge production is the transition to a new performance based funding system for institutional core funding of research institutes, in both the public and business sectors. The reform will enter into force this year 2009. The expected outcome of the reform is increased research quality at the research institutes. The performance based funding will initially affect a minor part (10 per cent) of the institutes' core funding, but may nevertheless be expected to have a significant impact on orientation and attitudes. Another important change in terms of knowledge production is the Norwegian ratification of the European Patent Convention (EPC), which entered into force in January 2008.

The FORNY programme run by the RCN is the most important measure for supporting the commercialisation of R&D results. The programme will be evaluated this year 2009.

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	<ul style="list-style-type: none"> New performance-based system for institutional core funding Ratification of the European Patent Convention (EPC)
Ensuring exploitability of knowledge production	<ul style="list-style-type: none"> Evaluation of FORNY- programme for commercialisation of R&D results

2.3.4 Knowledge circulation

No major changes have been made to policies for knowledge circulation during the recent year. In 2008 the new industry PhD scheme started as collaboration between companies and universities or university colleges. Both parties co-fund the PhD positions under the scheme. The government announced in its White Paper on Innovation that the scheme will be strengthened, and an additional €2.5m (NOK20m) was allocated to the scheme in the rescue package one month later.

Internationalisation of education and research is a strategic policy priority. This is confirmed in the white paper on internationalisation in higher education presented by the government in February 2009. Among the priorities, internationalisation and mobility of researchers is mentioned as well as the importance of making PhD education more attractive for international students. More concretely it is proposed that the financial support systems for studies abroad are to be revised.

For a small open economy like Norway, access to international knowledge networks is paramount. A survey from 2005 by Statistics Norway indicated that 93 per cent of

Norwegian industry groups were engaged in R&D activities with foreign partners in Norway, 39 percent in the Nordic region and 40 per cent in the EU. The innovation white paper states that the single most important opportunity for increasing access to international research is through participation in EU framework programmes. A strategy aiming to make Norwegian researchers more active in the ERA was presented by the government in 2008.

It is also seen as highly important that Norwegian research can secure competitive funding from the European Research Council (ERC). The Norwegian Parliament has also approved the participation of Norway in the European Institute of Technology (EIT).

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	<ul style="list-style-type: none"> • New industry PhD scheme
Profiting from access to international knowledge	<ul style="list-style-type: none"> • New strategy for better access to European research • New white paper on internationalisation in higher education
Absorptive capacity of knowledge users	<ul style="list-style-type: none"> • Strengthening of the Skattefunn scheme

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

In light of the recent policy changes mentioned above and in terms of opportunities for resource mobilisation, the increased public funding for research in the Norwegian national budget for 2009 is a leading example. With an expanded research system there is more room for dealing with the identified shortcomings. It remains to be seen however how this opportunity is used to overcome the current challenges and direct the economy towards more and new knowledge based activities. Connected to this challenge is the wide increase in funding of research in renewable energy, climate and carbon capture and storage technologies. Further opportunities for enhanced access to international knowledge are strategies to increase Norwegian participation in the ERA.

The transition to a performance based institutional core funding system is an opportunity to raise the quality of the research by research institutes. Policy tools such as the expanded rules for the R&D tax credit scheme and the introduction of the industry PhD scheme respond to key challenges of knowledge demand and production in SMEs in particular.

As for risks, it is a pervasive concern to policymakers that little progress seems to have been made to solve the supply problem in domestic human resources in S&T. A related policy opportunity is, however in policies for skills and life-long learning; these are high on the government's agenda, and Norway holds an advanced position on this issue. A further policy opportunity is represented by the full membership of Norway in the European Patent Organisation (EPO), which is expected to strengthen the competitiveness of Norwegian businesses.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related threats
Resource mobilisation	<ul style="list-style-type: none"> • Access to public funding (Pension Fund) • Wide increase in funding of research in renewable energy, climate and carbon capture and storage (CCS) technology • Increase added value of public financed research • Further development of international cooperation 	<ul style="list-style-type: none"> • Unstable global macro-economic conditions which may impact research and innovation budgets • Inertia in shifting the economy towards a knowledge based society
Knowledge demand	<ul style="list-style-type: none"> • Focus on Centres • Transition to a performance based funding system to enhance quality in research 	<ul style="list-style-type: none"> • Highly sectorised funding system • ineffective strategies in utilising research funds
Knowledge production	<ul style="list-style-type: none"> • Membership of EPO • Performance based funding • Expansion of the research system through increased public funding 	<ul style="list-style-type: none"> • Institutional rigidities in universities • Inability to change and adapt
Knowledge circulation	<ul style="list-style-type: none"> • Policies for skills and life-long learning high on the government's agenda 	<ul style="list-style-type: none"> • Insufficient strategies to lift education in S&T studies

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at

investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

The level of national research funding has been a dominant research policy issue since the adoption in 1999 of the objective to raise total national research expenditure to the average of OECD countries, i.e. from about 1.7 to 2.2 per cent. Main barriers to progress on these objectives have been the high growth of Norwegian GDP, in particular during the 2003-2007 period, and the structure of the Norwegian economy, which is strongly dominated by SMEs and by resource based industries with low R&D intensity. In 2005, Norway adopted the far more ambitious Barcelona 3 per cent target. While there have been some increases in budget appropriations during the 2006-2008 period, they have barely kept pace with the high increase in GDP, driven in large part by high prices on petroleum. The latest statistics for 2007 indicate, however, that both public and private investments in R&D had increased sizably. The current economic crisis may facilitate making progress towards the target, both through stagnating or negative growth in GDP, and in creating opportunities for shifting the economy towards more R&D intensive activities.

The Norwegian BERD in 2007 stood at a low 0.77 per cent of GDP. That year total expenditure on R&D performed by Norwegian enterprises was around €2.2b, 46 per cent of total R&D expenditure. This is an increase of €0.2b compared to 2006, which amounts to an increase of 15 per cent in nominal value, and 11 percent in fixed prices. This is significantly higher than both the EU and other Nordic countries. The service industry accounts for 42 per cent of total BERD Enterprises with 10-49 employees had a 9 per cent increase in R&D expenditure, and accounts for 24 per cent of total R&D in 2007 (Statistics Norway).

Norwegian research and innovation debate has, during the last couple of years, focused on the "Norwegian puzzle", i.e., the apparent paradox that while Norway underperforms on almost standard innovation indicators, its economy performs better than almost all other national economies in the world. While it is generally assumed that part of the explanation lies with the industrial structure of the Norwegian economy, with its low activity in R&D intensive industries, and deficiencies in innovation indicators, strong concerns persist that the Norwegian economy is not sufficiently innovative to be viable in the longer term. The OECD, in a comprehensive review of Norwegian innovation policy, has strongly emphasized the need to restructure the Norwegian economy towards other knowledge based activities, in order to be able to sustain growth beyond the peak of oil and gas production.

Almost 11,000 doctoral degrees were awarded at Norwegian institutions during the 1990-2006 period. While the annual number of degrees has doubled during the last 15 years, the increase has been slower than in other Nordic countries. Norway's overall growth in the number of trained research personnel has been lower than in its neighbours. Since 1990, the number of degrees in natural sciences and the engineering has decreased.

The number of new S&E graduates is far below the EU-average, and the decline on this indicator continues, if at a lower rate, in the EIS for 2007. The government has focused on this challenge for a number of years, and the issue pervades policy

debates and documents. Students' interest for S&T subjects and careers has, in particular at the secondary level, apparently increased somewhat as a consequence of campaigns and the general attention paid to the issue.

3.2 Policy objectives addressing R&D investment and barriers

The 2005 White Paper on research policy stated that the overall research policy objective is to make Norway "a leading nation of research". It is further specified in the objectives that Norway should be "among the leading nations" in terms of:

- Measurable research results, i.e. the number of scientific publications, citations and patents
- Success in the EU's framework programmes
- The number of researchers per 1,000 employees
- The attractiveness of a research career for young talents
- The attractiveness of research communities for top international researchers
- The research intensity of business and industry
- Society's ability to transfer and use research based knowledge
- The population's knowledge of research, as well as its interest in and commitment to this area.

To achieve these objectives, R&D expenditure should be increased according to the Barcelona objective that total R&D expenditure should amount to 3% of GDP by 2010, 1% of which should be funded by public sources.

Although the White Paper was produced by the previous Centre-Right Government, there was extensive consensus on all main objectives and priorities. Hence, they remain valid for policy by the present Centre-Left Government.

The only large new measure implemented during the 2000s to increase private R&D expenditure is the Skattefunn scheme from 2002.

One distinctive feature of recent developments is a strong focus on centre formation as an emergent and increasingly important instrument in both research and innovation policy. Centres of Excellence, Centres of research-driven innovation and Centres of Expertise have all been established to enhance excellence, competitiveness and critical mass, all modelled on foreign examples and forerunners, and in line with general international trends.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

The overall characteristic of trends in Norwegian research policy during the last decade may be described in terms of an increasing emphasis on the enhancement of

the excellence and productivity of research, on research-based innovation and on the internationalisation of research. Among the key instruments to enhance quality/productivity are:

- Centres of Excellence;
- Scheme for supporting young, excellent researchers;
- performance-based institutional core funding for research (HEIs). In Norwegian research funding there is a relative emphasis on institutional over competitive/strategic funding. Instead of devolving funds from the institutional to the competitive/strategic channels, much effort has been made to make an increasing part of institutional funding performance based;
- systematic/periodic evaluations of research institutes, research programmes and disciplinary fields of research; and the development of effective follow-up measures by the Research Council of Norway; enhancement of the strategic management of university research.

The internationalisation of research has been strengthened through:

- continued participation in international organisations/projects (CERN, ESRF, EMBL, etc.);
- efforts to increase Norwegian participation in EU Framework Programmes for Research;
- bilateral agreements for research collaborations with, in particular, the USA, Canada, Japan, China, Russia;
- making Norway a more attractive host country for foreign researchers (for example, Arctic, epidemiological and environmental research);
- increased research collaboration with developing countries.

Research-based innovation is supported by:

- the establishment of Centres for research-driven innovation, a scheme for establishing collaborative partnerships between companies and public research institutions;
- expanded support for RCN programmes for user-driven industrial research;
- the establishment of centres for regional industry/research collaboration (Centres of Expertise).
- support programmes and infrastructure to facilitate the commercialisation of academic research;
- the introduction of the tax-deduction scheme Skattefunn

The thematic priorities (energy and environment; health, food; marine/maritime research) are to a large extent funded by sector ministries.

The technology priorities (ICT, biotechnology; nanotechnology) are mainly funded by the large research ministries, i.e. the Ministry for Research and Education and Ministry for Trade and Industry.

All priorities encompass both general programmes and specific projects/items. The main strategic programmes related to the priorities are so-called "Large programmes" under the Division of Strategic Division of the Research Council of Norway. These programmes include (with 2006 budgets):

- FUGE - Research in Functional Genomics (€20m)

- NANOMAT - Nanotechnology and New Materials (€10.5m)
- RENERGI - Clean Energy for the Future (€17m)
- NORKLIMA - Climate Changes and its Impact in Norway (€10.5m)
- PETROMAKS - Optimal Management of Petroleum Resources (€32m)
- AQUACULTURE - Aquaculture - An Industry in Growth (€16m)
- VERDIKT - ICT - Core Competence and Growth (€4.5m)

In addition to direct funding from various ministries, these strategic programmes are to a large extent funded from the proceeds of the Fund for Research and Innovation.

3.3.2 Policy Mix Routes

The “Policy Mix Project” identified the following six ‘routes’ to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one ‘route’, the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

There is no clear or specific focus on innovative start-ups, and there are no comprehensive policy frameworks developed specifically addressing this target group. The issue of innovative start-ups has so far not been a specific topic in any research policy initiative, nor has it been explicit in innovation initiatives ([INNO-Policy TrendChart, 2008](#)). However, as part of the broader industrial and innovation policy framework, a number of measures and programmes have been implemented of relevance to innovative start-ups.

Over recent years, a national seed capital scheme has been implemented, now providing new risk capital for new, knowledge-based firms. Although the scheme generally addresses knowledge based start-ups with a high growth potential, innovative start-ups in particular account for a significant share of the portfolio of firms receiving support under this scheme.

Knowledge parks aim to establish new companies through actively connecting industry, public authorities, research and education institutes and investors. Another relevant scheme is the R&D incubator programme which provides support for incubator facilities which – in principle - address R&D based and innovative start-ups specifically.

Route 2: Stimulating greater R&D investment in R&D performing firms

Report no. 20 to the Storting (2004-2005) "Commitment to Research" stresses the importance of stimulating Norwegian trade and industry to increase their R&D investments. The Research Council has established a comprehensive portfolio of industry-oriented R&D schemes, which includes these key components:

The SkatteFUNN tax deduction scheme: the Research Council's most important instrument for promoting larger and more targeted R&D investments across a broad spectrum of Norwegian trade and industry. The scheme is linked primarily to individual companies' ongoing needs in development and innovation. SkatteFUNN is the first tax-deduction scheme for research in Norway. It was introduced in 2002 following an extended and contentious political process initially meant to target small- and medium-sized firms (SMEs). The objective of the scheme is to increase private R&D expenditure and to enhance value creation in trade and industry. Under the scheme all enterprises subject to taxation in Norway are now eligible for a tax deduction for R&D expenses in approved projects.

As part of the government's financial crisis package presented on 26th January 2009, the maximum deductible support amounts under the R&D tax credit scheme were raised from €0.4 to €0.55m for intramural R&D and from €0.8 to €1.1m for extramural R&D expenses.

Specific programmes: Specific, industry-oriented programmes have been established to address areas which hold unique challenges and show great potential for strengthening national advantages. Such programmes, including the large-scale programmes targeting industry, have been designed to meet national challenges in designated areas of industry and technology.

BIA (programme for user driven research based innovation): This programme focuses exclusively on research-based innovation, without being confined to particular thematic areas or branches of industry. Applicants are not assessed on the basis of pre-determined thematic priorities, but compete for funding on the basis of how well their proposed projects can contribute to research-based innovation and value creation. BIA complements the Research Council's other instruments for funding industry-oriented research. As a consequence, the programme is directed primarily toward the innovation challenges of companies with R&D strategies which do not qualify for funding from the existing specific programmes (including the Research Council's large-scale programmes) or whose aims can only to a minor extent be achieved through the SkatteFUNN tax deduction scheme.

CRIs (Centres for Research-based Innovation): CRIs are designed to promote innovation by supporting long-term research projects which are conducted in a close collaboration between research communities and research-intensive private enterprises.

Route 3: Stimulating firms that do not perform R&D yet

On an aggregate level, companies in Norway seem to have a lower than average absorption capacity as they invest modestly in R&D. The absorption capacity of SMEs is increasing but still relatively low if measured by levels of investments in R&D. Investments are still concentrated in the large companies.

Nevertheless, some support mechanisms are in place to stimulate firms that do not yet perform R&D. This is mainly done by providing innovation infrastructure to firms

in the start up phase. Important in this regard are the national innovation networks, and science and knowledge parks (for further information we refer to the section below on “the importance of education and innovation policies”). In addition, the R&D tax credit scheme (important also for route 2) may be seen as an incentive for non-R&D performing firms to invest in R&D.

Route 4: Attracting R&D-performing firms from abroad

In general terms, the government does not specifically target inward foreign direct investments (FDI) in R&D. Policy is focused on creating an appropriate setting for attracting foreign private R&D performers, such as maintenance of a well performing private R&D sector, appropriate technology transfer and research valorisation mechanisms, strong public research base, internationalisation of Norwegian research performers, etc.

FDI into Norwegian industry takes place in general through the buying up of existing Norwegian firms, and not by the establishment of new companies. This means that FDI with related R&D investments in the merged companies contributes to a minor extent to develop new R&D intensive companies in Norway (Herstad et al. 2006).

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The OFU and IFU programmes (Public and Industrial Research and Development Contracts) have been in place since 1968 and are currently operated by Innovation Norway. The aim of the programmes is to stimulate innovative firms and improve the quality and efficiency of public services through the acquisition of new technologies or solutions by promoting co-operation between a company and a public institution acting as customer. An important aspect of the programme is the focus on establishing business relations between Norwegian and foreign firms. It is a flagship programme and has proved to be a successful public procurement tool, which the government intends to strengthen further (see White Paper on innovation, December 2008).

Route 6: Increasing R&D in the public sector

In its latest white paper on innovation policy, the government states its intention to increase research investments in the public sector. Among the proposed initiatives are to:

- Extend the duration of demand-driven innovation and business development in the health sector to ten years, and also extend it to include research-based innovation;
- Increase competency on how public procurements can contribute to innovation and simplify the use of R&D contracts for public procurers;
- Strengthen the public R&D contract scheme, with a particular focus on the promotion of innovation in the social care sector.

Following the proposals in the 2005 White Paper, there has been a move to establish new research centres with generous funding guaranteed over an extended time period. One type of centre – the “centres of excellence” – has been selected primarily on academic quality criteria; as of 2007, 21 have been chosen. Another type of centre, of which there are 14, has been selected to support the performers of long-term research that promotes innovation and the competitiveness of Norwegian

industry, and a third type of centre – the "centre of expertise" – is a scheme to support long-term R&D in regional industrial clusters; nine centres are supported. A common rationale for all types of centre formation is the support of R&D with world-class quality and/or global competitive capacity.

The importance of education and innovation policies

As part of the broader industrial and innovation policy framework, a number of measures and programmes of relevance to innovative start-ups have been implemented. Briefly, it is possible to distinguish between national innovation networks that provide infrastructures for innovative start-ups, and specific programmes which provide direct support for innovative start-ups.

Innovation policy measures are implemented in close interaction between the Research Council of Norway (RCN), Innovation Norway (IN) and SIVA. While SIVA focuses on developing infrastructure and may be regarded as the coordinator of the national innovation network, RCN organises programmes aiming at commercialisation of research while IN organises programmes that more broadly address start-ups, including innovative start-ups.

The **national innovation network** comprises more than 80 units spread across the country, and includes science parks located on the main university campuses, knowledge parks (a 'light' version of science parks) located close to the state university colleges, and business gardens which are smaller facilities located in peripheral parts of the country. As a main rule, the science parks and knowledge parks also operate incubator facilities. Although all units should have a role in facilitating innovative start-ups, in practice, it is mainly the **science parks and knowledge parks** (in total 25 units) that do this through their incubator activities.

The following programmes may be regarded as the most important in Norway for supporting innovative start-ups:

The objective of **FORNY - Commercialisation of R&D results** is to support commercialisation of research based business ideas either by licensing or by start-ups of new firms. The primary target group of the programme is the researchers themselves. However, instead of targeting the researchers directly, FORNY works through the institutions that employ them, the technology transfer offices of these institutions, and a selection of their cooperating innovation companies and science parks.

The target group of the **incubator grant** is start-ups based on a high level of knowledge and technology, with high risks and which are regarded to have a significant growth potential and a potential for international markets. Grants can be given to start-ups located in incubators supported by the R&D incubator programme.

The recently established **New Growth programme** will support newly founded firms with significant growth potential in peripheral areas (Innovation Norway). The **State Investment Fund**, invests in newly started companies with great growth potential in peripheral areas. The fund will be organised in a daughter company, 100 percent owned by Innovation Norway, but with a professional board of directors with no representatives from Innovation Norway ([INNO-Policy TrendChart, 2008](#)).

Several measures target scientific and technological subjects in secondary education and form parts of a "Strategy for a Joint Promotion of Mathematics, Science and Technology" which has been in operation and continually updated since 2002.

Norway is the world's third-largest exporter of oil and gas. The petroleum sector is a strong player in national R&D policy in Norway. Building up Norwegian petroleum expertise has been an important element in its petroleum policy, and from an initial dependence on foreign companies, a well-developed and competitive national industry has been developed. This includes oil companies, supplier industry and research institutions. To a large extent, the oil and gas industry also drives innovation and technological development in other Norwegian industry sectors. Technologies for CO₂ capture and storage have been explored and used for several years in Norway and are a key area in Norwegian energy policy.

Petroleum policy developments have, over the last few years, been strong drivers of research investment, particularly through the **PETROMAKS, CLIMIT and Demo2000 programmes** under the Research Council of Norway. While research appropriations by the Ministry of Oil and Energy increased considerably in 2005 and 2006, the increase in appropriations stagnated in 2007.

In spring 2007, the Minister of Oil and Energy initiated a process aimed at establishing a broad and unifying R&D strategy for the Norwegian energy sector. The process is called **Energi21** and is expected to have a decisive impact on Norwegian energy research in the future. Energi21 will address topics relevant to stationary production of energy, energy transport and energy use. Moreover, Energi21 will encompass the entire chain of innovation with the exception of independent basic research – in other words, everything from strategic energy research to the introduction of new technologies to the market.

Assessment of the importance of policy mix routes and their balance

Table 7: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	There is no clear or specific focus on innovative start-ups, and there are no comprehensive policy framework developed specifically addressing this target group. However, as part of the broader industrial and innovation policy framework, there are a number of measures and programmes of relevance to innovative start-ups.	New instruments have been established recently supporting innovative start-ups (New growth and the State Investment Fund).
2	High on the government research policy agenda: the RCN has developed a wide portfolio to stimulate greater R&D investment in firms.	Increased budget appropriations for some of the main policy instruments (BIA and IFU/OFU) due to the financial crisis. The maximum deductible support amounts under the R&D tax credit scheme have been raised.
3	This route receives less attention both in policy documents and with regard to allocated resources. The main instruments are the tax credit scheme and the national innovation networks (science parks, knowledge parks, incubators)	New instruments have been established recently supporting innovative start-ups (New growth and the State Investment Fund).
4	The government is not sufficiently directly prioritising inward R&D FDI. However, policy is rather focusing on creating an appropriate setting for attracting foreign private R&D performers.	No major policy changes during last year.

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
5	The OFU and IFU programmes have been in place since 1968. It is a flag ship programme and has proved to be a successful public procurement tool.	Increased budget in the 2009 financial crisis package for IFU/OFU contracts.
6	High on the government's research policy agenda (especially with regard to the health sector).	In its latest white paper on innovation policy (December 2008) the government declares the intention to increase research investments in the public sector.

3.4 Progress towards national R&D investment targets

With the adoption of the 3 per cent Barcelona target in the White Paper on Research 2005 the government committed to increase the private R&D investment to 2 per cent of GDP by 2010. While the 2007 EU R&D Investment Scoreboard indicates that the largest Norwegian companies have increased their R&D investments, some of them by almost 50 per cent, private R&D funding remain far below the 2 per cent objective. It is being recognised that the 3 per cent target is unrealistic, and there is a nascent debate on how to set more appropriate targets for public and private R&D expenditure. The Minister of Research and Education announced a new White Paper on research to be launched in April 2009. The new white paper will among other things discuss how more concrete and realistic R&D targets could be set.

The Norwegian BERD is quite low in international comparisons. In recent years, however there has been an increase in private R&D expenditure.

GBAORD as a percentage of total general government expenditure was 1.69 per cent in 2005 compared to 1.58 per cent for the EU27 average (Eurostat).

After five years of activity, SkatteFUNN has been extensively evaluated. One of the main findings of the evaluation shows that the SkatteFUNN scheme is most effective for small businesses, in companies where education levels among the workforce are relatively low, and in companies with low R&D intensity. While emphasizing the non-conclusive basis of its estimates, the evaluation estimates that the scheme has triggered additional private R&D expenditure which is on average double the lost tax revenue. This is, according to the evaluation report, higher than the international average for comparable tax deduction schemes. The scheme has, however, not prevented the share of total R&D funding by domestic firms from declining from 47 per cent in 2003 to 44 per cent in 2005.

To mitigate the effects of the international economic crisis, on 26th January 2009 the Norwegian government presented a national financial rescue package. A sizeable part of the package consists of investments to stimulate research and innovation in trade and industry.

Table 8: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Insufficient political and public support of R&D as political priority	Opportunities for linking R&D to new priorities (clean energy, CCS, health). Risks of persistent/increasing political short-termism.
The strong sector based research funding system generates challenges regarding the coordination of research assignments.	Risk of failing overall and long-term commitment to R&D in Government. Opportunities for strong R&D-focussed policies within sectors (e.g., energy, health, defence). Opportunities exist for stronger coordination (in particular, energy/environment, presently on the agenda). Unexploited opportunities for coordinated implementation by the Research Council, including through collaboration with Innovation Norway and SIVA.
Relatively low absorption capacity of business enterprise sector	Opportunities in insufficiently recognised and targeted potential for increasing R&D in traditional industrial sectors. Strengthen the capability of research institutes to cooperate with firms. Risk of too weak competitive pressure on firms (cfr OECD).
Low business R&D expenditure due to structural barriers (few large R&D intensive firms, high share of industries with low R&D intensity, small share of R&D intensive industries)	Opportunities for growth of R&D intensive firms, in particular in services; stronger focus on new innovative firms. Strengthen the R&D tax credit scheme (SkatteFUNN). Risks of R&D cuts in large firms with high R&D activity

4 Contributions of national policies to the European Research Area

This Chapter provides a thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA¹ which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

¹ Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final (see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

Norway is among the OECD countries with the highest educational level in the population and the number of employees with higher education qualifications in both the private and the public sector is increasing considerably. The largest proportion of highly educated people in 2006 was in the sector *oil and gas extraction, mining*. The public sector was in third position with 10 per cent of the total work force with higher education. Since 2002 the number of students, including foreign students, has remained fairly constant at about 220,000. A trend seems to be that fewer Norwegian students are inclined to go and study abroad (NIFU STEP 2007).

Almost 11,000 doctoral degrees were awarded at Norwegian institutions during the period 1990-2006. While the number of annual awards has doubled in the last 15 years, the increase has been slower than in other Nordic countries. The overall growth in the number of trained research personnel has been lower in Norway than in neighbouring countries. Since the 1990 the number of degrees in natural sciences and the engineering has decreased. In 2006 37 per cent of the doctoral degrees were awarded in the natural sciences and engineering. The share of foreign doctoral graduates has increased, from 10% in the early 1990s to 20 percent in the more recent years (NIFU STEP 2007).

While most of the doctoral degree holders who earned their degree at a Norwegian institution are employed in the public sector, mostly at universities and colleges, the share of this group that work in the private sector is increasing.

Looking at total yearly remuneration averages in terms of PPS, Norway emerges as belonging to the group of EU25 and associated countries with a high remuneration level (€40,001– €60,000). If looking at the net yearly remuneration averages in terms of PPS (“Attractiveness” of countries) Norway falls in the group of medium remuneration level (€20,001 – €30,000).

If we look at remuneration per scientific domain, chemistry and physics are the research fields with highest annual remuneration level. Compared to similar professions, researchers in these fields also have a higher remuneration, with social and human sciences at the lowest levels.

Total annual salary average per sector of activity indicates that in Norway the business enterprise sectors (€63,084) has the highest remuneration followed by the higher education sector (€60,601) and government (€53,595) (European Commission 2007). The share of women in the business enterprise sector, 19 per cent, was among the lowest in the OECD countries that reported figures on share of women in 2003.

As in most countries, salary levels for men are higher than those of women. In recent years the difference between the remuneration of a female researcher and a male researcher is significantly reduced (difference below 15 per cent) in countries such as Bulgaria, Denmark, Greece, Iceland, Malta and Norway (European Commission 2007).

The share of female doctors has increased over time in Norway. In the first half of 2007 the women’s share jumped to 47 per cent (to compare with a level of 38-40% in

the period 2002-2006). However, the increase in the total number of doctorates awarded in Norway has been lower than in the other Nordic countries (NIFU STEP 2007).

The share of non-Norwegian citizens among doctoral graduates has increased, from 10 per cent in the early 1990s to about 20 per cent in recent years.

With regard to researchers' mobility the relatively late starting age for a doctoral candidate (25-26 years) in Norway may be seen as a barrier. The family situation of these researchers may provide disincentives forgoing abroad. A recent study looking at factors that inhibit mobility and career development of researchers indicate that researchers in the Nordic countries typically experience difficulties related to child care arrangements, other caring arrangements and personal relationships as more important than other factors (e.g. language, immigration rules, accommodation, etc.). In addition, the Norwegian model in which doctoral researchers are paid employees may be an additional disincentive for mobility (Rindicte 2008). This can in fact be problematic when the PhD student moves abroad and need to find salaried work in the country that s/he is moving to.

4.1.1 Policies for opening up the national labour market for researchers

Generally in Norway there are no barriers to foreign researchers to find both permanent and temporary positions in Norwegian research institutions. For EEA/EU-citizens and researchers from the US there are no restrictions according to the duration of their residence in the country. However, the situation is different for researchers from Third countries, for whom there are several regulations restricting their entry into the country and the duration of their stay. A new Norwegian law, however, allows for temporary residence and work permits for highly skilled immigrants typically from developing countries, such as, India. However, there is an upper limit of 5000 persons per year for issuing such visas and permits. However, this limit has never been reached as the number of high skilled immigrants invited to work in Norway is in practical terms far lower than that.

There are several programmes under the Research Council of Norway (RCN) which aim to attract international researchers to Norway. The YGGDRASIL mobility programme promotes the internationalisation of Norwegian research by offering grants to highly qualified, international Ph.D. students and younger researchers in connection with research stays in Norway. The programme seeks to make Norway an attractive research destination for highly qualified international Ph.D. students and younger researchers, thus strengthening the Norwegian research communities involved at the same time.

Grant applications are accepted from these 25 countries: Austria, Belgium, Bulgaria, the Czech Republic, Egypt, France, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Mexico, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Spain, Switzerland, Turkey, and the United Kingdom.

As part of the Quality Reform of Higher Education in Norway from 2003, the number of doctoral titles (previously 14) has been reduced to just two. Research courses now lead to a PhD, corresponding to the Anglo-American degree system.

Since 2004, the Norwegian Centre for International Cooperation in Higher Education (SIU) under the Norwegian Ministry of Education and Research promotes and facilitates cooperation, common accreditation standards and standardisation of degrees, mobility, and the lowering of cultural barriers hampering student and

researcher mobility. The NUFU programme (The Norwegian Programme for Development, Research and Education) supports independent academic cooperation based on initiatives from researchers and institutions in the South and their partners in Norway.

Further, the Norwegian ENIC-NARIC centre NOKUT (the Norwegian Agency for Quality Assurance in Education) considers applications for general recognition of foreign qualifications. The agency is also responsible for providing foreign institutions and partners with information about the Norwegian educational system and the procedures for recognition of foreign higher education qualifications.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

Uptake of the Charter of Researchers

In 2006, the Norwegian Association of Higher Education Institutions (UHR) and the Research Council became the first Norwegian players to sign the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers. In early 2008, the UHR appointed a committee to determine how to implement the Charter and Code at Norwegian universities and university colleges. The Norwegian University of Science and Technology (NTNU) was the first to implement the Charter and Code principles. In 2009, universities and higher education institutes were invited to sign and more institutions are expected to sign the Charter in the near future.

In Norway, all researchers, including early-stage researchers (PhD students and post-docs) are post-graduate employees. They are paid accordingly, pay tax and enjoy full social security rights. Thus, Norway already largely complies with the terms of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

Norway has implemented a universal, public health service financed by taxation, and a national insurance scheme, applicable to all citizens and residents, that provide a range of social benefits. Everyone who is a legal resident in Norway, and stays in the country for more than one year, is a member of the Norwegian National Insurance Scheme. Members of the National Insurance Scheme are entitled to benefits such as health care, financial benefits, the right to a pension and several other rights. National insurance contributions are deducted from the salary/pension.

Remuneration policies

Academic staff in Universities is remunerated according to national legislation and national or local collective bargaining agreements. This applies to researchers at all stages, allowing employers flexibility to offer higher salaries to individual researchers. Different rules apply at private research institutes, which have a higher flexibility in setting salaries, even though national collective agreements apply in any case. Generally, remuneration rules for researchers according to the European Charter for researchers are considered to be fulfilled (Research Council of Norway 2008b).

Promotion of women

According to the 2005 White Paper on Research, Norwegian research faces two major challenges concerning gender equality. Firstly, women are under-represented in scientific positions at all levels, and increasingly so as one goes up the hierarchy of positions. Secondly, there is a marked gender imbalance within certain subjects and fields of study. In 2007, women made up 60 per cent of the permanent academic staff within medicine and health sciences and 82 per cent of the university college lecturers at the public university colleges. Technology had the lowest female representation at 15 per cent (2007).

In 2006, 83% of all full professors in Norway were men. At the same time, more than half the students at the highest levels of study were women. The share of female doctors has increased over time in Norway. In the first half of 2007 the women's share jumped to 47 per cent from a level of 38-40% in the 2002-2006 period.

The Research Council has national responsibility for analysing and developing gender research, and for promoting gender equality in research. The White Paper No. 20 (2004-2005) *Commitment to Research* assigns a clear integration task to the Research Council and promotes the integration of gender-equality concerns at all levels of research administration, application processing and reporting.

A new research programme on gender research has recently been established. The budget for the *Gender Research Programme* is expected to reach a total of €7m (NOK 56m) for the 2008-2012 programme period. The Gender Research programme is a follow-up of the previous initiatives *Gender in Transition* (1996-2001) and *Gender Research: Knowledge, Boundaries, Change* (2001-2007).

The difference between Norway and the EU is that, thus far, Norway has only introduced a requirement for an action plan in connection with one of its funding instruments, the Norwegian Centres of Excellence (CoE) scheme, whereas the EU has introduced this requirement on a broader basis. Hence, the RCN claims in its latest policy document for gender equality and gender perspectives in research that the EU is ahead of Norway in this area. The gender-equality dimension was also integrated into the funding announcement for the Centres for Research-based Innovation (CRI) scheme.

In 2006, the second call for the Outstanding Young Investigators scheme (OYI) was amended in accordance with experience in the first selection process. This resulted in a much larger pool of female applicants for subsequent calls, and a far better balance in the gender distribution of awardees.

The report *“Women in research – from quotas to integration”* published by the Research Council in 2003, concludes that the challenge in coming years is to shift focus from schemes specially targeted toward the recruitment of women to the effective integration of gender and gender-equality concerns in all activities.

The Norwegian laws and regulations against gender discrimination are fairly radical, and are designed to promote gender equality. According to the Norwegian Gender Equality Act, all enterprises subject to a statutory duty are obliged to provide an annual account of the state of affairs regarding gender equality in the enterprise. An account must also be given of measures that have been implemented and are being planned to promote gender equality and to prevent differential treatment of men and

women. This law pertains to all public research and higher education institutions in Norway.²

In 2007 the Ministry of Education and Research established a national committee to promote gender equality in science. *The Committee for Mainstreaming - Women in Science* will support and provide recommendations on measures to facilitate the mainstreaming of gender equality efforts in the higher education and independent research institute sectors.

4.2 Governing research infrastructures

The main priorities in Norwegian science and technology were set in latest white paper on research (St.meld.nr 20 2004/2005 *Vilje til forskning*). The selected thematic research priorities are: energy and environment, food, health and sea, and prioritised technology fields are ICT, new material technology/nano- technology and biotechnology. National strategic priorities for investing in new or existing research infrastructure are selected with a view to these thematic and technology areas. Decisions regarding international research collaboration with long term investment commitments and national large scale facilities with costs over €22m (NOK200m) are taken at ministerial level on the basis of advice from the Research Council of Norway. In some cases, decisions are taken at the institutional level of research institutions. In other cases decisions rest with the deciding bodies of the research council, while decisions requiring substantial funds will be prepared by ministries and finally approved by parliament. This implies that there is no single procedure for establishing new infrastructures (Slipersæter et al. 2008).

The basis for Norway's engagement in the ESFRI (European Strategy Forum for Research Infrastructure) process is stated in the 2008 government strategy document for cooperation with the EU on research and development (Ministry of Education and Research 2008). The document states that the Ministry of Education and Research, in coordination with other ministries and the Research Council, will clarify and decide upon Norwegian priorities for infrastructures in a national and European context.

In the Research Council's recently launched strategy, *Tools for Research- National strategy for research infrastructure*, it proposed an increase annual infrastructure investments of approximately €100m (NOK800m) over a ten-year period. To ensure reliable and long-term financing, the strategy suggests that a government fund be established with a start capital of €2.5b (NOK20b), from which the entire yield (approximately €100m) would be reserved for investment in new and existing research infrastructure and associated operational expenditures.

The strategy also gives an overview of Norwegian participation in ESFRI projects. Currently Norway is interested in participating in 12 out of the 35 proposed ESFRI projects set to receive EU funding in the "Preparatory Phase". In addition, the strategy document indicates that Norway will consider future participation in these ESFRI projects: ESRF upgrade (European Synchrotron Radiation Facility), ESS (European Spallation Source), XFEL, ILL, IRUVX-FEL, ELT (The European Extremely Large Telescope), FAIR (Facility for antiproton and ion research), and SPIRAL2 – Rare isotope radioactive beams (EURISOL).

² More information about gender issues in Norwegian science can be found at <http://kvinneriforskning.no/english/>

The roadmap is currently under review by the relevant ministries. Decisions regarding the construction of new infrastructures are part of the budgetary process within government and parliament, and so far no conclusions have been drawn (Slipesæter 2008).

Norway participates in several international research infrastructure projects, the major ones being CERN, EMBL and EMBC, the two organisations for molecular biology, the ESRF and the Integrated Ocean Drilling Program (IODP).

At the Nordic level, Norway also participates in research infrastructure projects such as the Nordic Optical Telescope (NOT), NORDSYNC Consortium and the Nordic DataGrid Facility (NDGF).

More specific to the European Spallation Source, the Research Council of Norway recommended in June 2008, after consulting the relevant research milieus, that Norway should support the location of ESS in Sweden, and enter into negotiation with Sweden about possible Norwegian participation. Decisions on future action currently rest with the government. In the strategy, the Research Council suggests that Norway should consider future membership in the Nordic synchrotron facility MAX IV in Lund, in the European Southern Observatory (ESO) in Chile and Deutsches Elektronen-Synchrotron (DESY) in Hamburg. Norway wishes to promote and to host three of the new projects in the ESFRI Roadmap. The selected projects as part of the ESFRI update process are:

- European Carbon dioxide Capture and Storage Laboratory Infrastructure (ECCSEL).
- Svalbard Integrated Arctic Earth Observing System (SIAEOS)

As a Nordic country, Norway participates in the Nordic research cooperation under the aegis of NordForsk, the Nordic research board under the Nordic Council of Ministers for Education and Research. Nordic Centres of Excellence (NCoE) have been set up to increase the quality and competitiveness of Nordic research through enhanced collaboration. Basic funding of the NCoEs is expected to come from national sources while Nordic support supplements national funding.

4.3 Research organisations

Allocations by the Ministry of Education and Research to universities and university colleges are divided into four parts: basic funds for research and teaching, based on incremental changes to historically set levels (on average about 60 percent of institutional funding), a performance-based funding of teaching (25 percent), a performance-based funding of research (10 percent) and strategic funding of research. Strategic funds may include funds for research infrastructure. The main source of external, competitive funding of university is the Research Council of Norway. More than 70 percent of funds for HEI research is institutional funding from the Ministry of Education and Research.

The Quality Reform, which took effect in 2003, aims to respond both to the need for an improvement in the quality of tertiary education and research, and to the Bologna Process. The Reform involves changes in governance, funding, quality assurance, degree structures, student follow-up, student support and internationalisation (White Paper nr. 7, 2007-2008).

Changes to the structure of institutional governance have also been part of the Quality Reform. Traditionally the management of tertiary institutions in Norway has

been a divided responsibility between a rector elected for a four-year term who is responsible for academic matters, and a general director, appointed by the board of the institution who heads the administration. The new law on higher education passed by the parliament in spring 2005, contained provisions allowing for a choice between the traditional model and a model in which the board is chaired by an external member, with the rector appointed by the board and responsible for both academic and administrative matters. Greater institutional autonomy in financial matters has been encouraged in recent years (for example by allowing institutions to retain financial surpluses), as have moves towards a more managerialist, rather than collegiate, approach to internal management structures (OECD 2006).

A formalised system for government funding of research institutes has been in operation since the early 1990s. It is recognized, however, that the framework conditions of these institutes have changed extensively, and the funding system of research institutes is in a process of change. A new and more performance-based system for institutional core funding is being implemented in 2009 but will initially only apply to a small part (10 per cent) of their core funding.

Universities have the possibility to make decisions for allocating resources autonomously in line with their research priorities. In general terms, evidence indicates inadequate management and weak strategic direction of institutional policies for research.

4.4 Opening up national research programmes

Joint programming initiatives

Regarding participation in joint programming initiatives, since 2004 Norway, through the Research Council of Norway has been participating in the ERA NET partnership NORFACE - *New Opportunities for Research Funding Co-operation in Europe*. The twelve research councils forming the partnership have the objective to increase co-operation in research and research policy in Europe. The twelve partners involved are the research councils for the social sciences from Estonia, Denmark, Finland, Germany, Iceland, Ireland, The Netherlands, Norway, Portugal, Slovenia, Sweden and the United Kingdom. Canada and Austria participate in NORFACE as associate partners. This partnership is built on a history of less formal co-operation and joint activities between the Nordic and UK research councils. NORFACE formalises this existing working relationship and provides a framework and a vision for a durable multi-national strategic partnership in research funding and practice. Norway is participating in several other ERA-NETs. By June 2007, Norwegian participation was included in 32 ERA-NETs.

The plan of work follows a logical progression from putting governance and good management of the NORFACE network in place, to information exchange, analysis, research co-operation, strategic thinking and, finally, co-operation on two pilot programmes and the launch of a full scale transnational research programme.

As a Nordic country Norway participates in the Nordic research cooperation under the aegis of NordForsk, the Nordic research board under the Nordic Council of Ministers for Education and Research. Nordic Centres of Excellence (NCoE) have been set up to increase the quality and competitiveness of Nordic research through enhanced collaboration. Basic funding of the NCoEs is expected to come from national sources while Nordic support supplements national funding.

With regard to Norwegian participation in Joint Technology Initiatives (JTIs) in FP7, the Norwegian authorities, continuously monitor developments and are now laying the principles and strategy for Norwegian participation in these. The total funding for the participation in JTIs (financed by the Ministry of Trade and Industry and funnelled through the RCN) is €187m (NOK1.64m) in 2009. The RCN is also funding the art. 169 initiative AAL (Ambient Assisted Living) with a budget of €114,000 (NOK1m). The total spending on international cooperation from the RCN is €163m (NOK1.44m) in 2009. This represents an increase of 6 per cent compared to 2008 (Budget 2009 of the Research Council of Norway).

Opening up national programmes

While in countries such as Finland, Denmark, Ireland and Iceland it is possible for non-residents to apply for funding as project leaders, in Norway they cannot but, they can participate as co-applicants (NORFACE 2007). Applicants from abroad must as a rule have a formal affiliation with a Norwegian institution to be eligible to seek Norwegian funding. However, some financing opportunities, programmes, grants and scholarships are specifically designed for foreign researchers and partners.

Normally, applications for funding under the Research Council's research programmes and other funding opportunities are only accepted from Norwegian institutions and companies. Researchers from abroad must as a rule have formal affiliation with a Norwegian institution to be eligible to seek Norwegian funding.

Financing opportunities specifically designed for applicants from abroad include:

- International scholarships
- Research Programmes, such as:
 - The Cooperation Programme with Russia
 - The Leiv Eiriksson mobility programme (for researchers and research recruits from the US and Canada)
 - The South African-Norwegian Programme for Research Cooperation
- EU Framework Programme

Norway takes part in the EU Framework Programmes for Research and Technological Development, and doctoral students from all member countries can apply for a stay at one of the Norwegian Marie Curie Training Sites.

- Other Activities
 - The French-Norwegian Foundation

Norway is fully integrated in education- and research cooperation with the EU through the European Economic Agreement (EEA), various bilateral agreements and national action plans.

The Norwegian Cooperation Programme with Russia supports long-term collaboration in higher education and research between universities, university colleges and research institutes in Russia and Norway.

4.5 National ERA-related policies - a summary

As a member of the EEA, Norway participates in the ERA on a par with EU Member States. Since the fourth Framework Programme on research Norway has had a high participation rate in European research. The government is highly supportive of EU research developments and strongly encourage Norwegian participation in all EU funding and collaborative frameworks. The importance of ERA for the internationalisation of Norwegian research is frequently emphasized in policy documents and government strategy reports. Norway's white paper on research (2005) supports the Lisbon agenda and the Barcelona target including improving research quality by increasing internationalisation and facilitating researcher mobility.

The Research Council of Norway is actively involved in several ERA processes, such as researchers' mobility, infrastructure, opening up on national programmes and for advancing gender equality in research.

Norway is engaged in the ESFRI process and the government has in the 2008 strategy document for cooperation with the EU on research and development stated its commitment to participate in this process. The Ministry of Education and Research, in coordination with other ministries and the RCN will clarify and decide upon Norwegian infrastructure priorities within a national as well as EU context. The RCN has recently launched the strategy, *Tools for Research- National strategy for research infrastructure*, which provides an overview of Norwegian participation in ESFRI projects. The roadmap is being considered by the ministries (Slipersæter et al. 2008).

Researcher mobility is high on the agenda of the RCN which administers the Norwegian participation in EU research mobility programmes, such as EURAXESS and Marie Curie grants. The RCN is also a signatory agency of the European charter for researcher mobility.

Initiatives to open up national research programmes are in place with the participation of the RCN in the NORFACE ERA- NET initiative. But the general rules are still that applications for funding are only accepted from Norwegian institutions and companies.

During recent years more emphasis has arguably been put on university reforms (see the Quality Reform from 2003 mentioned earlier in this report) than issues such as opening up of national research programmes or opening up of labour markets for researchers. Internationalisation of research and research mobility has received increased attention recently, through new policy strategies for better access to European research (2008) and internationalisation of higher education (2009). However, perhaps the single ERA related policy issue that has been the most emphasised is the issue of research funding and the 3 per cent target, especially the two percent target for private R&D funding.

Table 9: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • High on the government's agenda with regard to several aspects. 	<ul style="list-style-type: none"> • Anglo-American PhD degree system • Uptake of the European charter for researchers and the Code of conduct for the recruitment of researchers • National committee to promote gender equality in science • Gender equality dimension in funding announcements • Participation in EU research mobility programmes, such as EURAXESS and Marie Curie grants. • Financing opportunities specifically designed for attracting foreign researchers exist under the RCN
Governance of research infrastructures	<ul style="list-style-type: none"> • Strategic importance, new roadmap in 2008. 	<ul style="list-style-type: none"> • National policy engagement in the ESFRI process • Participation in Nordic research infrastructures
Autonomy of research institutions	<ul style="list-style-type: none"> • High importance, and emphasised in the latest reform of higher education and research (2003) 	<ul style="list-style-type: none"> • Reform of the higher education and research (Quality Reform) • New and more performance based system for institutional core funding • Greater institutional autonomy in financial matters • Move towards managerial approach in internal management structures in universities
Opening up of national research programmes	<ul style="list-style-type: none"> • Not particularly emphasised in policy documents and in actual implementation. 	<ul style="list-style-type: none"> • High levels of participation in ERA-Nets • Participation to national R&D programmes is not open to non-nationals without having an affiliation to a Norwegian organisation.

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

For a small open economy like Norway, collaboration in international research and participation in the ERA is of central importance.

Following the adoption of the 3 per cent Barcelona target, issues of skills and human resources for research have received more attention. Examples of policy instruments in this context are the introduction of an industry PhD scheme in 2008. The relatively low level of private funded R&D is of particular concern for Norwegian policy makers and has been the target for policy instruments such as the R&D tax credit scheme. Recent statistics indicate that the private funding of R&D increased remarkably in 2007. By international comparison, business expenditures of R&D are still low. The low level of private R&D investments can be explained by the industrial structure of the Norwegian economy, as characterised by smaller share of R&D intensive industries than the OECD average.

The Norwegian business sector R&D is strongly concentrated in a few companies and sectors. The larger part of business R&D is moreover constituted by *development* and not of research. In Norway the 20 largest firms account for 25 per cent of business intramural R&D. As many as 80 per cent of all companies do not report having any R&D activities. Five per cent of all companies account for 85 per cent of all intramural R&D, while 95 per cent of R&D in the business sector is performed in 10 per cent of the companies (Kallerud and Spilling 2008).

Policy makers also see great opportunities for knowledge users to increase their access to international knowledge through participation in the European Research Area. This has been specifically addressed in several policy and strategy documents during 2007 and 2008.

Policies for skills and life-long learning are high on the government's agenda but insufficient strategies to lift education in S&T studies could be seen as a risk in achieving policy goals.

In light of more recent developments it can be concluded that unstable global macro-economic conditions may impact the research and innovation budgets of firms. Furthermore, inertia in shifting the economy towards a knowledge based society can also be seen as a potential barrier to private R&D investments.

As a response to the current financial crisis, the government has increased funding to several research and innovation related instruments and is orienting research spending towards more environmental friendly sectors. The attention towards energy and climate related research is strengthened, with particular emphasis on offshore wind and CCS. These developments therefore contribute to expand the research system.

5.2 ERA-related policies

The development of the ERA was extensively discussed in the 2004 White Paper on research policy, and efforts to "strengthen collaboration between national and international priorities" are explicitly supported, "possibly on the ERANET model". Norway takes part in a large number of ERANET projects. By June 2007 Norwegian participation was included in 32 ERA- NETs.

Official policy strongly emphasizes Norway's orientation towards and commitment to the ERA conception, as seen in i.a. the strong role assumed by Norway in the Bologna process and its literal adoption of the Barcelona target as national target.

ERA plays a key role in Norwegian research policy, and it is also emphasised that, for Norway, research collaboration within the context of the EU is an important part of Norwegian foreign policy in relation to the EU. Seventy-five per cent of Norwegian subscription under the EEA agreement is for Norwegian participation in European research collaboration. It is a key priority in Norwegian research policy that national participation in European research programmes should be facilitated and extended.

The main challenges for the national R&D system in relation to ERA include further opening up of national research programmes and to increase the share of private R&D spending. A major challenge hence exists in relation to the realisation of the objective to reach the 3 per cent Barcelona target. A more in depth analysis of this particular challenge is made previously in this report.

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List of Abbreviations

BERD	R&D expenditure in the Business Enterprise sector
BIA	Programme for user driven research based innovation (Brukerstyrt innovasjonsarena)
CCS	Carbon Capture and Storage
CMR	Christian Michelsen Research
CRI	Centres for Research based Innovation (Sentre for forskningsdrevet innovasjon -SFI)
EEA	European Economic Agreement
EIS	European Innovation Scoreboard
EIT	European Institute of Technology
EPO	European Patent Organisation
ERC	European Research Council
EU	European Union
ESFRI	European Strategy Forum for Research Infrastructure
EUFP	European Framework Programme
FDI	Foreign Direct Investment
GBOARD	Government budget appropriations or outlays on R&D
GDP	Gross Domestic Product
GERD	Total intramural R&D expenditure
GOVERD	Government Intramural Expenditure on R&D

HEI	Higher education institutions
HERD	R&D expenditure in the Higher Education Sector
ICT	Information and Communication Technology
IFE	Institute for Energy Technology (Institutt for energiteknikk)
IGL	Integrated Guidelines for Growth and Jobs
IPR	Intellectual property rights
NCE	Norwegian Centres of Excellence
NCoE	Nordic Centres of Excellence
NTNU	Norwegian University of Science and Technology (Norges tekniske- og naturvitenskaplige universitet)
OECD	Organisation for Economic Cooperation and Development
OFU/IFU	Offentlige og industrielle forsknings- og utviklingskontrakter (public and industrial R&D contracts)
PRO	Public research organisations
RCN	Research Council of Norway
R&D	Research and development
UMB	Norwegian University of Life Sciences (Universitetet for miljø og naturvitenskap)
SF	Structural funds
S&T	Science and Technology
SIVA	The Company for industrial growth (Selskapet for Industrivekst)
SME	Small and Medium sized Enterprises
TTO	Technology transfer office

RESEARCH SYSTEM ANALYSIS REPORT

Elements on Research System Analysis relevant for
the policy Mix Reports 2009 for non EU Member
States

Country: Norway

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

Knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the economy are at the heart of the strategy for economic growth of many countries. The aim is to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks.

To ensure comparability across countries, a dual level analytical framework has been developed. On the *first level*, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Table 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
<ul style="list-style-type: none"> • Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources 	<ul style="list-style-type: none"> • Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment 	<ul style="list-style-type: none"> • Quality and excellence of knowledge production • Exploitability of knowledge production 	<ul style="list-style-type: none"> • Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following four steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis; and finally the fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory¹ and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains four main subsections in correspondence with the four steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and risks across all four domains in the light of the Lisbon Strategy's goals.

¹ ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home>. Other sources are explicitly referenced.

1.2 Overview of the structure of the national research system and its governance

Norway is a small open economy with a population of 4.4 million. In international comparisons, Norway has a very strong economic performance with a GDP per capita 1.8 times higher than the EU average. The oil and gas sector provides a solid contribution to this macroeconomic success. According to Statistics Norway, the R&D intensity (measured as a percentage of GDP) stood at 1.65 per cent in 2007, an increase compared with 1.52 per cent for 2006. For comparison, the average share of GDP was 1.83 in the EU countries in 2007. The relatively low R&D share of GDP is primarily due to a high increase in Norwegian GDP, driven to a large extent by high oil prices ([INNO Policy TrendChart, 2008](#)). Moreover, when compared with its Nordic neighbours, Norway spends the smallest proportion of GDP on R&D. If normalised by population rather than by GDP the rate is still lower than the other Nordic countries but is increasing (OECD 2008).

The low Norwegian performance indicators may be seen as reflecting the specific structure of the Norwegian economy. Hence, comparisons made by normalising against GDP tend to show Norway in a relatively lower position compared to countries with less resource based economies (OECD 2008).

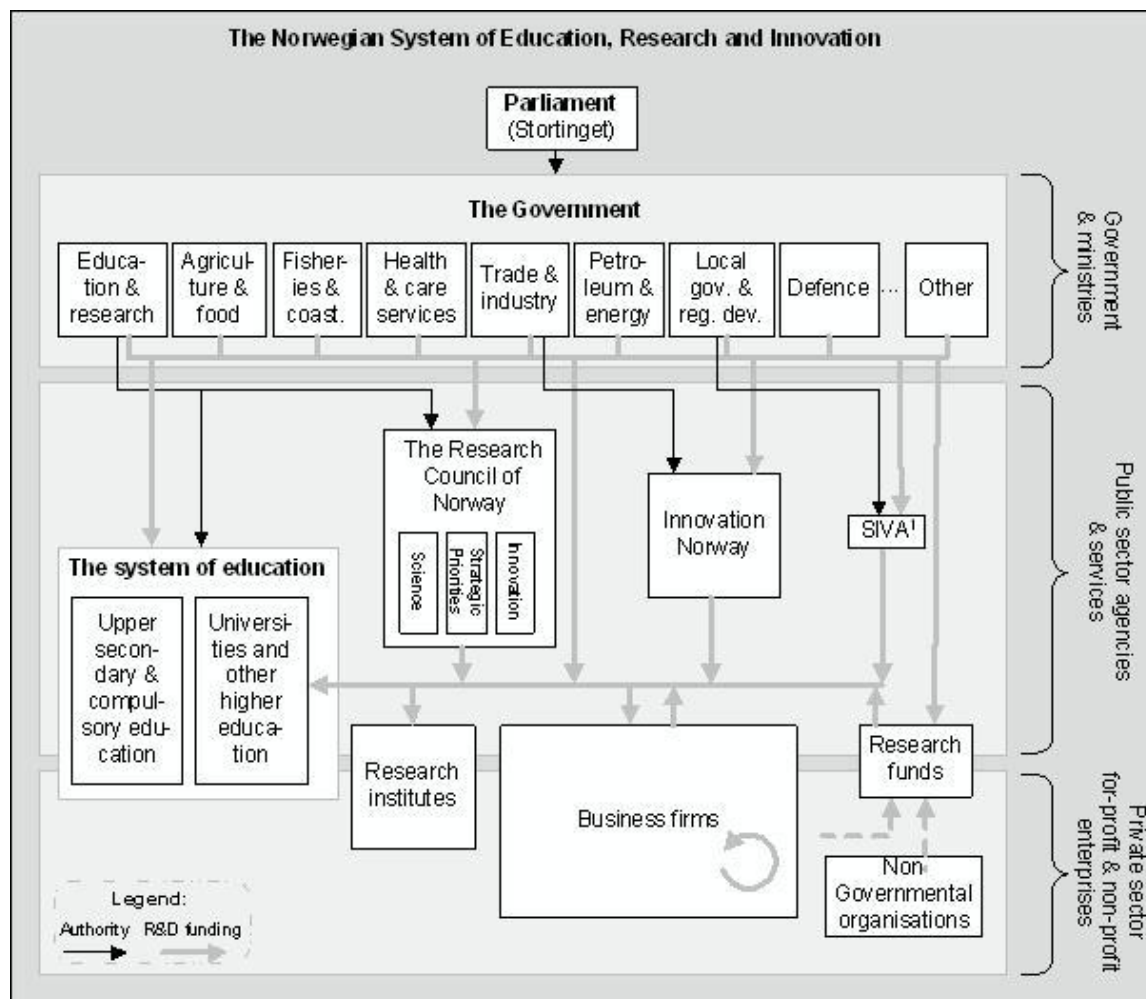
Main actors and institutions in research governance at national level

At government level the Ministry of Research and Education has the main responsibility for coordinating overall research policy and is the largest source of government research funds. Several other ministries also have large research portfolios and each ministry is responsible for research related to its own sector in society. In addition to the Ministry of Research and Education, the main ministries that fund research are: the Ministry of Trade and Industry, Ministry of Health and Care Services, Ministry of Oil and Energy, Ministry of the Environment, Ministry of Agriculture and Food and the Ministry of Fisheries and Coastal Affairs. The ministries with the largest research portfolios are also standing members of the Government's Research Board (*Regjeringens forskningsutvalg*). The strong sector-based research funding generates challenges regarding the coordination of research assignments (OECD 2008).

The Research Council of Norway (RCN) is the only operational research policy agency in Norway. In addition to funding research, RCN has the mandate to advise the government on research policy and to create communication and coordination arenas for actors of research, industry and government. The Council had a budget of €0.7b (NOK5.6b) in 2007. Another important organisation for policy advice is the Norwegian Association of Higher Education Institutions. Other actors that provide policy advice are the Confederation of Norwegian Business and Industry (NHO), the Norwegian Confederation of Trade Unions (LO) and Tekna, the Norwegian Society of Chartered Technical and Scientific Professionals.

Innovation Norway and SIVA are the two main public institutions that provide for R&D and innovation. Innovation Norway is owned by the Ministry of Trade and Industry and provides programmes and services with the objective of promoting innovation at regional and national level, mainly in small and medium size companies. SIVA (the Company for Industrial Growth) is involved in the provision of science parks, incubators and services to developing companies and venture capital mainly to start up firms.

Figure 1: Overview of the Norwegian system of education, research and innovation



¹ SIVA – The Industrial Development Corporation of Norway.

Source: NIFU STEP

The institutional role of the regions in research governance

Norway is a unitary state divided into 19 county administrations (*Fylke*). The county councils together with the municipalities form the regional governance system. The government and the parliament (*Storting*) are politically responsible for formulating objectives and establishing the framework for Norwegian research activities. However, initiatives have, been taken by some county authorities to develop research and innovation policies of their own.

In late October 2008, the government presented a proposal for regional administrative reform to be made effective from 2010. According to the proposal, the regional administrative structure is to remain the same but with a wider set of policy tools at their disposal. The proposals include the setting up of new regional research funds that will receive a government contribution of €722,195m (NOK6b). The counties will also be responsible for selecting board members for the university colleges in the region.

Main research performer groups

In 2007, €2.2b or 46% of total R&D expenditure, was performed by private companies, an increase of €0.2b compared with 2006. Norwegian BERD in 2007

stood at 0.77% of GDP. According to Statistics Norway, this corresponds to an increase of 15% in nominal value, or 11% in fixed prices, markedly higher than the EU average and in the other Nordic countries. The service industry now makes up 42% of total R&D. Enterprises with 10-49 employees had a 9% increase in R&D expenditure, and made up 24% of total R&D in 2007 (Statistics Norway).

The R&D performed in higher education institutions (HEIs) and research institutes respectively were €1.4b and €1b in 2007. The HEI sector's expenditure on R&D (HERD) in 2006 was €1.27b.

About one third of R&D in research institutes is related to the business sector (BERD) category. The extramural business R&D is to a large extent performed by private technical and industry oriented research institutes, such as SINTEF, Rogalandsforskning, the Institute for Energy Technology (IFE), etc.

Industry is the largest research performer and funder. Its share at 46% is, however, relatively low. The low level of private funded and performed research can be explained by the lack of large R&D intensive companies. The largest private R&D performer in Norway is the state owned petroleum company StatoilHydro.

Norway has a relatively large institute sector. Strategic responsibility for the institute sectors has traditionally been within the ministries, but in recent years there has been an increasing shift to delegate responsibility directly to the Research Council of Norway (RCN).

The seven universities perform the largest part (83% in 2007) of research in the HEI sector. A large part of funding of HEI research is the core funding channelled directly from the Ministry of Education and Research, but funds are also provided from project funding through the RCN. Since 2003 the universities have the opportunity to establish independent companies for performing commissioned research.

The universities are:

- University of Oslo
- University of Bergen
- University of Tromsø
- Norwegian University of Science and Technology (NTNU)
- University of Stavanger
- University of Life Sciences in Ås
- University of Agder

In addition, there are 26 university colleges, where approximately 10% of the HEI R&D is performed. A small proportion (about 6%) of research is performed in the five public university institutions (vitenskaplige højskoler), specialising in veterinary medicine, architecture, physical education and sports, music and economics and business administration.

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to the provision of inputs for research activities are addressed by the national research system. Its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, with the Barcelona EU overall objective of a R&D investment of 3% of GDP and an appropriate public/private split as orientation, but also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

- Justifying resource provision for research activities;
- Securing long term investment in research;
- Dealing with uncertain returns and other barriers to private R&D investment; and
- Providing qualified human resources.

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

The justification to invest in research reflects the need, based on broad political consensus, to restructure the Norwegian economy towards more knowledge-intensive industries. The underlying strategic goal is to maintain a high and sustainable growth even after oil and gas production has peaked, along with the concerns of an increasingly aging population. The need to diversify the economy is seen as a central prerequisite to maintain a functioning welfare system in the future. Measures have been introduced to achieve these objectives, such as the tax credit scheme for private R&D investments.

Little progress was made in terms of increasing R&D as a percentage of GDP in the period 2001-2005, when a main research policy target was introduced to increase the share of national R&D expenditure to the OECD average. Some increase in the budget appropriations occurred between 2005 and 2008. Experts claim, however, that this increase will struggle to keep pace with the high increase in GDP, which has been to a large extent driven by high oil prices ([INNO Policy TrendChart, 2007](#)).

With the adoption of the three per cent Barcelona target in the White Paper on Research 2005, the government committed to increase the private R&D investment to 2% of GDP by 2010. While the 2007 EU R&D Investment Scoreboard indicates that the largest Norwegian companies have increased their R&D investments, some of them by almost 50%, private R&D expenditure will remain far below the 2% objective. While it has been recognised that the 3% target is unrealistic, there has been little debate on how to set more appropriate targets for public and private R&D expenditure. This year the Minister of Research and Education announced that a new White Paper on research would be launched in April 2009. This new white paper will, among other things, discuss how more concrete and realistic R&D targets could be introduced.

Looking at government appropriations or outlays on R&D (GBAORD), Norway's specialisations include social sciences research, agriculture (especially marine research) and exploitation of the earth (mainly in the extraction of petroleum and gas) ([ERAWATCH R&D specialisation report Norway, 2006](#)). GBAORD as a percentage of total general government expenditure was 1.69% in 2005 compared to 1.58% for the EU27 average (Eurostat).

2.1.2 Securing long term investment in research

In its latest white paper on research, the Norwegian Government adopted a long term perspective on research investment by introducing the 3% Barcelona target by 2010. While there have been some increases in budget appropriations in 2006, 2007 and 2008, they will probably barely keep pace with the high increase in GDP, driven in large part by high prices on petroleum. The latest statistics however indicate that especially private investments in R&D increased in 2007.

Of the total amount of Gross Expenditure on R&D (GERD) in 2005, 46% was funded by the business enterprise sector and 44% by the public sector. Almost half of all public funds are channelled directly to institutes and HEI institutions, while 27%, or €440m, was channelled through the Research Council of Norway (RCN). HEI institutions receive 48% of RCN's funds and institutes, 46%, while industry receives about 6%. The share of foreign funding is now at 8% of all R&D expenditure, a share which has increased in large part due to funding from the EU Framework Programmes.

A formalised system for government funding of research institutes has been in operation since the early 1990s. It is recognized, however, that the framework conditions of these institutes have changed extensively and the funding system of research institutes is in a process of change. A new and more performance-based system for institutional core funding will be implemented in 2009; but it will initially only apply to a small part (10%) of their core funding.

Following the merger, in 1993, of the five previous research councils into one single, "integrated" Research Council of Norway (RCN), this organisation has been a dominant research funding agency and policy advisory organisation in Norwegian research. The council was reorganised in 2003 following an international evaluation of its first decade of operation. The new organisation of RCN reflects in particular a prevailing emphasis in current Norwegian policy on basic research and industrial research and innovation.

A salient feature of RCN policies are measures to enhance research excellence, including the scheme for funding Centres of Excellence, and a number of measures to stimulate the commercialisation of academic research. While reforms have been pervasive and comprehensive on the strategic and performance levels of the Norwegian research system, an entrenched sectorised system remains largely unaltered at the governmental level of R&D funding and policy-making.

The establishment of the Research Fund from the proceeds of the Pension Fund (state income from petroleum activities) has to some extent ameliorated these mismatches, providing a larger budget for funding strategic, cross-sectoral research priorities, thematic as well as structural. As the fund has increasingly become an integral part of normal budgeting, concerns are increasingly being voiced that the space created by the fund for long-term, strategic policymaking is again diminishing.

According to the RCN's recently launched strategy for long-term investment in research facilities, an increase in infrastructure investment of approximately €100m annually over a ten-year period is needed. To ensure reliable, long-term financing for the operation and renewal of infrastructure, the strategy proposes the establishment of a government fund with a start capital of €2.5b from which the entire yield (approximately NOK800m) would be reserved for investment in new and existing research infrastructure and associated operational expenditures. The strategy also lists Norwegian participation with regard to the ESFRI (European Strategy Forum for Research Infrastructure) initiatives. Currently Norway has expressed an interest in participating in 11 out of the 35 projects proposed by ESFRI.

Large research programmes have been shown to be important in securing the long-term knowledge development that is necessary in Norway and have benefitted the long-term development of the high tech industry. Several large research programmes in different technology domains are funded under the auspices of the RCN. These programmes are especially important for the realisation of the prioritized areas set by the government. These comprise research programmes for nanotechnology and new materials (Nanomat), genome research (Fuge), development of new energy technologies (Renergi), and knowledge development in ICT (Verdikt).

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

The Skattefunn scheme was established in 2002 following a protracted and somewhat controversial debate, as the first tax exemption scheme for R&D in Norway. A major evaluation of the scheme was published in 2007. The evaluation was largely positive and, contrary to expectations, did not trigger much public debate. The extensive evaluation of the scheme by Statistics Norway provided an overall very positive assessment of the appropriateness and effectiveness of the scheme, and gave some indications that the scheme may qualify as a good practice example. The scheme quickly became very popular and it is still extensively used by SMEs, although a decline has been seen in the number of applications since the peak in 2003.

Key stakeholders, such as the RCN and the Confederation of Norwegian Business and Industry (NHO), are staunch defenders of the scheme and argue strongly for its continuance, supported by evidence provided by the evaluation. The scheme is relatively un-bureaucratic that can be accessed without too much effort and a high proportion of Norwegian firms are eligible. It addresses the core functions of some the main players in the innovation system, in particular SMEs with a potential for enhancing their innovative potential through more extensive involvement with R&D. The evaluation provides evidence that the Skattefunn scheme enhances the learning capacity and R&D orientation of firms with limited previous R&D experience ([INNO Policy TrendChart, 2008](#)).

The Norwegian Government's enterprise policy has, in recent years, increasingly focused on facilitating access to finance for start up firms. Connected to this approach is the newly established State Investment Fund (Investinor AS) with capital of €275m to support early stage companies with growth potential. Targeted sectors are environment, energy, tourism and the marine and maritime sectors. A new measure was introduced by Innovation Norway in February 2009. Called NewGrowth (Nyvekst in original language), it was set up to support new small and medium size firms with growth potential. The budget for 2008 is €5m allocated by the Ministry of

Local Government and Regional Development of which €4,373,000 goes directly to the County Councils. Companies from all sectors can apply for funding. The policy aim of the measure is to help entrepreneurs put their ideas into effect and to increase the survival rate of companies. The measure will support young enterprises that have difficulties in finding venture capital in the private market. A desired effect is that many women entrepreneurs will benefit from the funding.

Over the last few years, a national seed capital scheme has been implemented and now provides risk capital for new, knowledge based firms. Although the scheme generally addresses knowledge-based start-ups with a high growth potential, it may be assumed that innovative start-ups account for a significant share of the portfolio of firms under this scheme.

As part of its enterprise policy, the Norwegian Government has also made efforts in recent years to reduce the administrative burdens of companies. A new action plan to cut bureaucratic red tape for businesses was presented in August 2008 by the minister of trade and industry. The government started a large simplification project in 2006 with a mapping of the business sector's actual costs arising from regulation. Client participation and international perspectives have been emphasized.

One of the most significant measures implemented at the end of 2008 was the development and improvement of the internet portal Altinn, which gives access to information about public schemes, regulations and required information. The portal will be the business door to public administration. Important measures will be introduced in order to ease the work situation for the smallest companies in particular.

2.1.4 Providing qualified human resources

The importance of a highly skilled human resources base in the research field was stressed by the previous Government in the White Paper on research *Commitment to Research* (2004-2005). The types of skills mentioned as especially important were mathematics and natural sciences. Despite the existence of prioritised research areas in Norway, there are in general, apart from mathematics and natural sciences, no specific types of skills indicated by the Government that are of strategic importance for Norway.

Support measures have been introduced to increase the number of PhD students. With reference to earlier commitments (White Paper, St. meld. no. 35, 2001 -2002) to gradually increase the number of PhD students, with the goal to reach 2000 more PhD positions (compared to 1999 figures) by the end of 2007, the importance of increasing the number of PhD graduates has been maintained. Since Norway has set the 3% objective for research as a target, the importance of fostering highly competent researchers has increased.

The new industry PhD scheme, launched this year, is based on collaboration between a company and a University or University College. Both parties are committed to fund the PhD position. The aim is to increase research activities in companies and strengthen knowledge exchange between industry and academia. In the fiscal budget for 2009, the government proposes to increase the resources to the PhD scheme by €3m.

Norway is among the OECD countries with the highest educational level and the numbers of employees with higher education qualifications in both the private and the public sector are increasing considerably. The largest proportion of highly educated

people in 2006 was in the sector of *oil and gas extraction, mining*. The public sector was third with 10% of the total work force having passed through higher education. Since 2002, the number of students, including foreign students, has remained relatively constant at about 220,000. A trend seems to be that fewer Norwegian students are inclined to study abroad (NIFU STEP 2007).

The most extensive reform in Norwegian higher education was implemented in 2003. The Reform of the Quality of Higher Education was implemented with the aim to shorten the time of student graduation and take measures against student dropouts.

In terms of doctoral degrees, almost 11,000 doctoral degrees were awarded at Norwegian institutions during the period 1990-2006. While the number of annual awards has doubled in the last 15 years, the increase has been slower than in other Nordic countries. Overall growth in the number of trained research personnel has been less in Norway than in neighbouring countries. Since the 1990s, the number of degrees in natural sciences and engineering has decreased. In 2006, 37% of doctoral degrees were awarded in natural sciences and engineering. The share of foreign doctoral graduates has increased, from 10% in the early 1990s to 20% in recent years (NIFU STEP 2007).

While most of the doctoral degree holders who earned their degree at a Norwegian institution are employed in the public sector, mostly at universities and colleges, the share of the same group working in the private sector is increasing.

2.2 Assessment of strengths and weaknesses

A challenge in Norway is to make large firms and more R&D-intensive and innovative industries play more prominent roles in the economy than in the prevailing structure. The long-term, structural nature of that challenge needs, however, to be acknowledged and emphasized more clearly than in the current policy debate and processes under the strong influence of the Barcelona target.

The number of new S&E graduates is far below the EU average, and past declines in this indicator continue, albeit at a lower rate, in the EIS for 2007. The government has focused on this challenge for a number of years and the issue is pervasive in policy debates and documents. Students' interest for S&T subjects and careers, in particular at the secondary level, has apparently increased as a consequence of campaigns and the general attention paid to the issue. Several measures target the position of scientific and technological subjects in secondary education, as parts of a "Strategy for a Joint Promotion of Mathematics, Science and Technology" which has been in operation and continually updated since 2002.

The main strengths and weaknesses of the Norwegian research system in terms of resource mobilisation for R&D can be summarised as follows:

Main strengths	Main weaknesses
<ul style="list-style-type: none"> • Relatively high public spending on R&D • Strong international orientation of research policy 	<ul style="list-style-type: none"> • Relatively low business investment in R&D relative to GDP • Low number of new S&T graduates • Strong sector based research funding system

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

- Identifying the drivers of knowledge demand;
- Co-ordinating and channelling knowledge demands; and
- Monitoring demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

In terms of BERD specialisation (Business Enterprise Intramural Expenditure on R&D), the largest percentage shares of R&D expenditure are in the primary sectors (petroleum and gas, agriculture and fisheries), and the low- and medium-tech manufacturing sectors (ship building, basic metals, food, printing and publishing). The BERD specialisation is also reflected, in general terms in public R&D funding, business R&D expenditure and industrial specialisation ([ERAWATCH Specialisation report, 2006](#)).

The policy drivers of knowledge demand, as mentioned previously, are the need to restructure the economy and mitigate the threats that an increasingly ageing population and the potential decline in oil production can bring to a well functioning and maintained welfare system.

Large energy resources have played an important role in the development of the Norwegian economy. Several knowledge intensive industries have been created thanks to the presence of abundant waterpower, such as Norsk Hydro, Elkem and Norske Skog. However, in international comparisons, Norway lacks large R&D intensive companies, which explains the relatively low level of privately funded and performed research. The largest private R&D performer is the state owned petroleum company StatoilHydro. The oil sector is therefore the largest knowledge demand sector in Norway.

The global demand for clean carbon technologies is increasing. Great potential is therefore attached to increased exploitation of the world-class knowledge in the oil sector for developing leading knowledge for Carbon Capture and Storage (CCS) technology. The 2008 white paper on innovation allocates a central role to the development of new energy technologies, where CCS and off-shore wind energy are identified as strategically important.

3.1.2 Co-ordinating and channelling knowledge demands

Norwegian policy makers have for many years paid attention to the importance of networks and clusters (for example, schemes such as ARENA Innovation in Networks and NCE Norwegian Centres of Excellence). However, these programmes have a focus on *national* level networks. There are some examples, however, of policy tools that include and foresee international collaboration, such as the IFU-programme (Industrial Research and Development contracts) and the SkatteFUNN tax deduction scheme which also support collaboration with foreign companies and research institutes respectively. Some of the main instruments for coordinating and channelling knowledge demand are described below.

The IFU scheme, in place since 1996, has the objective to stimulate R&D co-operation between a customer and a supplier on the development of competitive products that have a potential for export; it aims to stimulate the establishment of new business relations and networks between customer and supplier, in order to develop partnerships or alliances between Norwegian firms or between Norwegian and foreign companies. It also aims to strengthen the competitive ability of Norwegian industry locally and abroad through co-operation between a company and a public institution/customer.

Evaluations of the IFU scheme indicate that this kind of measure (which directly targets the international value chain interaction of SMEs) successfully supports new projects, new products and the growth of companies. In particular, companies that have collaborated with foreign companies benefit the most from the scheme.

Policy tools of this kind, if combined with tools supporting the build up of internal knowledge bases domestically (such as the Norwegian tax credit scheme, SkatteFUNN), have proven to be successful.

The BIA-programme (User driven Research based innovation) is one of the Research Council's most high profile and extensive programmes. The BIA-programme funds industry-oriented research and has no thematic restrictions. The projects must result in substantial value creation for the companies and for society-at-large, and must take an international perspective.

3.1.3 Monitoring demand fulfilment

Policy reviews, in the form of White Papers and public reports (*Norges offentlige utredninger*, NOU), are relatively frequent in Norway. While there are no formal rules on the frequency of white papers, some are published regularly with only few years' interval. This applies, for instance, to the white papers on research policy. The Government frequently commissions public reports that serve as a knowledge base for designing policies. These reports are prepared by a commission or work group appointed by the Government or an individual ministry to account for and discuss a specific topic.

There is a conscious approach to evaluating innovation policy in Norway, although evaluations of agencies and measures are not carried out systematically. Evaluations are to some extent initiated internally, but in cases of large-scale evaluations of strategic agencies and measures, the initiative often comes from the responsible ministries. Third parties, such as the European Commission, are not central driving forces for the performance of innovation policy evaluations.

Evaluations are regularly commissioned to independent experts, using both national and international research institutions as external evaluators. Evaluations are typically published and debated in public, and often attract the interest of media.

In general terms, major policy measures and/or reforms are subject to major evaluations at a very early stage of their implementation. Intermediary reports are openly published, and have become subject to extensive policy awareness and debate among stakeholders and in the media. This applies i.a. to evaluations of Skattefunn and of the so-called “Quality Reform” in higher education.

The extensive use and openness of both evaluations and indicators in the policy-making process contribute to the transparency and quality of the policy-making process ([INNO Policy TrendChart, 2007](#)).

3.2 Assessment of strengths and weaknesses

Studies indicate that whereas 53% of Norwegian large enterprises collaborate with their domestic science system, only 17% of SMEs do. This may indicate that linkages between SMEs and the science system are weak (Herstad et. al 2008).

The Norwegian business sector R&D is strongly concentrated in a few companies and sectors. The larger part of business R&D is moreover constituted by *development* and not of research. In Norway the 20 largest firms account for 25% of business intramural R&D. As much as 80% of all companies report no R&D activities. Some 5% of all companies account for 85% of all intramural R&D, while 95% of R&D in the business sector is performed in 10% of the companies (Kallerud and Spilling 2008).

In the concept of horizontal policymaking, issues of cross-ministerial coordination and coherence emerge as particularly challenging in the development of Norwegian innovation policy. Norwegian Ministries are by tradition strongly autonomous and coordination mechanisms often focus on short-term co-ordination and steering needs. Few policies in which cross-ministerial coordination are essential are in the longer term organized directly under the Prime Minister. This generally limits the scope and effectiveness of coordination of any policy at the governmental level where strong coordination is required or desired, such as research, environmental and innovation policy. The OECD MONIT report argued in the same vein that there are strong barriers within the Norwegian governance structure against the development of the kind of coherent, horizontal policy envisaged for innovation policy ([INNO Policy TrendChart, 2007](#)).

The organizational preconditions for a high level of coordination and coherence are, however, far better at agency level, as a simplified organisational structure has been established, assigning responsibility for the implementation of research and innovation policies to a small number of organisations. Collaboration takes place within the framework of formal collaborative agreements between the three main agencies (RCN, Innovation Norway and SIVA). These agreements sustain enhanced collaboration at the operational level, including the joint management of measures such as the Centres of Expertise and joint regional offices ([INNO Policy TrendChart, 2007](#)).

The main strengths and weaknesses of the Norwegian research system in terms of knowledge demand can be summarised as follows:

Main strengths	Main weaknesses
<ul style="list-style-type: none"> • Extensive use of evaluations and policy reviews in monitoring knowledge demand • High coordination and coherence at agency level • High R&D intensity in private service sector 	<ul style="list-style-type: none"> • Weak linkages between SMEs and science system • Cross-ministerial coordination is weak • Specialisation in low tech industries • Major imbalance and concentration of business sector R&D

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role to create and develop excellent and useful scientific and technological knowledge. A response to knowledge demand has to balance two main generic challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities which often emerge at the frontiers of scientific disciplines. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge.

Both challenges are addressed in the research-related Integrated Guideline and in the ERA green paper.

4.1 Analysis of system characteristics

4.1.1 Ensuring quality and excellence of knowledge production

The performance of Norwegian science, measured by scientific publishing and citations, is presented in a biannual indicator report, published by the Norwegian Institute for Studies in Innovation, Research and Education (NIFU STEP). According to the latest report, Norwegian researchers published 7,200 scientific articles in 2006, which represents around 0.6% of the world production of scientific publications. In terms of citations, Norwegian publications have been cited above the world average since the mid 1990s. Since then there has also been an increase in the share of international co-authorships.

Recent studies show that the number of Norwegian scientific publications has been increasing during recent years. The increase applies to publications in highly ranked scientific journals. A possible explanation is the increase in public funded research and new incentive mechanisms for research funding ("Tellekantsystemet"). A new incentive-based financing system in the Higher education sector was introduced in 2002. Scientific publishing is now one of four indicators for the distribution of research funding for universities and research institutes (Sivertsen, NIFU STEP).

When normalised by population size, Norway is, like the other Nordic countries, in the forefront with regard to scientific publications, ahead the United Kingdom, the USA and Germany. This positive trend can also be observed in terms of citations, where Norway takes second place after Denmark, when seen in a Nordic context. The high number of articles with foreign co-authorship is contributing to the increase, which would indicate that Norwegian researchers are particularly good at international research cooperation (Walløe 2008).

In recent years, Norway has seen an extensive effort to establish different arrangements specifically in order to raise the quality of Norwegian research. Some of these arrangements are the 21 Centres of Excellence, 14 Centres for Research-based Innovation and six clusters within the Norwegian Centres of Expertise programme. All the centres were established in 2006.

In general terms, quality in knowledge production at university level is claimed to be hindered by institutional rigidity and weak strategic usage of research funding.

4.1.2 Ensuring exploitability of knowledge production

The FORNY programme run by the RCN is the most important measure for supporting the commercialisation of R&D results. The programme will be evaluated in 2009. The universities have established their own Technology Transfer Offices (TTOs). Following law amendments (a Bayh-Dole shift) in 2003, which gave intellectual property rights (IPR) to institutions, universities and colleges were assigned a more explicit commercialisation mission. In January 2008, Norway formally joined as a full member of the European Patent Office (EPO).

A review of the measures for stimulating the commercialisation of public funded research results and conducted in 2007, indicated that a general shift has taken place within public research institutions towards regarding commercialisation as one of their core objectives. Targeted public measures have been effective in this regard. There is, however, still some way to go before commercialisation is fully incorporated as a primary objective. Remaining conflicts still need to be addressed between academic and commercial objectives. Several issues concerning regulation and practice for the management of IPR need further discussion and clarification.

The evaluation suggests a shift in rationale and orientation from profit to social utility, thus aligning commercialisation objectives more effectively with overall institutional objectives. Furthermore, competence building for technology transfer, in institutional Technology Transfer Organisations in particular, is important. Feedback mechanisms between actors along the full commercialisation spectrum also need to be enhanced.

While the FORNY programme is the main instrument for commercialisation, the stronger focus on commercialisation has led to an increasing number of actors and initiatives with diverging and overlapping roles and objectives. Some of the conclusions of the review pointed at issues such as the need to address effort to enhance and strengthen ongoing trends, within the framework of an approach which emphasizes continuity and incremental change. Better links between research environments and business need to be strengthened at all stages.

4.2 Assessment of strengths and weaknesses

The main strengths and weaknesses of the Norwegian research system in terms of knowledge production can be summarised as follows:

Main strengths	Main weaknesses
<ul style="list-style-type: none"> • High quality of research • Introduction of Bayh-Dole type of act in 2003 with a resulting commercialisation mission of universities • FORNY commercialisation programme 	<ul style="list-style-type: none"> • Weak links between business and research environments • Remaining weak commercialisation culture in HEI

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA green paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

In Norway, the proportion of firms co-operating with the public research infrastructure, especially research institutes, is at a very high level and above the OECD average. The proportion of Higher Education Expenditure on R&D (HERD) funded by industry is similar to that in the USA and just below the OECD average. In 2005, industry funded approximately €44m of the research in Norwegian universities and also provided 22% of the institute sector's income (OECD 2008).

In the last ten years Norway has seen an extensive effort to establish different arrangements specifically in order to strengthening the links between industry and the knowledge infrastructure. The RCS's major instruments are the user driven

Research based innovation (BIA) scheme, one of the Research Council's most high-profile programmes and the Centres for Research based Innovation (CRI) and the Centres of Expertise programme.

As mentioned earlier, since the commercialisation act was introduced in 2003, universities and university colleges have been increasingly setting up technology transfer offices (TTOs) and using science parks and incubators to link up with industry. The role of incubators is increasingly growing in importance.

The aim of the industry PhD scheme, established in 2008, is to increase research activities in companies and strengthen knowledge exchange between industry and academia. During the first phase resources were allocated for funding up to ten PhD positions. The total budget of the scheme, approximately €0.7m is funded by the Ministry of Industry through Norwegian Research Council allocations. The government announced its ambition to establish the scheme in the White Paper on Research in 2005. The government has announced in its latest White paper on Innovation that the scheme will be strengthened in 2009 with an additional €3m, which indicates that this is an instrument that is attributed high importance.

5.1.2 Profiting from access to international knowledge

For a small open economy like Norway, good access to international knowledge networks is crucial. According to a 2005 survey by Statistic Norway, 93% of Norwegian industry groups had R&D activities with foreign partners in Norway, 39% in the Nordic region and 40% in the EU. In the December 2008 innovation white paper, the Norwegian government claims that the single largest opportunity for increasing the access to international research is by participating in EU framework programmes. To achieve this aim a strategy on how to make Norwegian researchers more active in the ERA was launched in 2008.

Great importance is also attributed to Norwegian participation in the European Research Council (ERC). The Parliament has also decided that Norway will participate in the European Institute of Technology (EIT).

Norway has participated in the framework programmes since 1994. Evaluations indicate that the results of Norwegian participation in the Framework Programmes have been very good. In the sixth framework programme, Norwegian participants cooperated with R&D actors from over 100 countries. The Norwegian success rate is 30%, which is 10% above the EU average, for FP6 (NIFU STEP 2007). R&D funding from the EU Commission amounted to €21m in 2005. Most of the funding went to R&D within the natural sciences, medicine and health care.

Public arrangements exist to support applicants to the EU FP both with financial support and with information. Courses are frequently arranged on how to access and apply for EU funding.

Norway is also actively taking part in Nordic cooperation in research and innovation. Since approximately the mid 1990s the Nordic cooperation initiatives have also included the Baltic States. The available financial resources of the Nordic joint organs, such as NordForsk, Nordic InnovationCentre and Nordic Energy Research, are not particularly large but the initiatives have nevertheless been effective for strengthening cooperation between Nordic and Baltic researchers.

In terms of international collaboration in publications, there was a strong increase of articles published by Norwegian researchers in international scientific journals during

the 1990s. The USA is the largest collaborator for Norway, the Nordic countries also being close collaborators.

At the end of 2006, the stock of foreign direct investments (FDI) in Norway amounted to €73b 15.6% more than at the same time in 2005. More than 70% of the foreign direct investment capital in Norway at the end of 2006 belonged to European investors, of which 95% were investors within the EU. The largest investing countries were Sweden, Denmark, the United Kingdom, the Netherlands and France, as well as the USA. The investments took place mainly within oil and gas exploration and manufacturing industries. These industries comprised about 55% of Norway's FDI (Statistics Norway 2008).

FDI into Norwegian industry is by large represented by buying up of existing Norwegian firms, and not by establishing new companies. This means that FDI with related R&D investments in the merged companies only contributes to a minor extent in the development of new R&D intensive companies in Norway (Herstad et al. 2006).

5.1.3 Absorptive capacity of knowledge users

On an aggregate level, companies in Norway seem to have a lower than average absorption capacity as they invest modestly in R&D. The absorption capacity of SMEs is increasing but is still relatively low if measured by levels of investments in R&D. Investments are still concentrated in the large companies.

During the period 1995-2005, the number of R&D personnel in the Norwegian industrial sector doubled. Recently, however, the sector has experienced a serious decline in the number of researchers (NIFU STEP 2007).

The Norwegian Government has set the goal for Norway to become one of the leading nations in the world in developing new technologies, knowledge and skills. Studies indicate that Norway is already amongst the leading nations regarding the level of education, participation in lifelong learning and public and private investment in education and learning. The importance of fostering skills is a central topic in Norwegian policy debate and is increasingly being linked to the innovation debate.

The debate can generally be described as anti-elitist and non-technical with a strong focus on eliminating social inequalities through better access to knowledge for low skilled groups. Furthermore, it has a system-based approach. The debate is actively driven by the workers' (LO) and the employers association (NHO). The Norwegian Society of Chartered Technical and Scientific Professionals (Tekna) is also an important stakeholder in this context.

The Competence Reform of 2003 was launched to give adults more opportunity to acquire education and training and to improve their qualifications. The main objective of the reform was to help meet the needs of society and the workplace for skills and knowledge.

A range of policy measures are in place to improve the absorptive capacity of firms. Innovation Norway is the main body with the task to promote innovation and to enhance SMEs' participation in R&D. The Research Council is managing the tax credit scheme for R&D investment which is one of several measures that has been introduced to stimulate private participation in R&D.

A further example is the Arena programme owned jointly by Innovation Norway, the Research Council of Norway and the Industrial Development Corporation of Norway

(SIVA). The main objective of the programme is to increase value creation in regional business communities by strengthening interaction between the business sector, knowledge providers and the authorities. Knowledge participants play an active role in the regional innovation system. Mobility is a central feature in the programme with the exchange of personnel between companies, between companies and knowledge institutions, corporate student projects, etc.²

5.2 Assessment of strengths and weaknesses

The main strengths and weaknesses of the Norwegian research system in terms of knowledge circulation can be summarised as follows:

Main strengths	Main weaknesses
<ul style="list-style-type: none"> • Intensive cooperation between firms and research institutes • Presence of Centres of Excellence, TTOs and industry PhD scheme • High levels of education, participation in lifelong learning 	<ul style="list-style-type: none"> • Relatively low absorption capacity of business enterprise sector • Declining numbers of research personnel in industry

² For more information on processes enhancing the absorptive capacity of firms we address the reader to the recently published Pro INNO TrendChart reports for Norway.

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List of Abbreviations

BERD	R&D expenditure in the Business Enterprise sector
CCS	Carbon Capture and Storage
EEA	European Economic Agreement
EIS	European Innovation Scoreboard
EIT	European Institute of Technology
EPO	European Patent Organisation
ERC	European Research Council
EU	European Union
ESFRI	European Strategy Forum for Research Infrastructure
EUFP	European Framework Programme
FDI	Foreign Direct Investment
GBOARD	Government budget appropriations or outlays on R&D
GDP	Gross Domestic Product
GERD	Total intramural R&D expenditure
GOVERD	Government Intramural Expenditure on R&D
HEI	Higher education institutions
HERD	R&D expenditure in the Higher Education Sector
ICT	Information and Communication Technology
IGL	Integrated Guidelines for Growth and Jobs
IPR	Intellectual property rights
NCE	Norwegian Centres of Excellence
NCoE	Nordic Centres of Excellence
OECD	Organisation for Economic Cooperation and Development
PRO	Public research organisations
RCN	Research Council of Norway
R&D	Research and development
SF	Structural funds
SIVA	The Industrial Cooperation of Norway
SME	Small and Medium sized Enterprises
TTO	Technology transfer office

European Commission

EUR 23976 EN/24

**Joint Research Centre – Institute for Prospective Technological Studies
Directorate General Research**

Title: ERAWATCH Country Reports 2009: Analysis of policy mixes to foster R&D investment and to contribute to the ERA: Norway

Authors: Lisa Scordato and Egil Kallerud

Luxembourg: Office for Official Publications of the European Communities
2009

EUR – Scientific and Technical Research series – ISSN 1018-5593

ISBN 978-92-79-13331-2

DOI 10.2791/24584

Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Norway.

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