

Strategy for Norway's Scientific and Technological Cooperation with North America

Foreword

The Royal Norwegian Ministry of Education and Research hereby presents a strategy for strengthening Norway's scientific and technological cooperation with North America. The strategy is a follow-up of *Strong Bonds across the Atlantic. A Strategy for Norway's Relations with the United States*, adopted by the Norwegian government in 2001, where the need for increased research and higher education cooperation with the United States is emphasized. North America is an important region for Norwegian research collaboration. The present strategy is intended to help ensure that Norwegian research groups will be in an even better position to exploit the vast opportunities represented by the United States and Canada in research, technology and research-based economic development.

The strategy is based on recommendations from a steering group chaired by the Ministry of Education and Research. The group was appointed in response to an initiative taken by the Norwegian embassies in the U.S. and Canada. The steering group consisted of representatives of 11 ministries, the Research Council of Norway, the Norwegian Council for Higher Education, Innovation Norway and the Norwegian Industrial Research Institute Association. The Norwegian embassies in the U.S. and Canada have also been involved in the work.

Norway's participation in international research cooperation has increased rapidly in recent years, not least through the EU's Framework Program for Research and Technology. This is a very favorable trend. Although cooperation with the United States and, to some extent, also with Canada is comprehensive, it has been outpaced by the growth rate of Norway's collaboration with Europe. Moreover, there has been a steep decline in the number of Norwegian students in North America. The Norwegian authorities want to redress this situation by intensifying Norway's scientific and technological cooperation with North America.

Norway's trans-Atlantic research collaboration has long traditions. A number of Norwegian researchers have earned their doctorates or spent time studying in North America, and many have performed projects in collaboration with North American colleagues. Accordingly, the countries' further collaboration would be based on a strong foundation.

This strategy covers research at academic institutions as well as industrial R&D. The close contacts developed between industry and the world of academia in the U.S. and Canada have enriched both sides, contributing to creative, innovative business and industry in these countries. This offers a potential for training and partnership for Norwegian enterprises.

Bringing the measures described in this strategy to fruition is a link in the Norwegian government's campaign to augment the internationalization of Norwegian research. Many of the world's most prominent research groups are located in North America. Quality is at the heart of the collaboration this strategy is designed to promote, and the strategy is intended to further strengthen the quality of Norwegian research.

This strategy spans across sectoral divisions and thus involves many ministries' spheres of responsibility. Accordingly, it is important that the work has enjoyed broad support at the ministerial level, as well as throughout the Research Council of Norway, Innovation Norway and the Norwegian research community. The Research Council of Norway will bear special responsibility for implementing the present strategy in conjunction with Innovation Norway.

I would like to take this opportunity to thank the members of the steering group and all the others who have contributed to the preparation of this strategy.

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Minister of Education and Research

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Summary

The Norwegian Ministry of Education and Research hereby presents the Norwegian *Strategy for Scientific and Technological Cooperation with North America*.¹ The strategy is based on the recommendations of a steering group comprised of representatives of a total of 11 ministries, the Research Council of Norway, Innovation Norway and the institutions in the R&D sector.² The work has taken place in contact with the Norwegian embassies in Washington, D.C. and Ottawa, and the Norwegian science counselor for the United States and Canada.

The objective of this strategy is to strengthen Norway's scientific and technological cooperation with the United States and Canada. Contact with these countries is a profoundly important part of Norway's international research cooperation, and there is a significant potential for expanding this cooperation. The Strategy for Norway's Scientific and Technological Cooperation with North America is also a follow-up of the strategy adopted by the Norwegian government in 2001: *Strong Bonds across the Atlantic. Strategy for Norway's Relations with the United States*.

The government and the Storting (Norwegian parliament) aspire to bring Norway's aggregate spending on research and development (R&D) up to the OECD average and to raise the quality of Norwegian research. Moreover, it has been determined that research and development work should promote more innovation and result in a greater extent of commercialization. International collaboration is essential for achieving such goals, and this strategy is part of those efforts. Stepping up R&D collaboration with North America is not intended to take place at the expense of collaboration with the EU or other international research cooperation; it will supplement and reinforce it.

Background

Research and higher education cooperation with Europe has gained momentum in recent years. Higher education in the United States used to be of exceptional importance to Norway, but lately Norwegian students have increasingly embarked on studies in European countries and in other parts of the world rather than in the U.S. The same tendency is emerging in relation to the training of researchers.

North America has traditionally played a central role in international research cooperation. One of the main explanations for this is that many of the world's most prominent research groups are located in North America, i.e. groups that have attracted researchers from many countries for shorter and longer visits. A favorable tax arrangement between Norway and the United States has offered advantages for Norwegian researchers, and there are few linguistic or cultural barriers between Norwegian and North American researchers. Norway shares common interests with the U.S. and Canada in a number of disciplines. The level of interest in professional collaboration is reflected, for example, in the number of agreements between Norwegian and North American institutions.

Increasing collaboration with North American research groups would open up new opportunities for Norwegian researchers and research groups and help improve the quality of Norwegian research. Further, U.S. and Canadian industry is among the most creative and

¹ In this context, the term 'North America' refers to the U.S. and Canada. Further, the term 'North American' embraces both the U.S. and Canada, as opposed to 'American' which refers solely to the U.S., and 'Canadian' for Canada.

² The steering group consisted of representatives of the Ministry of Education and Research (chair), the ministries of Trade and Industry, Petroleum and Energy, Health, Social Affairs, the Environment, Transport and Communications, Fisheries, Agriculture, Foreign Affairs and Defence, as well as the Research Council of Norway, the Norwegian Council for Higher Education, Innovation Norway and Norwegian Industrial Research Institute Association.

innovative in the world. Efforts must be made to ensure that collaboration and contact with these groups will help contribute to R&D-based economic development in Norway.

Objectives and relevant subject areas

The Ministry of Education and Research is responsible for coordinating Norwegian research policy. The strategy will be normative for all Norwegian ministries' activities when it comes to R&D collaboration with the United States and Canada.

The strategy has three primary objectives, each supplemented by secondary objectives:

1. The strategy will contribute to the long-term escalation of R&D collaboration with the United States and Canada.

1. More Norwegian researchers and research recruits will spend time in the U.S. or Canada, and more researchers and research recruits from these countries will have comparable stays in Norway.
2. Norway's trans-Atlantic collaboration on R&D projects will be stepped up, bilaterally or through projects involving parties from several countries.
3. Norwegian research and Norwegian business and industry will receive more and faster access to research results, knowledge and expertise from the U.S. and Canada.

2. The strategy will help enhance the quality of Norwegian research.

1. More collaboration with North America will stimulate the revitalization of Norwegian research, improving the quality and efficiency of researcher training.
2. Priority will be given to fields of research and groups that maintain high quality standards.

3. More R&D collaboration with the United States and Canada will contribute to more knowledge-based economic development in Norway.

1. More partnerships will be developed for the purpose of innovation and R&D-based economic development.
2. More people from Norwegian research, industry, the authorities and others will be familiar with relevant groups for research and economic development in North America, with a view to augmenting entrepreneurship in Norway.

Quality must be the main criterion for all programs and projects. Thematic programs are to be consistent with the priorities in the general research policy. Emphasis will be attached to the development and application of basic knowledge, as well as to innovation and value creation. The ranking of priorities must be further developed through collaboration between the ministries involved, the Research Council of Norway and other partners. Special emphasis is attached to certain subject areas in particular (not in order of priority):

- Energy research with the focus on hydrogen, CO₂ sequestration and new forms of energy
- Oil and gas-related research
- ICT, materials and nanotechnology, maritime technology
- Biological and biotechnology research, including genomic research, medical, epidemiological and health research

- Research on food quality and safety
- Marine research and technology, including the production of seafood
- Climate research
- Polar research and research related to the High North
- Research on sustainable development, economic growth, resource management and environmental impacts
- Social science research, including research on migration, multi-cultural societies, indigenous peoples and social evolution
- Research in the humanities, including research on North American culture
- Research on international politics, conflicts and peace processes
- Defense and terrorist-related research
- Space-related research, including satellite and telecommunications research

Researchers and research institutions

The Research Council of Norway bears special responsibility for the further follow-up and implementation of this strategy. The Research Council must initiate measures relevant to research collaboration and mobility which, in principle, ought to include all disciplines and themes and be open to participation by third party states. Initiatives should also promote more collaboration and contact within researcher training, and stimulate incoming mobility to Norway from the United States and Canada. Further follow-up ought to emphasize more institutional support for research cooperation with the United States and Canada.

The establishment of university chairs would be a visible, high-profile initiative for promoting trans-Atlantic collaboration. Such posts would help support and serve as bridgeheads for collaboration between Norwegian and North American research groups and institutions. Various alternatives for establishing such bridgeheads should be considered, i.e. part-time professorships at Norwegian and North American institutions. Preferably, the establishment of such schemes would be reciprocal. This will be examined in more detail, not least as regards expenses, funding, number and subject areas.

Industrial R&D collaboration

This strategy also covers industrial R&D collaboration. Although several ministries are involved, the Ministry of Trade and Industry bears special responsibility for industrial R&D. Innovation Norway is a major player for developing such collaboration with partners in the U.S. and Canada. The strategy's recommendations have been made in consultation with the Ministry of Trade and Industry and the other ministries involved.

Innovation Norway and its representatives ought to further develop the existing arenas for training and stimulate partnerships between Norwegian enterprises and enterprises in the U.S. and Canada.

Innovation Norway should, in collaboration with the Research Council of Norway, consider developing a commercialization channel aimed at the North American market.

The scope of the industrial research and development work that targets North America in the Research Council's portfolio should be expanded.

Information and Norwegian representation

In conjunction with Innovation Norway as well as with the embassies in Washington D.C. and Ottawa, the Research Council must consider which initiatives are relevant and feasible for improving information and knowledge on research and development work in North America.

The Fora for Scientific and Technological Cooperation established at the embassies in Washington, D.C. and Ottawa should be further developed as meeting and networking venues

for Norwegian research, in close cooperation with the Research Council of Norway and Innovation Norway.

Funding

This strategy is based on the recommendations of a widely diversified steering group. In the opinion of the steering group, the national budget's total allocations to research collaboration with North America should be increased considerably in the years ahead. The steering group recommends that most of the allocations be granted through the budget of the Ministry of Education and Research, and that sector-related allocations be made through the budgets of the various sectoral ministries.

The Ministry of Education and Research agrees with the steering group, i.e. that it is necessary to augment allocations for collaboration with North America. The allocations should be made by the Ministry of Education and Research as well as by the other ministries involved. The size of the allocations will be dealt with in connection with the ministries' annual budgets.

Chapter 1 Introduction

The objective of this strategy is to strengthen Norway's scientific and technological cooperation with the U.S. and Canada. The strategy is also a follow-up of the Norwegian government's general strategy for collaboration with the United States from 2001, which expressly stated a desire for closer trans-Atlantic research collaboration.³ Expanding R&D collaboration with North America will not take place at the expense of collaboration with the EU or other international research cooperation; it will rather supplement and reinforce it.

1.1 International research collaboration

Dynamic, vital Norwegian research groups have extensive contact and collaboration with research groups in other countries and participate actively in international research organizations. In many disciplines, collaboration that extends beyond the country's borders is a prerequisite for maintaining vigorous Norwegian research communities. Over the past two decades, Norway's international contacts and different types of participation in international R&D collaboration have increased substantially. Growing internationalization has also been an important political objective for research and education at Norwegian universities and university colleges.⁴

A prerequisite for successful R&D

Contact and collaboration with strong international research communities is professionally enriching; it expands the horizons of Norwegian researchers' own activities, creates new opportunities and contributes to professional revitalization. Accordingly, international collaboration is an important means for enhancing the quality of Norwegian research. In 'big science', i.e. research that calls for highly advanced equipment or special installations, such collaboration is a prerequisite. It is also a prerequisite for research that involves several countries' economic, political or territorial interests.

Norwegian R&D activities are very modest on a global scale, accounting for a mere 0.4 per cent of the aggregate R&D conducted in the OECD area. Through international participation, however, Norwegian specialist groups and enterprises gain access to knowledge based on research and technology that would otherwise have been difficult to develop on their own. While the import of such knowledge is crucial, it cannot be viewed in isolation from the country's own potential contributions. High-quality domestic research is essential for successful participation in international knowledge development.

Individual and organized collaboration

A large proportion of international cooperation takes place directly between individual researchers and specialist groups; it is based on little or no organizational affiliation or involvement. However, international R&D collaboration is becoming increasingly formalized and subject to agreements between institutions in different countries. Such collaboration may, for example, include exchange schemes, researcher training and stays for visiting researchers. More comprehensive formalized collaboration takes place through joint projects linked to special research programs and international cooperative organizations.

The initiatives included in this strategy are primarily stimuli and incentives. Support for major research projects must be based on other sources of funding.

³ *Strong Bonds across the Atlantic. A Strategy for Norway's Relations with the United States.* See: <http://odin.dep.no/ud/engelsk/p10002187/bn.html>

⁴ See, for example, White Paper No. 36 (1992-93) *Research for the Community* and White Paper No. 39 (1998-99) *Research at the beginning of a new era*, in Norwegian only.

1.2 Three main regions for Norwegian R&D collaboration

Norway's international R&D activities have traditionally been aimed in three main directions, i.e. Nordic, European and trans-Atlantic cooperation. In recent years, Norway's international research cooperation has also involved other countries and regions, although the extent of such activities has been limited thus far.

The Nordic countries

Norwegian R&D groups have traditionally had extensive contact with colleagues in Sweden and Denmark, and to some extent also in Iceland. Over the past decade, Finland has gained importance as a partner. Nordic collaboration is very important to Norwegian research in terms of research institutions and communities, between the Nordic research councils, and at the political level.

Research is also an integral part of organized Nordic collaboration, partly through the Nordic Council of Ministers and partly through different types of cooperative bodies in which the Nordic research councils are key stakeholders. To further promote Nordic research cooperation, the Nordic Council of Ministers adopted a policy designed to develop the Nordic countries into a leading region for research and innovation (the Nordic Research and Innovation Area - NORIA) by 2010.

Europe

Norway has participated in the EU's research collaboration since 1988, and has been a full member of the Framework Programs for research and technology since 1994. This has made the EU a principle axis for Norway's international R&D involvement. Participation in the Framework Programs has facilitated the establishment of stronger and broader contacts between Norwegian and foreign research groups. The Framework Programs have acted as a catalyst for European research collaboration, including joint projects not funded by the EU.

To further stimulate European research cooperation, the EU has taken the initiative to set up a common European Research Area (ERA). Meanwhile, efforts are being made to raise aggregate R&D spending to 3 per cent of the gross domestic product (GDP) by 2010 to reach a level comparable to that of the U.S. and Japan. Coupled with this initiative, the European Commission also proposes intensifying efforts aimed at basic research.

In addition to collaboration organized under the auspices of the EU, Norway is a member of several large European research organizations. Among them are the *European Organization for Nuclear Research (CERN)*, the world's largest laboratory for particle physics, the *European Space Agency (ESA)*, the *European Molecular Biology Laboratory (EMBL)*, which has extensive laboratory facilities for molecular biology, *EUREKA*, a network for industrial R&D collaboration involving more than 30 countries, the *European Incoherent Scatter Radar (EISCAT)*, which is involved in radar surveillance at northern latitudes for studies of the earth and the atmosphere, and has installations in Tromsø and on Svalbard, among other places, and the *European Science Foundation (ESF)*, a cooperative body for research councils and academies of science.

North America

Norwegian researchers have traditionally had strong bonds with North America, particularly the United States. In recent years, research cooperation with Canada has also gained importance. Although the U.S. and Canada to some extent participate in the research cooperation taking place under the auspices of the EU and some of the European research organizations, trans-Atlantic research cooperation is not organized at the national level to any great extent. Norwegian research collaboration with the U.S. and Canada is largely based on personal

contacts, although Norwegian universities, university colleges and research institutes also have a number of agreements with similar institutions in the U.S. and Canada.⁵

As a follow-up to the Norwegian government's USA Strategy, in December 2001, the Norwegian embassy in Washington established a Research and Technology Forum. A comparable forum was subsequently established in Ottawa. The Fora have led to a certain revitalization of trans-Atlantic R&D relations and helped focus more attention on such research collaboration.

In 2003, an initiative was taken to draft a general bilateral research agreement between Norway and the U.S. Further, in 2004 a special Norwegian-American MoU (Memorandum of Understanding) on energy research was signed between the Norwegian Ministry of Petroleum and Energy and the U.S. Department of Energy (DoE).

1.3 About the strategy

One of the main reasons for drawing up this strategy is to enhance and intensify Norway's R&D cooperation with the U.S. and Canada. Closer collaboration will offer new opportunities for Norwegian research and technological development. North America is home to many of the world's leading research groups in a variety of disciplines. There are also close ties between academia and industry in North America, which has contributed to the development of high productivity and innovative industry.

This strategy primarily addresses research and development work, including R&D-based innovation and economic development, as well as researcher training. Higher education in general is not covered by the strategy. Nonetheless, implementation will probably be relevant to and important for trans-Atlantic relations with regard to higher education, e.g. student exchange programs.

Spheres of activity

The strategy being presented by the Norwegian Ministry of Education and Research is based on recommendations made by a broad-based interministerial steering group. The Ministry of Education and Research bears the primary responsibility for basic research and has the ultimate responsibility for coordinating state-funded research. This strategy also covers the activities of the other ministries. Accordingly, it will be normative for Norwegian research collaboration with the U.S. and Canada for the Ministry of Education and Research as well as for the other ministries.

The Ministry maintains that research collaboration with North America must primarily be designed to generate added research-related value beyond that created through existing bilateral relations with the U.S. and Canada, i.e. as a supplement to and support for ongoing research collaboration with the region. The main focus should be on general instruments and measures that can enhance bilateral cooperation in the sectors involved. Emphasis should be attached to fields in which Norway and North America have a special potential for additional collaboration. This will be discussed in more detail in connection with the implementation and follow-up of the strategy.

In light of its strategic role, the Research Council of Norway will bear special responsibility for the implementation of this strategy. The Research Council must collaborate closely with the Ministry of Education and Research and the other ministries involved, suggesting special target areas and devising relevant instruments. The Research Council will also collaborate closely with Innovation Norway in areas of particular importance for industrial R&D.

As far as industrial activities are concerned, the Ministry sees Innovation Norway as having an especially important role to play in the implementation of the strategy, both in terms of

⁵ Cooperation agreements between Norwegian universities and university colleges with comparable institutions in the U.S. and Canada are discussed in Appendix III.

collaboration with the Research Council of Norway and as a key player for promoting collaboration between Norwegian and North American industry. Other public bodies in various sectors should also contribute to the constructive follow-up of this strategy.

The target groups for the strategy are research communities at the countries' universities, state and private university colleges, research institutes and enterprises. An effort to enhance R&D collaboration with the U.S. and Canada cannot be brought to fruition without their active participation. The aim of this strategy is primarily to pave the way for such collaboration so that opportunities and potential can be realized, and thereby benefit Norwegian research and R&D-based economic development.

Evaluation

After the strategy has been in place for some time, e.g. about five years, it should be evaluated. An evaluation will be essential for possible further follow-up and the choice of instruments. Decisions should be based on quantitative and qualitative factors alike.

Indicators chosen for this evaluation must provide information on key aspects of the strategy and largely be related to the targets that have been set. Potentially useful indicators are, for instance:

- the development of co-authorship, Norway-U.S. and Norway-Canada
- the citing of Norwegian-American and Norwegian-Canadian articles, compared with other Norwegian articles
- trans-Atlantic mobility
- doctoral-level education in the U.S. and Canada
- patent cooperation with the U.S., Canada and other countries
- innovation cooperation between Norwegian enterprises and enterprises in the U.S. and Canada
- partnerships between enterprises in Norway and enterprises in the U.S. and Canada

The choice of indicators must be specified in more detail, in accordance with the design and choice of instruments.

Chapter 2 Research cooperation with North America

This chapter contains a brief description of North America as a research region, the development of Norway's trans-Atlantic R&D collaboration and different funding schemes for such collaboration, the system for dealing with Norwegian R&D interests in the United States and Canada, and a brief discussion of what certain other countries do to promote R&D collaboration with North America.

2.1 The world's leading R&D region

Following the end of World War II, the United States evolved into the world's leading R&D region. The U.S. has maintained and further developed this position, even though many countries separately and together have made considerable efforts to strengthen their positions in relation to the research and development work done there.

The U.S.' strong position has set a standard for other countries and regions in terms of both quantity and quality. This is particularly obvious in the European Union (EU), whose goal it is to achieve strong growth and promote extended research collaboration through the EU's Framework Program for Research and Technology and by establishing a common European Research Area (ERA). The EU objective is to increase aggregate R&D spending in member countries to three per cent of their gross domestic products (GDP) by 2010. Through concerted, more intense efforts, the EU aspires to catch up with the U.S. and become a world leader itself, both in relation to R&D and in the development of knowledge-based, innovative industry.

Owing to geographic proximity, extensive financial cooperation and a high degree of common linguistic and cultural background, the United States and Canada are considered a single region. Meanwhile, the two countries are also very different. With about 280 million inhabitants, tremendous financial strength and formidable resources, the U.S. is the world's greatest R&D region. With a population of 33 million, Canada has less overall strength, but nonetheless has strong research and innovation groups. The Canadian research and innovation system is in many ways similar to the system in Norway, and there is considerable potential for collaboration.

In 2001, the United States and Canada spent an estimated total of NOK 2 750 billion on research and development. Together, the countries accounted for some 46 per cent of the OECD's aggregate R&D volume, while USA alone accounted for 44 per cent. Compared with its GDP, the U.S.' level of R&D investment is high.

Table 2.1: R&D as a percentage of GDP and relative per capita, 2001

Country	R&D/GDP 2001	R&D per capita (Norway = 100)
Norway	1.60	100
Denmark	2.40	125
Finland	3.40	161
Sweden	4.28	196
Canada	1.94	104
USA	2.82	175
EU average	1.93	87
OECD average	2.33	103

American research – strength and diversity

The U.S. research system is highly complex, consisting of a large number of different types of institutions and enterprises. The system for determining research policy may rightly be described as pluralistic.⁶ At the federal level, military and defense-related research plays a major role, accounting for nearly half of federal research allocations.

Two-thirds of American research and development work is funded by business and industry and other private sources. The majority of government allocations are granted at the federal level. State allocations play a part in certain areas, especially for the work done at universities.

Federal allocations for civilian research purposes are generally related to four key areas:

- *energy research*, associated with and funded by the *Department of Energy (DoE)*, and generally performed at large national laboratories,
- *space research* related to the *National Aeronautics and Space Administration (NASA)*, with its huge national research centers,
- *health research* at the *National Institutes of Health (NIH)*, the world's largest research organization, which, in addition to performing research, is also a research funding agency, and
- *general scientific research*, where the *National Science Foundation (NSF)* is the main federal player and source of funding for research conducted by universities, colleges and other research institutes.

Moreover, the *Department of Commerce (DoC)* has special research and innovation-oriented programs and activities, including the *National Institute of Standards and Technology (NIST)* and the *Advanced Technology Program (ATP)*.

Over the past few years, there has been strong steady growth in federal allocations to research. NIH's grants have been doubled in five years. NSF has also experienced substantial growth in funding; the aim is to parallel the development of NIH.

The size and diversity of American research mean the United States can point to outstanding research groups in all disciplines. The country accounts for roughly one-third of all published scientific articles in the world. International university rankings often place U.S. institutions in the most prominent positions. Besides these flagships, American research consists of many groups that are not world leaders but nonetheless maintain a high caliber. Based on bibliometric data, which is often used as an indicator of quality, American research scores high compared with other countries. In addition to universities and colleges, national laboratories, independent research institutes and 'think tanks' are important research facilities.

The U.S.' strong international position in research is reflected, for example, by the number of Nobel Prizes won by scientists working in the United States. From 1990 to 2002, three-fourths of all the Nobel laureates were affiliated with institutions in the U.S., a far higher proportion than any other country.⁷ In addition to its own inhabitants, U.S. institutions have managed to attract many outstanding researchers and a large number of research talents from other parts of the world.

⁶ This presentation is largely based on Tore Li: *FoU-politikk i USA – systemer, trender og utfordringer (R&D Policy in the USA – systems, trends and challenges (in Norwegian only))*, the Research Council of Norway, 2001, and Kerstin Eliasson: *American Science – the Envy of the World?* Swedish Institute for Growth Policy Studies (ITPS), 2004.

⁷ *Nobel Prizes. The Changing Pattern of Awards*. The Sutton Trust, September 2003. Some of the Nobel laureates affiliated with US institutions are originally from other countries. Some 60 per cent of the prizewinners during the above-mentioned interim (1990-2002) were U.S. citizens.

The American system's magnetic attraction for people in science and higher education is reflected, for example, by the large number of applicants for higher education at U.S. universities and colleges. Of the more than 40 000 PhDs awarded in the United States annually, 40 per cent are awarded to students from other countries.⁸

In addition to research of a high professional caliber, there are close relations between research and economic development in the U.S. where industry performs about 75 per cent of all R&D activities. Besides performing their own research, U.S. enterprises have taken advantage of close, lasting ties to universities and research groups, thanks not least to a high degree of mobility. Innovation-oriented industry in the United States would hardly have been conceivable without the positive attitude to business and industry demonstrated by many of the country's academic institutions.

Canadian research – goal-oriented growth

The Canadian authorities have adopted an ambitious escalation plan for their R&D policy. In addition to escalation through public budgets, a system of tax incentives promotes more and better industrial R&D initiatives.

Canada has placed considerable emphasis on developing a national research policy. One paramount goal is for R&D to contribute to the production and application of knowledge; one of the key elements of this is to encourage more interaction between basic and applied research.⁹ Research is a means of ensuring access to highly-qualified personnel, modernizing the country's business and industry, and paving the way for investment, commercialization and innovation. One important feature of this is the establishment of industrial clusters based on the participation of several stakeholders, e.g. private industry, universities and public industrially-oriented research institutions.

The Canadian R&D system is more readily understood than the U.S. system and is, in many ways, more comparable with the system in Norway and the rest of Europe. Canadian research policy ranks priorities in much the same way as Norway.¹⁰ Cooperation between Norwegian and Canadian R&D groups is further facilitated by a high degree of common language, attitudes and culture. It is also relatively easy for foreign enterprises to set up operations in Canada.

The most important national institution for promoting R&D-based economic development in Canada is the *National Research Council (NRC)*. This is an umbrella organization for industrially-oriented research institutes. The NRC is responsible for different types of programs and initiatives, e.g. promoting R&D in small and medium-sized enterprises. The NRC maintains a strong focus on spin-offs and the commercialization of R&D, in collaboration with research councils and universities.

Canada has three (basic) research councils:

- Natural Sciences and Engineering Research Council (NSERC)
- Social Sciences and Humanities Research Council (SSHRC)
- Canadian Institutes of Health Research (CIHR)

Canada's research councils are mainly funding bodies. The Natural Sciences and Engineering Research Council (NSERC) cooperates closely with the NRC on energy and polar research, for example, and on research projects through which the NRC supports applied research and the NSERC supports basic research. In addition, there are several national programs and initiatives

⁸ These data are from a National Science Foundation database, see <http://www.nsf.gov/sbe/srs/srsdata.htm>

⁹ This description is based on information from the Science and Technology Division of the Department of Foreign Affairs, Canada, the National Research Council and the Canadian research councils.

¹⁰ The high-priority subject areas for Canadian research are ICT, Life Sciences, Resource and Environmental Technologies, Advanced Manufacturing Technologies, and Aerospace Technologies.

that address more narrowly defined objectives, e.g. *Genome Canada*, designed as a national push for genomic research and featuring extensive international cooperation.

The universities are public, with the exception of a handful of private tertiary educational institutions related to business management and commercial subjects. Canadian universities and research institutes cooperate with research institutions the world over. To attract outstanding professionals, Canada has established a large number of academic posts, including special professorships and posts for particularly promising researchers, which can be filled by people from Canada or from abroad.

Canada has established a number of Centers of Excellence based on the distributed network model. The Canadian centers are similar to the Norwegian system, although they have a stronger leaning toward industrial research.

More than half Canada's R&D is funded by private sources. As regards public funding, the provinces play a significant role in addition to the federal authorities, and the regional aspect is important in Canadian research.

Owing to geographical proximity and cultural bonds, relations with the U.S. are crucial for Canada. This is reflected in a very high level of bilateral mobility, for example. Each year, 500 Canadians are awarded doctorates in the United States.

Thus far, Canada has not experienced the same difficulties as many other countries with recruiting talented young individuals to do research in science and technological subjects. What is more, Canada has managed to attract many students and research recruits from other countries. One-third of the 4000 doctorates awarded by Canadian universities each year are earned by foreign students.

This internationalization policy also applies to postdoctoral grants. Sixty per cent of these grants are spent outside the country's borders.

2.2 Norwegian research and North America

Norwegian research has long and strong bonds with North America, primarily the United States. In the latter half of the 20th century, strong ties were forged when Norwegian researchers spent time at North American research institutions. In the early years, a considerable portion of this collaboration was concentrated on defense and security technology. Research collaboration subsequently grew strong in a number of subjects, especially in the natural sciences and technology, and more recently also in medicine, the social sciences and to some extent the humanities.

The following is a brief overview of Norwegian research collaboration and contact with the U.S. and Canada. It covers research collaboration and mobility, R&D-based economic development, post-graduate education, researcher training, and formalized collaboration between universities and university colleges. The relationships mentioned here are described in more detail in the appendices.¹¹

Research collaboration and mobility

Growing internationalization has been one of the most pronounced trends in research in recent years in Norway as well as abroad. For Norway, the United States is still the single most important individual country involved in such collaboration. More than every fourth article with international co-authorship has been written in collaboration with one or more researchers from U.S. institutions. In the Norwegian University Survey of 2001 conducted by the Norwegian Institute for Studies in Research and Higher Education, more than half the academic staff at

¹¹ Appendix II contains a more detailed discussion of the status of and trends in Norwegian R&D collaboration with North America. Appendix III deals with agreements between institutions. Appendix IV provides a list and analysis of co-authorship and Appendix V deals with patent collaboration.

Norway's technological, scientific and medical faculties stated that they cooperate with colleagues in the U.S. or Canada.¹² The same was true of more than 40 per cent of the staff at the faculties of social science and 30 per cent in the humanities.

At the same time, the geographical pattern for research collaboration is changing. Data on international co-authorship indicate that Nordic and European collaboration is growing significantly faster than trans-Atlantic collaboration. This trend is also reflected in mobility. The Norwegian University Survey of 1992 revealed that North America had been the destination of 38 per cent of those who had been abroad the preceding year. The percentage had dropped to 33 per cent in the 2001 survey. Owing to the growing frequency of travel, however, in absolute figures, there were still more Norwegians who visited North America in connection with professional activities in 2000 than 10 years earlier.

Although Norway has maintained its contact with North America, there is nonetheless a pronounced shift towards Europe for international research cooperation. One of the main explanations for this trend is Norway's participation in the EU's Framework Programs. Norwegian researchers have expanded their contacts with European research groups, to some extent at the expense of trans-Atlantic relations.

North America has limited importance in relation to incoming researcher mobility. Of the academic staff at the Norwegian institutions in the university and college sector and the institute sector, 12.5 per cent have foreign backgrounds; and one in ten of those staff members is from the U.S. or Canada. The North American contingent is strongest, relatively speaking, in the social science research communities, followed by the humanities.

R&D-based economic development, innovation and patent cooperation

The Norwegian Innovation Survey of 2001 indicated that North America has significantly less impact on innovation cooperation than the Nordic countries and the rest of Europe. The survey indicated that just 14 per cent of the Norwegian enterprises that cooperated with other enterprises in Norway or abroad, found partners in the United States, and very few found partners in Canada. By comparison, the figure for the Nordic countries was 31 per cent and for Europe apart from the Nordic countries, it was 33 per cent.

The number of Norwegian patents and patent applications in the U.S. and Canada is relatively low, but rising, especially with regard to the U.S. A study of patent cooperation in the U.S. and Canada indicates that a growing number of patents are resulting from international cooperation, cf. Appendix V. In 2001-2002, 25 per cent of all Norwegian patent applications in the U.S. were a result of collaboration with partners in other countries, as were 20 per cent of the Norwegian patent applications in Canada.

The United States was the most important partner in Norwegian patent applications filed in the U.S. and Canada, followed by Sweden and Great Britain, while Canada has played a more modest role in such collaboration.

Stagnation in the recruitment of PhD students

The United States has traditionally been the most important country for Norwegian researcher training outside Norway. While this is still true, in recent years there has been stagnation and even a decline in the influx of Norwegian PhD students to the United States. This is largely a consequence of the general decline in the number of Norwegian students in the U.S. (see below). If this trend continues, there is reason to expect that the number of Norwegians receiving researcher training in the U.S. will decline further in the years ahead. There are only a handful of Norwegian PhD students in Canada.

¹² Jarle Trondal and Jens-Christian Smeby: *Norsk forskning i verden. Norske forskeres internasjonale kontaktflater* (Norwegian research in the world. Norwegian researchers' international contacts (in Norwegian only)). Norwegian Institute for Studies in Research and Higher Education (NIFU) series no. 17/2001.

About half the PhD students at Norwegian universities spend a month or more abroad during their studies.¹³ North America is the destination of roughly 30 per cent of those who venture abroad. The majority head for European countries.

Of about 700 doctorates awarded in Norway each year, the proportion of candidates from other countries has climbed to nearly 20 per cent in recent years. Six per cent of the foreigners, or one per cent of the total number, are from the U.S. or Canada.

Fewer Norwegian students in the United States

The influx of Norwegian graduate students to U.S. colleges and universities has dropped by more than half over the past 10 years. The total number of foreign students has doubled during the same period. The proportion of Norwegian students who choose to study in the U.S. has declined from 27 per cent of all Norwegian foreign students in 1993 to 7 per cent in 2004. The number of Norwegian graduate students in Canada has doubled during the same period, although it is still low, i.e. fewer than 200, and the increase far from compensates the decline in the U.S. The largest groups of Norwegian students in the U.S. and Canada are those who study technical and business-related subjects, and it is these subject areas in particular that have been affected by the decline.¹⁴

The general explanations for this trend are the high cost of living and high tuition fees in the U.S., the complexity of the American education system, and the fact that the application processes are experienced as cumbersome. Furthermore, American educational institutions do not do much advertising in Norway. The after-effects of September 11th, including more stringent restrictions on residence permits, have probably also had an impact on this trend.

The decline in the number of students is also a result of Norway's priorities. The limits on the financial support made available to students have probably had an impact on the recruitment of students to the institutions with the highest tuition fees, i.e. the leading American universities. In the mid-1980s, the regulations governing financial aid for students were changed and the State Educational Loan Fund was only allowed to grant support for a freshman year in the U.S. in exceptional cases. Freshman year is the first year in a four-year bachelor's degree.¹⁵ Those regulations may have made it difficult for Norwegian students to start their studies in the U.S. As a result, many may have preferred to study in other countries. The Ministry will consider whether freshman year should qualify for financial support from the State Educational Loan Fund.

The United States has traditionally been the destination for a large percentage of the Norwegian students spending short periods abroad as part of their education in Norway, but over the past few years, such periods have increasingly been spent at institutions in other countries and continents, while the figures for the U.S. have declined. This is due to several factors, including the great expense of such stays and the fact that opportunities for supplementary grants from the State Education Loan Fund have been limited.

As of the 2004/05 academic year, the State Education Loan Fund has expanded its support for students taking a degree abroad as well as for those studying at a foreign institution for shorter periods of time. This includes PhD students. Being offered better financial conditions may have an impact on the number of Norwegian foreign students in the U.S.

¹³ *Evaluering av norsk forskerutdanning (Evaluation of Norwegian researcher training (in Norwegian only))*. Research Council of Norway, 2002, og *Evaluering av dr.scient.-utdanningen i Norge (The evaluation of dr. scient. education in Norway (in Norwegian only))*, The National Meeting of Faculties of Science, 2000.

¹⁴ The trend in the number of Norwegian foreign students, by subject, is based on the list from State Educational Loan Fund.

¹⁵ One of the main reasons for not providing financial support for freshman year was that it largely comprised general studies, making it very similar to upper secondary education in Norway.

Post-graduate students comprise the recruitment base for researcher training and research. For the research communities, it is important that recruits (collectively) come from well-diversified professional backgrounds, preferably different types of institutional and regional networks, and that they maintain high professional standards. Professional networks and contacts in Norway and abroad are established, among other things, through education. In the long term, it would therefore give cause for concern if very few Norwegian students were to receive their higher education at American colleges and universities.

University and college cooperation

When it comes to research and higher education, Norwegian and North American institutions have extensive formal cooperation. A 2003 survey covering 11 Norwegian universities and university colleges indicates that these institutions had a total of 105 bilateral agreements with partners in the U.S. and 39 in Canada, cf. Appendix III. The vast majority of the agreements were registered as active, defined as having been used within the past two years. The report identifies the scope of mobility as a serious challenge, particularly because American students rarely apply to study in Norway.

Successful agreements are primarily distinguished by extensive, binding interest and involvement on the part of the parties to the agreements. For researchers, an institution's standing or reputation is of great importance, as are opportunities for research in terms of operating costs and equipment. Shared professional interests, disciplines or niches between the institutions are also very important for collaboration. In addition to professional factors, it is essential that housing and other practical conditions are conducive to such stays, and that relevant information and advice are available.

Students from the U.S. and Canada pay tuition to their schools, even when they are abroad, but Norwegian students are not liable for such fees. Smoothly-functioning schemes and mutual student exchange programs depend on clear agreements on these issues. Moreover, it appears that contacts and exchanges of academic staff are also highly significant for students' interest in and willingness to participate in foreign exchange programs.

Although many agreements have been signed and there is activity in conjunction with most of the agreements, there is a huge potential for increasing and developing institutional cooperation. For Norwegian universities, internationalization is an important part of the country's quality reform. In addition to help with practical matters and information, students need sufficient financial allocations and, in some cases, formal rights are also required.

2.3 National funding schemes

The following section presents a brief discussion of national funding schemes for R&D collaboration with North America. A large part of international research cooperation in general, and not least with North America, is funded over the budgets of institutions and enterprises, without special subsidies, and will not be discussed in this context.

The Research Council of Norway

As a strategic body, the Research Council of Norway has broad, overall national responsibility for funding all types of research and development work. This also includes different types of international cooperation. Norway's participation in the EU's Framework Programs plays a key role, as does participation in various European and Nordic alliances and programs. The Research Council has several bilateral cooperation agreements with other research councils, and is responsible for following up a number of agreements signed by the Government and various ministries. Although many of them have had a significant impact on development in some fields, such agreements have nevertheless not been among the main policy instruments in international research cooperation.

Research is international, and a large part of Norwegian research is performed in contact and collaboration with researchers and research groups in other countries. A great number of the Research Council of Norway's grants to individual researchers, groups of researchers or institutions and enterprises contain elements of international research cooperation, without that necessarily being explicitly expressed in the budgets. On that account, there is no collective, specified list indicating the percentage of the allocations related to research collaboration with the U.S. or Canada.

The Research Council has a bilateral cooperation agreement with the National Science Foundation (NSF) in the U.S., but none with comparable institutions in Canada. The agreement with the NSF applies to polar research; during the current period, each party will contribute roughly MNOK 2 per year to joint projects. Beyond this, no particular general funding has been set aside for cooperation with the U.S. or Canada. The Research Council's 2004 budget had a total of MNOK 12 earmarked for bilateral cooperation with several countries, including the U.S. and Canada.

In recent years, the Research Council has awarded 15 to 20 doctoral fellowships to applicants taking researcher training in North America, most of whom are in the United States, and awarded 10 to 15 postdoctoral fellowships. The number of grants to the U.S. has declined somewhat in the past few years for both doctoral and postdoctoral fellowships, accounting for less than one per cent of the post-graduate fellowships and three to four per cent of the post-doctoral fellowships covered over the Research Council's budget. In addition, the Research Council funds temporary stays for researchers and fellows in the U.S. as well as a handful of the same in Canada. Allocations for individual grants to the U.S. and Canada and for support for temporary stays in these countries has amounted to about MNOK 40 in recent years.

State Educational Loan Fund

Over the past few years, the State Education Loan Fund has financed approximately 80 Norwegian PhD students in the U.S. (slightly declining number) and fewer than 10 in Canada (rising number). For the vast majority, temporary loans and grants from the State Education Loan Fund covered only part of their financial package. As from the 2004/05 academic year, PhD students can apply for loans to cover tuition abroad. Furthermore, from the same time, the scheme of supplementary grants will also cover part-time students and PhD students. These changes may improve conditions for doctoral studies in the U.S., where housing and living are very costly and tuitions are high.

Fulbright scholarships and the Norway-America Association

The *Fulbright Program* is one of the world's largest exchange programs for students, scientists and teachers. One of its objectives is to increase mutual understanding between the U.S. and other countries. More than 150 countries belong to the scheme, and Norway has participated since 1949. The Norwegian-American program currently receives 65 per cent of its funding from the Norwegian state, and the rest from the U.S.

Fulbright scholarships are awarded as one-year subsidies for living expenses, and are normally based on recipients having additional funding. The Norwegian-American program has awarded 40 to 50 grants per year in recent years. A total of more than 3300 Norwegians and 1225 Americans have received such support.

The *Norway-America Association* was founded to strengthen ties between Norway and America in the field of education, especially higher education. Since the program was founded in 1919, the Association has awarded several thousand grants, mainly to Norwegian students. Today about 40 to 50 grants are awarded annually to qualified Norwegian students, while 15 to 20 grants are awarded for summer courses for Norwegian teachers and five to ten grants to Americans.

2.4 National R&D representation in the U.S. and Canada

Norway's national R&D interests in the U.S. and Canada are promoted by the Norwegian embassies. Since 1989, Norway has had a special science counselor in Washington, D.C. who is responsible for promoting research collaboration with the U.S. and Canada. As of 2004, Innovation Norway is more closely integrated into the embassies' activities.

Science and Technology Fora in Washington, D.C. and Ottawa

The establishment in 2001 of a Science and Technology Forum at the Norwegian embassy in Washington, D.C. has been a tool for further enhancing contact and collaboration.

The Forum largely focuses on special conferences, symposia and seminars. The science counselor and the Forum also strive to develop trans-Atlantic networks and to expand collaboration between Norwegian and U.S. research institutions and enterprises. The first forum was established in the U.S., then another forum was subsequently established at the embassy in Ottawa, Canada. The activities and themes that receive priority are contingent on trends and developments in Norwegian and North American research.

During the Forum's first two years, more than 1500 individuals participated in the meetings and events organized under its auspices, and most of them have been American or Canadian. One of the paramount objectives of this initiative is to promote networking and collaboration between different types of R&D communities and institutions on both sides of the Atlantic. Another impact of the Forum is that research is now more frequently being used to project an image of Norway in the U.S. and Canada. The Forum's activities have also been useful for forging stronger bonds with the authorities, research councils and other national research institutions in the U.S. and Canada.

Innovation Norway and Norwegian technology attachés

Innovation Norway was established in 2004 through a merger of the Norwegian Tourist Board, the Norwegian Trade Council, the Norwegian Industrial and Regional Development Fund and the Government Consultative Office for Inventors. The institution is represented in more than 30 countries, not least through a scheme of technology attachés with special responsibility for transferring relevant technological knowledge to Norwegian enterprises. One central task in recent years has been to build networks that focus special attention on research institutions and on small and medium-sized enterprises. In the U.S. and Canada, this work has been concentrated on Massachusetts and California, widely considered two of the world's most innovative research regions, as well as on Houston (oil/gas) and Toronto, Canada.

Considerable attention has been devoted to building up competence in Norway's high-priority national target areas. Subject priorities are based on the Research Council of Norway's strategy. The Norwegian technology attachés have mainly concentrated on developing networks that include prominent academic research groups in the U.S. and Canada. This has facilitated the identification of important trends and developments in relevant subject areas. In addition, the technology attachés organize membership-based subject, sector and theme-oriented networks of Norwegian stakeholders involved in academic, government and commercial activities.

About 15 excursions that include Norwegian and U.S. participants are organized annually to visit academic and commercial specialist groups in North America. Funded by participation fees, the excursions are an effective tool for conveying information and making professional contacts.

Innovation Norway has begun developing a new concept, *Springboard Americas*, under which Norwegian research and technology-based enterprises will be given assistance to set up operations in the U.S. The scheme will bring the enterprises into closer contact with relevant partners as well as with academic and commercial stakeholders. There are plans to expand this concept in 2004, focusing on Boston, San Francisco, Houston and Toronto.

In addition to Innovation Norway, *INTSOK*, which was established by the Norwegian authorities in collaboration with partners in the oil and gas development sector, has local representation in Houston, Texas, the capital of the petroleum industry. The Ministry of Petroleum and Energy has also established a special program, *Demo 2000*, intended to enhance Norway's long-term competitiveness in the oil industry and continued profitable development of the resources on the Norwegian Continental Shelf. INTSOK and Demo 2000 cooperate on development and demonstration projects aimed at the U.S. market.

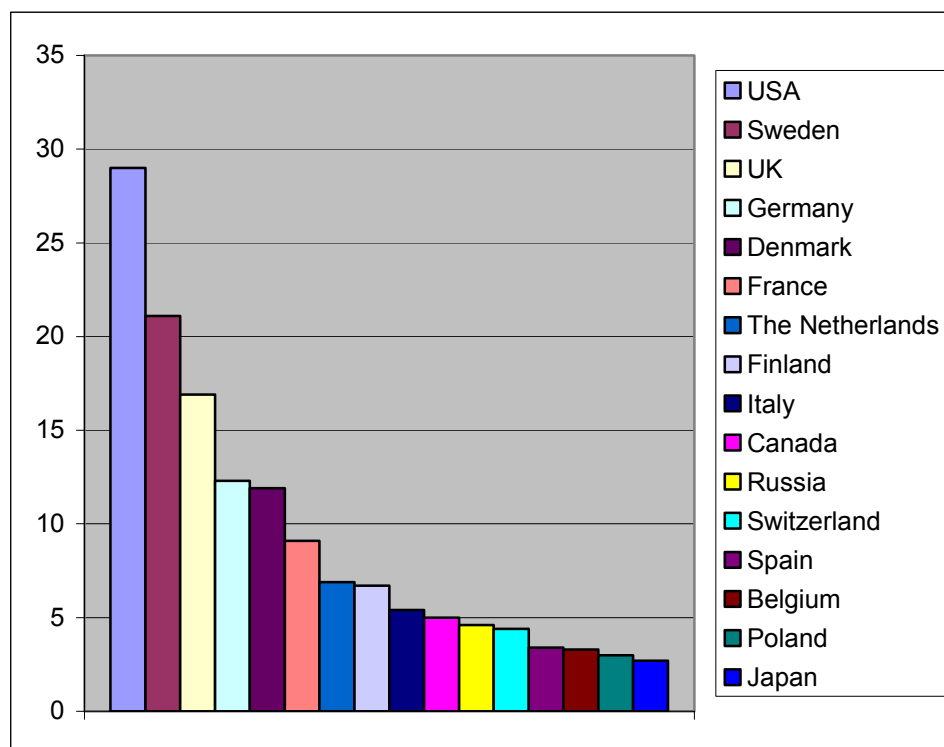
2.5 Europe and North America

The following is a brief summary of some other countries' R&D cooperation with the U.S. and Canada, and of some of the initiatives designed to promote such collaboration.

Scope of research collaboration

All European research nations have extensive contact and collaboration with the United States, and to some extent also with Canada, as reflected in the figures for co-authorship, cf. Appendix IV. Scientific publications are increasingly the result of collaboration across national borders. For Norway and other western European countries, the percentage of co-authorship with the U.S. often amounts to 25 to 30 per cent of all articles resulting from international cooperation. In recent years, the number of joint articles by researchers in European countries has grown, largely because of research cooperation under the auspices of the EU's Framework Program and the extended European contacts in which this cooperation has resulted.

Figure: Norwegian international research cooperation through joint articles with 16 countries from 1981 to 2002. (A total of 28 382 articles)¹⁶



The patenting of inventions can result from research and technological development, and in some cases from international cooperation. A list of patents awarded in the U.S. indicates that most countries with which it is natural to compare Norway have a larger scope of patenting in the U.S. in relative as well as in absolute terms. Patents are normally sought for commercial

¹⁶ International research cooperation in respect of co-authorship is discussed in more detail in Appendix IV.

purposes, and the awarding of a patent does not necessarily mean that research collaboration has taken place.¹⁷

Table 2.2: Number of patents notified in the U.S., by inventor's address, 1990-2001¹⁸

Country	Annual average 1990-2001
Norway	160
Denmark	294
Austria	397
Finland	454
The Netherlands	992
Sweden	994
Canada	2429
USA	64629
Total*)	183 957

*) Please note that total figure also encompasses many countries not on the list.

Agreements

In 2003, Norway began negotiating a general bilateral cooperation agreement on R&D with the U.S. The agreement does not entail financial commitments for any of the parties.

As of January 2004, the U.S. had 32 such agreements at the national level, including with the EU.¹⁹ Finland signed such an agreement with the U.S. in 1997. Like Norway, Sweden has also taken the initiative to sign a cooperation agreement. The major research nations of Europe have not signed such agreements, but have very extensive collaboration with a large number of institutions.

Very few European countries have comparable agreements with Canada.

Representation and special initiatives in certain countries

Most European countries have their own designated representatives in Washington, D.C. who specialize in facilitating research collaboration. However, the science counselors, or corresponding positions, are organized in different ways and the various countries have opted to work in different ways. The countries with which it is natural to compare Norway have taken a variety of special initiatives to promote trans-Atlantic R&D collaboration.²⁰

Swedish research is represented in the U.S. through the *Swedish Institute for Growth Policy Studies* (ITPS), a research and analytical agency under the auspices of the Swedish Ministry of Industry, Employment and Communication, with offices in Washington, D.C. and Los Angeles. The activity is closely associated with the Swedish embassy and the head of the Washington

¹⁷ International collaboration through patenting is discussed in more detail in Appendix V.

¹⁸ Source: Norwegian Institute for Studies in Research and Higher Education/U.S. Patent and Trademark Office/TAF Data Base.

¹⁹ Information from the Office of Science and Technology Cooperation, Washington, D.C. In the EU area, Finland, Greece, Italy and Spain have bilateral R&D agreements with the U.S., as do a large number of the new member states from eastern and central Europe. In addition to Norway, Switzerland and Sweden are negotiating similar agreements.

²⁰ The information is based on the Internet and lists representatives for the different countries and their organizations.

office has authorizations comparable to those of science counselors from other countries. In addition to representing Swedish research, ITPS' representatives draw up reports and analyses.²¹

The Swedish Research Council supports the U.S. research organization for diabetes, the *Juvenile Diabetes Research Fund (JDRF)* and also helps support Swedish medical researchers affiliated with the *National Institutes of Health (NIH)* for shorter or longer periods of time. Stem cell research is an important element of both these cooperation schemes. The Swedish Research Council has discussed more extensive trans-Atlantic research activities with representatives of the *National Science Foundation (NSF)*. *Vinnova*, Sweden's organization for innovation and economic development, has also discussed whether there is a need to formalize cooperation with the U.S., but the discussions have not yet resulted in any special initiatives. In 2003, the *Foundation for Strategic Research* introduced a special program for genomic research in close collaboration with *Genome Canada*.

Finnish R&D interests in the U.S. are handled by the office of the national Finnish agency for technological development *Tekes*, which is closely integrated with the Finnish embassy. *Tekes'* offices in the U.S. (Washington, D.C. and San Jose) are primarily an avenue for establishing contact with prominent research and technology communities and for procuring information on trends and developments. *Tekes'* representatives also maintain close contact with other Finnish institutions. *The Academy of Finland*, which is a research council for basic research, provides funding for research and researcher mobility. The Academy has earmarked special funding for postdoctoral fellowships at the *National Human Genome Research Institute* at NIH in the fields of molecular biology, genetics, genomic research and molecular medicine. Further, the Academy has initiated collaboration with the U.S. on biodiversity and global change.

The Netherlands is represented in the R&D area in roughly the same way as Norway. *TNO*, the national organization for technological development, innovation and economic development, is in the process of escalating its international activities in the U.S., Europe and Asia. *TNO's* activities in the U.S. generally have the same objectives as the Finnish *Tekes*, but the office has no formal affiliation with the Dutch embassy.

Denmark used to have a separate R&D post at the embassy, but the Danish government has chosen to withdraw it. Denmark has signed a MoU with Canada regarding collaboration on genomic research.²²

The *EU* has a special delegation in Washington, D.C. that draws up regular reports on developments in American research policy.²³

Austria has wide-ranging contacts with American research communities, and has established a separate office, the *Office of Science and Technology* for that purpose. The office, which is partially linked to the Austrian embassy, has established a database of Austrian researchers on shorter or longer stays in the U.S., for the purpose of strengthening trans-Atlantic collaboration and to provide information for the authorities and contacts in Austria.²⁴

In Ottawa, a mere handful of countries have diplomatic representatives with research and science as their specialty. The U.S., China, France, Great Britain and Italy all have posts at their embassies that have formal responsibility for research. Like Norway, Switzerland and The Netherlands have scientific consultants in Washington who also have collaboration with Canada within their sphere of responsibility.

²¹ Reports and analyses from the Swedish science counsellor in Washington are available on ITPS' website at: www.itps.se.

²² Memorandum of Understanding on Cooperation in Genomics between Denmark and Canada.

²³ See <http://www.eurunion.org/>

²⁴ See <http://www.ostina.org>

2.6 Strong cooperative traditions – development potential

Norwegian research needs strong, lasting collaboration with North America in addition to research cooperation with the EU and the Nordic countries. Norwegian R&D institutions have many relationships and contacts with research institutions and communities in the U.S. and Canada.

Nonetheless, Norway does not take full advantage of the opportunities presented by these countries.²⁵ Moreover, there are signs that trends could move in a negative direction in the long term. Norwegian students are increasingly choosing new places to study in other parts of the world. If this trend continues, the U.S. could be marginalized as a place for Norwegians to study. The stagnation in the number of Norwegians who take American doctorates may eventually serve to weaken the bonds between Norwegian and American research.

However, Norway has ample opportunities for increasing collaboration. Norway has:

- long and strong traditions for research collaboration in many disciplines;
- a network of cooperation agreements between institutions in Norway, the U.S. and Canada, and bridgeheads for collaboration on research and technological development in the U.S. and Canada;
- a high degree of common culture with research groups in the U.S. and Canada, and few language barriers;
- common national interests that offer additional potential for research collaboration;
- an organized system for funding international R&D collaboration.

Research cooperation with the United States has been stimulated by a favorable tax scheme that has encouraged many Norwegian researchers to do research at U.S. institutions for longer periods of time.

All in all, everything should be in place for R&D initiatives in respect of North America to generate good results and strong returns. The success of this strategy should contribute significantly to strengthening Norwegian research and to the development of Norway's knowledge economy.

²⁵ The mammoth US research system for medicine and health, the NIH, is an example of untapped opportunities. In 2003, more than 2700 researchers from 99 countries were affiliated with the institution. Seventeen came from Sweden, 25 from The Netherlands and 10 from Denmark, but Norway had just four. Finland had the same number. Source: NIH, Division for International Cooperation.

Chapter 3 Strategic objectives and thematic target areas

The preceding chapters have described factors of importance for Norway's R&D collaboration with the U.S. and Canada, as well as the opportunities this cooperation represents for Norway. One of the principal objectives of this strategy involves maintaining, revitalizing and further developing this collaboration in breadth and depth alike.

The strategy is based on the long-term escalation of Norway's R&D cooperation with the U.S. and Canada. Accordingly, the Ministry advocates increasing allocations for that purpose, cf. Chapter 5.

3.1 Objectives

Primary objective 1

The strategy will contribute to the long-term escalation of R&D collaboration with the United States and Canada.

Secondary objectives:

1. More Norwegian researchers and research recruits will spend time in the U.S. or Canada, and more researchers and research recruits from these countries will have comparable stays in Norway.
2. Norway's trans-Atlantic collaboration on R&D projects will be escalated, bilaterally or through projects involving parties from several countries.
3. Norwegian research and Norwegian business and industry will receive broader, faster access to research results, knowledge and expertise from the U.S. and Canada.

Primary objective 2

The strategy will help enhance the quality of Norwegian research.

Secondary objectives

1. More collaboration with North America will stimulate the revitalization of Norwegian research, improving the quality and efficiency of researcher training.
2. Priority will be given to fields of research and groups that maintain high quality.

Primary objective 3

Increased R&D collaboration with the United States and Canada will contribute to more knowledge-based economic development in Norway.

Secondary objectives

1. More partnerships will be developed for the purpose of innovation and R&D-based economic development.
2. More people from Norwegian research, industry, the authorities and others will be familiar with relevant groups engaged in research and economic development in North America, with a view to augmenting entrepreneurship in Norway.

3.2 Professional and thematic areas of collaboration

The scientific priorities must be based on the objectives established in this strategy: enhancing collaboration with the U.S. and Canada, improving the quality of Norwegian research and achieving more R&D-based economic development.

National ranking of priorities

In White Paper No. 39 (1998-99) *Research at the beginning of a new era*, the Norwegian government attached high priority to long-term basic research and designated four thematic target areas:

- marine research
- information and communication technology
- research in the interface between energy and the environment
- medicine and medical and health-care research

Three more target areas have subsequently been added: research in functional genomics (FUGE), materials research and petroleum research.

The Norwegian government has signaled that it will present a new White Paper on Research in the spring of 2005. Consequently, the priorities in the current White Paper on Research are not the only priorities that must be taken into consideration when devising special initiatives in respect of North America.

The type of entrepreneurial culture that exists in the interface between industry and academia in North America is poorly developed in Norway. The Norwegian government would like to strengthen R&D-based economic development, and its policy assumes that R&D efforts on the part of private industry will be increased considerably. Expanding collaboration with North American research groups is a contribution to this.

The priorities in the White Paper on Research have also been the point of departure for the Research Council. Some themes are organized into so-called Major Research Initiatives:

- FUGE (functional genomics)
- NANOMAT (nanotechnology and new materials)
- AQUACULTURE
- NORKLIMA (climate changes and consequences for Norway)
- RENERGI (clean energy systems for the future)
- PETROMAKS (maximum exploitation of petroleum reserves)
- VERDIKT (core competence and value creation in ICT)

These initiatives are based on research that attaches importance to the development of basic knowledge as well as to applications, innovation and economic development.

As regards institutional initiatives, the Research Council has further developed strategic programs for universities, university colleges and research institutes. International collaboration is an important element of such programs. In connection with future allocations, particular consideration should be given to the opportunities offered by North American institutions.

National advantages and needs

The evaluations of Norwegian research made thus far indicate that many Norwegian research groups maintain high scientific standards. In certain fields, in fact, they maintain the highest international standards. At the same time, the evaluations outline some general weaknesses, e.g. in relation to strategic focus, research management, mobility and recruitment.

One important feature of the most prominent research communities is that they are attractive to international partners, and are able to attract highly-skilled researchers to Norway. Special emphasis should therefore be placed on the best research communities when implementing the strategy. In 2003, Norway established 13 Centers of Excellence in the following subject areas: aquaculture, geological disasters, geological processes, the biology of memory, information technology, climate research, mathematics, medieval studies, molecular biology, petroleum research, ship and marine structures, civil war studies and theoretical linguistics.²⁶ The second call for establishing CoEs will take place in 2005.

Norway brings several national advantages to its cooperation with North America, including the country's geographic location, its polar areas, its proximity to large ocean territories and its access to natural resources such as fish, oil and gas. Furthermore, Norwegian society is interesting in the context of research because the general public is relatively homogeneous, and the country has central registers and databases for demographic data that lend themselves well for research purposes.

In many of these areas, Norway shares specific, common research interests with the U.S. and Canada. This includes, for example, energy and petroleum-related research and maritime technology, marine research, climate research, research on food safety and plant and veterinary health, the use of medical technology in sparsely populated areas (telemedicine), polar research, satellite and telecommunications technology, the exploration, use and management of areas at northerly latitudes, migration and research related to indigenous peoples. These are fields in which Norway can make substantial contributions to cooperation with the U.S. and Canada.

Potential areas of collaboration

More work should be done to determine which subjects or fields of research should be given special priority. The ministries, the Research Council, Innovation Norway and other involved bodies, as well as the research communities themselves, must play an active role in such a process.

The following elements are to be central in all thematic priorities:

- Quality is to be a main aspect of and criterion for programs and projects.
- The target areas in this strategy are to be consistent with the priorities in Norway's overall research policy.
- Emphasis will be attached to the development and application of basic knowledge, as well as to innovation and value creation.

One important aspect of this initiative is to pave the way for research in a greater number of areas, where choices will depend on needs and opportunities.

Relevant areas for collaboration will be discussed in more detail in the further follow-up of the strategy. Given the priorities and fields in which Norway has special interests in relation to North America, there is nonetheless reason to mention some relevant fields of research (not in order of priority):

²⁶ A full list of the CoEs with related links can be found on the Research Council's website at <http://www.rcn.no/>

- Energy research with the focus on hydrogen, CO₂ sequestration and new forms of energy
- Oil and gas-related research
- ICT, materials and nanotechnology, maritime technology
- Biological and biotechnology research, including genomics research, medical, epidemiological and health research
- Research on food quality and safety
- Marine research and technology, including the production of seafood
- Climate research
- Polar research and research related to the High North
- Research on sustainable development, economic growth, resource management and environmental impacts
- Social science research, including research on migration, multi-cultural societies, indigenous peoples and social evolution
- Research in the humanities, including research on North American culture
- Research on international politics, conflicts and peace processes
- Defense and terrorist-related research
- Space-related research, including satellite and telecommunications research

Chapter 4 Instruments and initiatives

The strategy should result in committed collaboration with R&D groups in the U.S. and Canada. It may be feasible to develop bilateral relations with each of the countries as well as initiatives that include both countries. The measures should also be open to participation from Third Party States.

Supranational research collaboration may be organized in several different ways:

- Between individual researchers and research groups in different countries, based on shared professional interests. Such collaboration is not usually formalized to any great extent.
- Between research groups/institutions and enterprises, for example, in the form of project collaboration, mobility and stays for visiting researchers. This form of cooperation will ordinarily be based on agreements between institutions in different countries.
- Between research programs, separate internationalization measures and special initiatives. Such collaboration poses further requirements for formalizing cooperative relations.

The measures in this strategy will largely be stimuli and incentives designed to enhance collaboration and contact with North America. It may also be feasible to fund research projects. Support for major research projects should also be based on other national sources of funding.

4.1 Research scientists, fellowships and research institutions

Mobility among researchers and fellows

International research cooperation ultimately rests on the willingness, ability and opportunities for contact and interaction between researchers from different countries. Hence one important element is to encourage such contact between individual researchers from the U.S., Canada and Norway, ensuring that it is maintained and strengthened.

The mobility of researchers between two countries should go both ways. Not only should Norwegian researchers spend time in the U.S. and Canada, but researchers from those countries should be encouraged to spend shorter or longer periods of time in Norway.

Mobility and international cooperation must be an integral part of a career in research. Those in recruitment positions, either doctoral or post-doctoral fellows, should establish contact with international research groups that maintain high standards. As a general rule, research fellows should spend some time at an appropriate research institution in another country, or collaborate with well-qualified visiting foreign researchers at their own institutions. Some research fellows ought to spend time at research institutions in North America.

The conditions for such stays must be made attractive and practically feasible in order to ensure that more people will choose North America as their destination. This is particularly true of junior researchers in the recruitment phase, where family obligations will often play a part.

A lengthy stay abroad should be a normal part of postdoctoral fellowships. That makes it especially important to ensure that post-doctoral fellows can spend time at U.S. and Canadian research institutions, and efforts must be made to ensure that these research fellows have adequate facilities to return to in Norway.

With a view to future recruitment to Norwegian research, a sufficiently large number of Norwegian students should earn doctorates in the U.S. and Canada. Norwegian research must also be able to attract research recruits from the U.S., Canada and other countries.

Students

Norwegians taking higher education, in particular doctoral studies, are also potential recruits for Norwegian research. For a variety of reasons, a dwindling number of Norwegians have chosen to study in the U.S. This applies to those who take their entire education abroad and those who spend shorter periods abroad as part of a Norwegian education. Studies in the U.S. are considered particularly cost-intensive. As from the 2004/2005 academic year, the State Education Loan Fund's subsidy schemes have been expanded, and this is expected to have a favorable impact on students' interest in studying in the U.S. The Ministry will monitor the effect of the changes to determine whether they provide enough incentives for studies in the U.S.

Institutional and formalized collaboration

International research cooperation is becoming increasingly institutionalized. Institutional involvement implies binding social, financial and academic guarantees for the duration, and may result in greater breadth and better exploitation of the contacts and networks established.

The *Quality Reform* at Norwegian universities and university colleges has entailed, among other things, that the institutions have been assigned considerable responsibility for international cooperation on research and education. Norwegian research institutions have spent many years establishing sizeable networks of institutional relations in the U.S. and Canada. A review of the cooperation agreements between North American and Norwegian universities and university colleges indicates that most of the agreements are active, but that there is a potential for additional exploitation in relation to research, researcher training and other types of human resource development, student exchange programs and the use of infrastructure. Meanwhile, such agreements are challenging in terms of striking a balance and reciprocity of funding, especially as regards tuition.

Researchers and students who arrive at a new place need support and help with practical matters such as housing or accommodations, office space, work permits, taxes, etc. A smoothly-functioning system to provide help with such issues is an integral part of a smoothly-functioning cooperation scheme. Most Norwegian institutions have considerable latitude for improvement in this area. Such practical assistance schemes should be professionalized.

Research collaboration related to special programs or other types of organization can be set up in different ways. One example of such collaboration is Norwegian-American collaboration on polar research, based on an agreement between the Research Council of Norway and the National Science Foundation and involving funding from both parties. Another alternative is to establish special initiatives related to existing activities, where it is assumed that the projects will be included in collaboration with clearly defined North American research groups, but where no special North American funding is required for the measures.

Bridgeheads for research collaboration – endowed professorships (chairs)

Cooperation between institutions can be promoted through a variety of schemes. The establishment and development of bridgeheads as special contact points and prime movers for collaboration between institutions can be an efficient policy instrument for increasing collaboration, and can be built up on the basis of different models. They can be linked to special subjects or have a general sphere of activity.

One model for such bridgeheads involves the establishment of special professorships – endowed professorships (chairs) - at prominent universities in the U.S. and Canada. Endowed professorships should generally be directed at research and researcher training, providing stimuli for more high-level exchanges between Norwegian and North American research groups in selected disciplines.

The establishment of endowed professorships should preferably be reciprocal. Thought will also be given to whether it is possible to establish comparable schemes at Norwegian institutions for higher education.

Part-time professorships are another possible alternative for developing more contact and collaboration. Such posts must be reciprocal between Norwegian and North American institutions. Such posts could also serve as visible bridgeheads for reciprocal relations, providing special impetus in selected subjects.

The establishment of endowed professorships or part-time posts with prominent North American research groups would project a clear, strong image of Norwegian research in the U.S. and Canada. These should be common reciprocal schemes between North American and Norwegian institutions. The measures should be considered and studied in more detail, not least with a view to the choice of subjects and possible funding opportunities. The schemes eventually established should also be attractive to private Norwegian and North American stakeholders and funders.

Initiatives:

1. The Research Council of Norway will be asked to initiate measures that address research collaboration and mobility in the U.S. and Canada as their main objectives. The Ministry is of the opinion that the measures ought to include the following elements:
 - In principle, they should encompass all subjects and thematic target areas, and be directed towards bilateral cooperation projects as well as projects open to researchers from other countries.
 - Be open to individual researchers, research fellows and institutions.
 - Funding for post-graduate fellows for stays of a certain duration in the U.S. or Canada and grants to candidates intended to do their entire researcher training at an institution in the U.S. or Canada.
 - Post-doctoral research fellowships for studies at prominent North American research institutions that offer favorable schemes for accompanying family members, and offer inducements to return to Norway, e.g. a supplementary grant at a Norwegian institution.
 - Stimuli for incoming researcher mobility from the U.S. and Canada, e.g. "starter packages" and funding for visiting foreign researchers. Institutions applying for support for such initiatives must have professionalized support systems for this purpose.
2. The Ministry will consider the possibilities for establishing endowed professorships (chairs) and part-time professorships at Norwegian and North American institutions. The factors that must be taken into account include costs, possible funding schemes, number and disciplines.

4.2 Industrial cooperation

The U.S. has long traditions of close links between industry and academia, often described as an entrepreneurial culture. This has helped enhance productivity and instilled a strong spirit of innovation. In recent years, Canada has also worked systematically to promote interaction between government and private stakeholders, with a view to developing knowledge-based, R&D-oriented industry.

Industrial R&D collaboration

International collaboration is also a key feature of the development of industrial R&D activities. The Research Council's grants to industrial R&D are intended to promote more innovation, build long-term competence and technology skills, enhance interaction between industry and

R&D groups and increase participation in international cooperation. The SkatteFUNN tax incentive system will also facilitate international cooperation.

In connection with future allocations, particular attention should be devoted to the opportunities for enhancing R&D collaboration with the U.S. and Canada.

Learning arena and partnership

Norway has a very open economy, and depends on trade with other countries for developing knowledge and competence, as well as for commercial purposes. Through R&D collaboration with enterprises and research groups in other countries, Norwegian enterprises and research groups are able to produce knowledge that contributes to the development of Norway's knowledge economy.

There is a huge potential for developing industrial R&D-related collaboration with the U.S. and Canada, both in terms of developing partnerships and as learning arenas. Norway has limited, but excellent experience with such collaboration. Established by the University of Oslo and being run in collaboration with Innovation Norway, Norway's School of Entrepreneurship accepts students from all the universities, and is organized in the U.S. as well as in other parts of the world. Thought should be given to expanding the School of Entrepreneurship with a view to including academic staff as well as students, and to ensuring that it includes Canada. The same applies to the excursions organized by Innovation Norway. Consideration should be given to whether the excursions can be made more accessible.

The establishment of a 'commercialization channel' for the North American market should also be considered more closely. Such measures could possibly include contact with R&D institutions, industrial networks and business development groups, capital, lobby and different regulatory agencies. The aim would be to ensure that Norwegian ideas develop more commercial potential, both in North America and in the rest of the world. Good ideas and start-up companies originating at universities and university colleges and that have a commercial potential might also benefit from being introduced to an American 'venture forum'. This might contribute to their professional and business-related development, and possibly result in access to capital, competence and markets.

The measures touch on several ministries' spheres of activity, especially that of the Ministry of Trade and Industry. The ministries will be responsible for the further follow-up of the measures. The aim is to better coordinate the various ministries' efforts during the further follow-up of the strategy.

Measures:

1. Innovation Norway should pave the way for developing and expanding industrially-oriented learning arenas in the U.S. and Canada.
 - a) The Norwegian School of Entrepreneurship in the U.S. should be expanded to also include Canada. The scheme ought to increase in scope and be expanded to include researchers and PhD students.
 - b) The excursions, like the Norwegian Schools of Entrepreneurship operated by the technology attachés, ought to be developed and expanded to include people from business and industry as well as researchers.
2. In collaboration with the Research Council of Norway and other agencies, Innovation Norway should consider developing a commercialization channel to address the North American market, providing special assistance to young companies that are just starting out. Consideration should be given to whether efforts should be made to ensure that Norwegian enterprises are exposed to a venture capital forum for the purpose of professional and commercial development.

3. The scope of Norwegian industrial research and development work directed toward North America should be increased within the parameters of the Research Council's portfolio of instruments.

4.3 Information and Norwegian representation

The need for knowledge and information

Knowledge and interest are important motives for collaboration across national borders. At a time of increasing globalization, interest in 'old' partners has diminished. The U.S. and Canada have increasingly had to share the spotlight with other countries and continents. This has had an impact on R&D.

Although there are long traditions of Norwegian researchers working at North American institutions, Norwegians' knowledge about research in the U.S. and Canada and the opportunities that exist, is relatively limited. The U.S. R&D system is perceived as vast, overly complex and complicated. Canadian R&D activities are more readily understood, but not well-known in Norway.

Norwegian representation

At the national level, Norwegian R&D interests are handled by the embassy in Washington, D.C. The science counselor at the embassy is also responsible for Canada, and the position is closely linked to the Forum for Science and Technology established in 2001. A separate Forum was subsequently established in Canada, in affiliation with the embassy in Ottawa. As they have succeeded in capturing the interest of representatives of prominent North American and Norwegian specialist groups in different events, the Fora for Scientific and Technological Cooperation have become an important meeting place for Norwegian trans-Atlantic R&D collaboration, and ought to be further developed.

The Fora's activities have also raised other issues. This refers first of all to questions involving overall capacity, relevant information on American research policy and R&D activities, and opportunities for serving Norwegian R&D interests. The embassies in Washington, D.C. and Ottawa have expressed a desire for more capacity and resources to deal with R&D-related duties.

Secondly, as of today the Fora are presented as no more than a small part of Norway's national R&D strategy. It is especially important to strengthen contacts with the Research Council of Norway, and to ensure that the Research Council gets more involved in the Science and Technology Fora. The two embassies and the Research Council ought to determine how this can best be accomplished in consultation with Innovation Norway.

In addition to the embassies in Washington, D.C. and Ottawa, Norwegian interests are attended to by Innovation Norway's technology attachés in the U.S. and Canada and INTSOK's technology attaché in Houston. As from 2004, Innovation Norway is more closely integrated with the foreign service. There was previously also close collaboration between the technology attachés and the embassies in the U.S. and Canada. In Canada, this has clearly been reflected in the operation of the Science and Technology Forum. Forging stronger bonds could have a favorable impact on Norway's overall activities in these countries.

Some of the measures proposed in this strategy call for increasing the scope of the duties assigned to the Norwegian technology attachés. Implementation and the follow-up of an ambitious strategy will call for close coordination and contacts between the embassies, Innovation Norway and the Research Council of Norway. The Ministry of Education and Research will work with the ministries involved, mainly the Ministry of Trade and Industry and the Ministry of Foreign Affairs, on the follow-up.

Measures:

1. The Research Council will be asked to consider which initiatives can be implemented to improve Norway's information and knowledge on R&D activities in the U.S. and Canada, in collaboration with the two embassies and Innovation Norway. In that context, consideration should be given to how Norwegian researchers at different institutions can contribute.
2. The embassies in Washington, D.C. and Ottawa ought to further develop the Fora for Scientific and Technological Cooperation as meeting places and networks for Norwegian research, in close collaboration with the Research Council of Norway and Innovation Norway.

Chapter 5 Funding and further follow-up

This strategy is based on the recommendations of a broad-based steering group, cf. Chapter 1.3. In the opinion of the steering group, the national budget's total allocations to research collaboration with North America ought to be increased significantly in the years ahead. The steering group has also recommended that the majority of the allocations ought to be granted through the budget of the Ministry of Education and Research, and that additional sector-related allocations be made through the budgets of the various sectoral ministries.

The Ministry of Education and Research recommends that special allocations be earmarked for scientific and technological cooperation with the U.S. and Canada. The special allocations for this purpose should be granted as stimulation and incentive packages. It should also be possible to fund research projects. Large-scale joint projects, comparable to EU research cooperation, would call for funding in conjunction with other sources of funding aimed at relevant subjects and themes. Pursuant to the objectives set out in this strategy, it is assumed that the quality requirements will be met in order for such funding to be provided. The Ministry will revert to this in connection with the annual budgets. Some measures, e.g. the establishment of endowed professorships (chairs), etc., must be considered more closely, as discussed in Chapter 4.

The Research Council of Norway will be asked to propose more specific initiatives. With a view to improving interministerial coordination, evaluating funding needs and monitoring development, it might be useful to prolong the steering group's activities.

The strategy addresses actions and initiatives that affect *researchers and research recruits, research institutions and enterprises*. These are the most important target groups for the strategy, and they must consequently play a leading part in its implementation. The initiation and implementation of the strategy will ultimately rest on their ability and willingness to follow-up and take advantage of the opportunities that arise.

It will be very important that the institutions themselves follow-up and play an active part in the schemes and initiatives outlined and pave the way for such collaboration. It is crucial for institutions to have a system for receiving visiting foreign researchers and for disseminating information about collaboration and mobility between Norway and North America in their respective communities.

5.1 The ministries' financial responsibilities

The funding of Norwegian research is based on the sector principle, i.e. the various ministries bear the ultimate responsibility for funding research and development work in their respective sectors. The responsibility is two-tiered. First of all, the different ministries bear broad-based responsibility for research in their respective sectors, encompassing the long-term development of competence as well as applied research. Secondly, the ministries are in charge of research used to support policy-making and management in their particular spheres of responsibility.

The sector principle is also the basis for the implementation of this strategy. The ministries' broad sectoral responsibility implies that they have a special responsibility for knowledge needs in their own given sectors as well as for how they can use collaboration with the U.S. and Canada in relevant areas to accomplish their objectives. For those fields of research that straddle the spheres of two or more ministries, sectoral responsibility entails a sharing of responsibility between the ministries involved.

Allocations over the national budget

The preceding chapter outlined a number of fields of research and thematic target areas that will be central in the development of research cooperation with the U.S. and Canada. They will have an impact on knowledge capture in important areas. Sufficient funding must be made available if opportunities are to be realized and targets reached.

The national budget's allocations for such collaboration should be increased if R&D cooperation with North America is to get the priority it needs. Some of the increased allocations should be rendered visible and profiled on the budget of the Ministry of Education and Research, which is in charge of following up the strategy. In addition, efforts should be made to secure special allocations for this purpose over the budgets of the different sectoral ministries. The aggregate growth in allocations will be an important contribution to Norway's trans-Atlantic R&D collaboration, providing incentives for enduring contacts and active cooperation.

5.2 Further follow-up

This strategy extends beyond the Ministry of Education and Research's primary spheres of responsibility and will be normative for all the ministries' activities in relation to R&D collaboration with the U.S. and Canada.

The *Ministry of Education and Research* will implement the strategy in its particular spheres of responsibility. The Ministry of Education and Research has the administrative responsibility for the Research Council of Norway, which will be assigned the main responsibility for implementing the strategy. The Ministry will take steps to evaluate the idea of establishing a number of endowed professorships (chairs) and part-time positions through reciprocal cooperation schemes.

The Ministry of Education and Research is also responsible for subsidy schemes for study abroad through the State Educational Loan Fund. The criteria for support for studies abroad have been expanded. In the years ahead, the Ministry will assess the impact of this in relation to applications for studies in North America.

All the ministries that bear responsibility for research in relevant fields are responsible for following up this strategy in their respective sectors, in collaboration with the Research Council, Innovation Norway and other professional bodies. The Ministry of Education and Research bears the main responsibility for coordination and overall public relations for the strategy.

The Ministry of Education and Research will ask the Research Council of Norway to undertake the main responsibility for the further follow-up and implementation of the strategy. Where relevant, follow-up should take place in collaboration with Innovation Norway.

The Ministry of Education and Research intends to collaborate closely with the other ministries involved on the further follow-up of the strategy. This refers in particular to the Ministry of Trade and Industry, as the ministry in charge of Innovation Norway.

The Research Council of Norway

The Research Council of Norway bears responsibility for advising the Norwegian government, the Ministry of Education and Research and other ministries on research issues. The Research Council must organize more funding for R&D collaboration with North America and channel it into activities and programs, and ensure expedient reporting on how that funding is actually spent. The Research Council must also ensure expedient routines for reporting results, both with a view to annual reports and the future evaluation of the strategy.

The Research Council of Norway is being asked to:

1. Devise proposals for thematic areas of collaboration, together with the ministries involved and research groups, cf. Chapter 3.2. In principle, the initiatives ought to cover all types of R&D activities, from long-term basic research to applied research and innovation. Furthermore, the Research Council should implement special measures to increase mobility between researchers in Norway, the U.S. and Canada, as described in the measures outlined in Chapter 4.1. The Research Council is asked to submit a more specific plan regarding how this can be put into practice.
2. Evaluate which initiatives can be implemented to enhance knowledge and information about research and development work in North America, in collaboration with Innovation Norway and the Norwegian embassies in Washington, D.C. and Ottawa, cf. Chapter 4.3. The evaluation will be presented to the ministries involved.
3. Cooperate closely with the ministries involved, Innovation Norway, R&D institutions and their representatives, and the Norwegian embassies in Washington, D.C. and Ottawa on the implementation and follow-up of the strategy.

Innovation Norway

Innovation Norway has a general responsibility in relation to industrial initiatives. In the further follow-up of this strategy, Innovation Norway must maintain close contact with the Research Council of Norway and other relevant bodies.

The Ministry recommends that Innovation Norway work out the specific content of the relevant measures, and ensure expedient reporting on the use of the funding and the results obtained. The reporting of results must also lend itself for use in a future evaluation of the strategy.

Innovation Norway should:

1. Develop and expand the schemes that address training, through schools of entrepreneurship, excursions or in other ways.
2. Consider establishing channels to promote the technological and commercial development of Norwegian enterprises, in consultation with the Research Council of Norway and other relevant bodies, cf. the measures in Chapter 4.2 and, on an ongoing basis, assess other relevant initiatives designed to enhance collaboration with the U.S. and Canada on R&D-based economic development and the commercialization of R&D.
3. Cooperate with the ministries involved, the Research Council of Norway, relevant segments of the business community and the Norwegian embassies on the implementation and follow-up of the measures in the strategy.

The embassies in Washington, D.C. and Ottawa

In addition to their contact with the North American authorities, the embassies are also important contact points in relation to American and Canadian research. Closer integration of Innovation Norway's activities into the embassies' activities would contribute to stronger, better coordinated profiling of Norwegian research in respect of the U.S. and Canada.

The embassies should:

Further develop the Science and Technology Fora and strengthen their cooperation with the Research Council of Norway, Innovation Norway and other relevant institutions and organizations with a view to coordinating measures to intensify trans-Atlantic R&D collaboration.

Appendix I

**Terms of reference for the framing of a general strategy for
Norway's scientific and technological cooperation with
North America**

Objectives

- a) The strategy is intended to stimulate collaboration and contact between Norwegian and North American R&D institutions, enterprises and research communities.
- b) The strategy will cover research and development work and is intended to contribute to revitalisation and quality enhancement through contact and collaboration between Norwegian and North American R&D institutions and communities. It will also include innovation and the commercialization of research related to especially promising R&D fields and results.
- c) The strategy will embrace Norway, the U.S. and Canada.

Contents

The strategy will result in a special report which, in addition to the strategy per se, will also include a description of the current situation for Norway's R&D cooperation with North America.

- a) The status report will include the following main elements:
 - A brief description of Norway's collaboration on R&D or R&D-related activities with the U.S. and Canada, including how the collaboration has developed over time and the current situation;
 - A brief discussion of some other countries' (e.g. Sweden, Finland, The Netherlands and other countries of interest) priorities and the R&D-related initiatives they have taken in respect of North America.
- b) The report will specify which challenges to Norwegian R&D activities this strategy is intended to address and which requirements it is to cover, based, among other things, on contacts with different specialist groups.
- c) Main elements of the strategy:
 - Specific objectives and priorities;
 - Different forms and models for contact and collaboration, e.g. between individuals, research groups and institutions, possibly also forms of cooperation that involve Third Party States;
 - The stakeholders designated as key players in the implementation of the strategy;
 - Budgetary consequences, instruments and initiatives.

Implementation

A steering group will be appointed. It will consist of representatives of the following ministries, institutions and organizations²⁷:

- The Ministry of Education and Research (Chair)
- The Ministry of Trade and Industry
- The Ministry of Petroleum and Energy
- The Ministry of Health
- The Ministry of Social Affairs
- The Ministry of the Environment
- The Ministry of Transport and Communications
- The Ministry of Fisheries
- The Ministry of Agriculture
- The Ministry of Foreign Affairs
- The Ministry of Defence
- The Research Council of Norway

²⁷ Norway reorganized some of its ministries in 2004. For an updated list, please see: <http://www.odin.no/odin/global/depliste-en/bn.html>

- The Norwegian Council for Higher Education
- Innovation Norway
- The Norwegian Industrial Research Institute Association

As a strategic body, the Research Council of Norway bears special responsibility for proposing priorities.

Close contact will be maintained with the science counselor in Washington, D.C. in connection with the implementation and with the Norwegian research and technology forum in the U.S. and Canada, respectively. Through their activities, the embassies will also contribute to the strategic efforts.

Close contact should also be maintained with Innovation Norway's technology attachés in the U.S. and Canada, as they will be important facilitators in this context. In particular, the technology attachés will contribute to the strategy on issues related to innovation and the commercialization of research results. Innovation Norway/the technology attachés will contribute to the development of the strategy at their own expense.

The strategy will be shaped through a dialogue with the specialist groups involved.

Besides discussions in meetings, the steering group's members will provide input in their specialist fields and ensure that the strategy has a firm grounding in their respective ministries and institutions.

Meeting costs and travel expenses, if any, will be covered by the respective ministries and institutions.

The Ministry of Education and Research will serve as coordinator, bearing the overall responsibility for the work and convening meetings as needed. The Ministry of Education and Research will endorse a draft strategy following a round of consultations.

Routine project management

The Research Council will provide a project manager to be responsible for drafting the strategy within a time frame of roughly four months.

The Ministry of Education and Research will cover the salary of the project manager. The Research Council will make funding available for minor studies, special travel, etc.

The project manager will work for the Ministry of Education and Research, the coordinating body responsible for the report.

Deadline

The work is to be completed by April 1, 2004.