NORWEGIAN MINISTRY
OF EDUCATION AND RESEARCH

Report

Research Barometer 2013

International Cooperation in Norwegian Research

The Research Barometer 2013

The Research Barometer (*Forskningsbarometeret*) is a publication of the Norwegian Ministry of Education and Research, and has been published yearly since 2011.

The report, which also has an accompanying website, presents the latest figures on a broad set of indicators assessing research and innovation, and gives an international benchmarking of Norway's performance in these areas.

Each year the *Research Barometer* highlights one or more themes which are presented and analysed more in detail. The 2013 edition has a part devoted to internationalisation of research, of which this is an English edition.

Chapter 1 looks at international cooperation in a broader perspective, with the aim of providing an overview of Norwegian participation in international research cooperation and a basis for discussion on how this cooperation should be further developed. Chapter 2 covers the main theme of this year's *Research Barometer* report: Norwegian participation in the EU Seventh Framework Programme.

In the *Research Barometer*, the following five countries have been selected as reference countries and figure in many of the comparisons: Austria and the Netherlands and the Nordic countries of Denmark, Finland and Sweden. These are similar to Norway in many respects, and provide a meaningful basis for comparison in the context of research and development.

International perspectives – main findings

Motivation and approach

With R&D expenditures totalling less than 0.5 per cent of the overall global total, Norway is one of the world's smaller research nations. At the same time, Norway has an open, competitive and highly adaptable economy. Thus it is obvious that Norwegian research environments must cooperate internationally to acquire and further develop knowledge and know-how at an advanced international level. The rapid pace of globalisation and the emergence of new, dynamic research actors on the global scientific arena are also forcing Norwegian research organisations to work more systematically to develop their international cooperation profiles and strategies.

The Norwegian government promotes international research cooperation by covering contributions to multilateral research programmes, particularly the EU framework programmes; by funding national research programmes and other instruments at the Research Council of Norway; and by providing basic funding to public research-performing institutions.

In May 2013 the Government announced that Norway will participate fully in Horizon 2020 – The Framework Programme for Research and Innovation (2014–2020). *The Research Barometer* provides an analysis of Norwegian participation in the EU Seventh Framework Programme that can be used as a basis for discussing potential objectives and measures for Horizon 2020.

International cooperation

Which countries do researchers in Norway collaborate with the most? What characterises cooperation with these countries? Chapter 1 presents an overview of international cooperation between researchers in Norway and researchers in 13 selected countries. These countries comprise large established knowledge nations: the US, Germany, United Kingdom, France and Japan; Norway's

Nordic neighbours: Sweden, Denmark and Finland; and the BRICS countries: Brazil, the Russian Federation, India, China and South Africa.

The overview is based on three different data sources:

1 international cooperation as reported by researchers extracted from the project archive database of the Research Council of Norway (RCN);
2 articles co-published by researchers in Norway with one or more authors from the selected countries (co-authorship);
3 cooperation on projects under the EU framework programme with countries that are not member states or associated countries.

All in all, the US is the most important individual country for researchers in Norway, both when it comes to cooperation through projects funded by the RCN and when it comes to the number of co-authored articles. However, if cooperation with all of the EU member states is combined, the total makes it Norway's most extensive and important partner by far. Viewed in relation to the size of the countries, cooperation with the other Nordic countries is the strongest. This is not surprising, given the countries' geographical and linguistic proximity, high R&D intensity and qualitatively good research communities in addition to their shared culture and history.

Cooperation with the BRICS countries is significantly smaller in volume, yet appears to be increasing the most. This is natural, given that these countries are emerging as important actors in global research cooperation. While the level of cooperation with Japan is low, it remains relatively stable. There is, however, well-developed institutional collaboration with Japan in the fields of nanotechnology and energy in particular.

There are indications that the country-specific activities under the auspices of the RCN play a vital role in promoting research cooperation with India and South Africa. There is significant cooperation with Brazil and the Russian Federation under thematic programmes focusing on energy research and polar research, respectively. Cooperation with China primarily takes place via independent projects and under several of the Large-Scale Programmes.

The figures show that researchers affiliated with industry cooperate most extensively with the leading research nations in Europe and the US and only to a limited extent with the BRICS countries. This is also supported by findings for industry-oriented projects funded through the RCN (primarily under the Programme on User-Driven Research-Based Innovation (BIA)), which report little cooperation with South Africa and India in particular but extensive cooperation with Germany and the Nordic countries. Conversely, researchers in the higher education sector report a large proportion of projects involving cooperation with the BRICS countries. A particularly large number of projects in the institute sector feature cooperation with Brazil. This is due in part to the SINTEF Group's presence in that country.

By looking at the number of co-authored articles and collaborative projects under the EU framework programmes, it is possible to compare figures for researchers in Norway with figures for researchers in other countries. In Figures 9, 10 and 12, the international cooperation patterns of the reference countries of the *Research Barometer* are compared.

In general, researchers in Norway tend to prioritise cooperation with many of the same countries as the reference countries, but there are certain differences. Norway appears to cooperate more closely with South Africa and the Russian Federation than most of the other reference countries. Cooperation with researchers in China, on the other hand, appears to be weaker for researchers in Norway than for researchers in the other countries. Although Denmark appears to cooperate extensively with China and the US under the EU framework programme, this is not reflected in the number of co-publications. On the whole, there is relatively little cooperation between the reference countries and India, Brazil, China and Japan.

The high values in the citation index for internationally co-authored articles presented at the end of Chapter 1 indicate that international cooperation has resulted in greater scientific impact for Norway. This is a good enough argument in itself for continuing efforts to increase the internationalisation of Norwegian research.

Norwegian participation in the EU framework programmes
The Seventh Framework Programme of the European Community for research, technological development and demonstration activities (FP7) is the world's largest research programme, encompassing activities from explorative and basic research and applied research aimed at small and medium-sized enterprises to mobility grants for talented researchers. Both the standard of quality and the relevance for Norwegian research of the research conducted under FP7 is considered high. Further, researchers in Norway have the same rights and obligations of participation as researchers in the member states. They have made good use of these; among other things, a large number of Norwegian participants are coordinators in their FP7 projects. Viewed together, this confirms that the EU framework programmes are a key instrument for promoting internationalisation in large segments of the Norwegian research community.

Adjusted for the size of the national R&D system, researchers in Norway have an equal or higher rate of participation in FP7 projects than researchers in the other Nordic countries. The Netherlands and Switzerland have consistently higher participation rates than Norway. The growth in EU contribution, however, has been weaker for Norway than for the other countries when comparing the 2002–2004 and 2010–2012 periods.

The fact that proposals involving researchers in Norway have a high success rate shows that the researchers are participating in consortia of high quality.

Looking at participation distributed among the individual themes under FP7, there is significant variation in participation. Researchers in Norway show strong participation in the themes on environmental, energy, security, food, space and social science research. Norwegian participation is also strong under the SME theme, which is tailored to the needs of small and medium-sized enterprises (SMEs). There is a relatively low rate of participation under the ICT and Health themes, which are the largest, the European Research Council (ERC), and the People programme, which focuses on researcher mobility.

The Norwegian higher education sector (including the university hospitals) receives a smaller EU contribution than the corresponding sector in the other reference countries (normalised for R&D size in that sector), while the Norwegian industrial sector receives a larger contribution than the other countries (measured in the same manner). The Norwegian institute sector accounts for the largest proportion of the EU contribution.

The SINTEF Group, the University of Oslo (UiO), the University of Bergen (UiB) and the Norwegian University of Science and Technology (NTNU) account for roughly one-half of the EU contribution to Norway under FP7. Adjusted for R&D size, Nansen Environmental and Remote Sensing Center, Gjøvik University College and the Norwegian Institute for Air Research (NILU) participate more intensively in FP7. DNV is the Norwegian company that participates most actively in FP7. MARLO AS is the Norwegian SME that participates most actively in FP7 and is among the 20 most active SMEs in the reference countries.

Chapter 2 also looks at which institutions in the reference countries receive the largest EU contribution. VTT Technical Research Centre of Finland receives the most funding, while the SINTEF Group (ranked 11th) is the only Norwegian actor among the top 20 recipients. When comparing the Nordic universities, Karolinska Institutet ranks highest, with UiO, NTNU and UiB in 11th, 13th and 15th place, respectively. UiO receives 50 per cent of its contribution under the ERC, and is thus the institution with the strongest ERC profile. Normalised on the basis of the number of academic personnel, UiB tops the list of general universities, while NTNU is ranked lower than the other technical universities in the reference countries. SINTEF lies behind VTT but ahead of the Dutch institute TNO (when normalised for turnover). There are no companies among the 20 institutions that receive the largest EU contribution. While there are three companies (Philips, Ericsson and Volvo) among the 20 most active actors from the reference countries under the ICT theme, the technical-industrial institutes (SINTEF is number three) and the universities (none of which are Norwegian) dominate here as well.

Given the generally weak growth in Norwegian participation compared with the other reference countries (2002–2004/2010–2012), the low participation rate under the large themes and the varying rate of participation at the sectoral and institutional levels, it is clear there is potential for boosting Norwegian participation under the EU framework programme.

Chapter 2 also discusses various methods of calculating the financial returns. Regardless of the method used, and in contrast to the other reference countries, Norway is a net contributor. The level and development of Norway's GDP is one important explanation for this.

Horizon 2020 will continue to use many of the same tools and instruments employed under previous framework programmes. Collaborative projects across participating countries will still be a main activity under Horizon 2020. At the same time the new framework programme represents a clear departure from earlier practice. Instead of using the thematic-oriented structure of previous framework programmes Horizon 2020 will be targeted towards interdisciplinary research aimed at solving societal challenges. Innovation activities are to be better integrated into Horizon 2020 than its predecessors. Horizon 2020 is being designed as a key instrument for developing the European Research Area (ERA). The budget of Horizon 2020 is expected to be roughly 50 per cent larger than the FP7 budget.

In this light, Horizon 2020 will offer both new opportunities for, and new challenges to, Norwegian participants.

1 International research cooperation

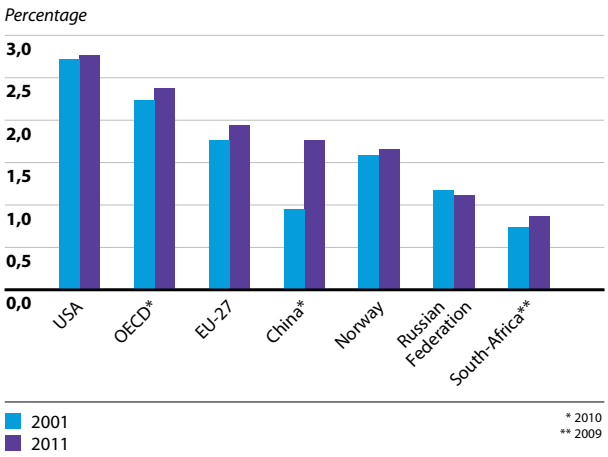
1.1 Premises for international cooperation

The white paper Meld. St. 18 (2012–2013) *Long-term perspectives – knowledge provides opportunity*, from the Ministry of Education and Research, confirms that international research cooperation is a top priority of Norwegian research policy. It is an objective of Norwegian research to generate new knowledge that benefits the global community as well as to ensure that Norway utilises knowledge developed abroad. It is therefore crucial that government authorities, research institutions and companies create a framework that enables researchers to participate in international research cooperation.

This chapter on international cooperation looks mainly at the countries with which researchers in Norway have the most extensive cooperation and what this cooperation consists of. In addition, an effort is made to explore the links between research cooperation that takes place at the governmental level and the cooperation taking place between researchers.

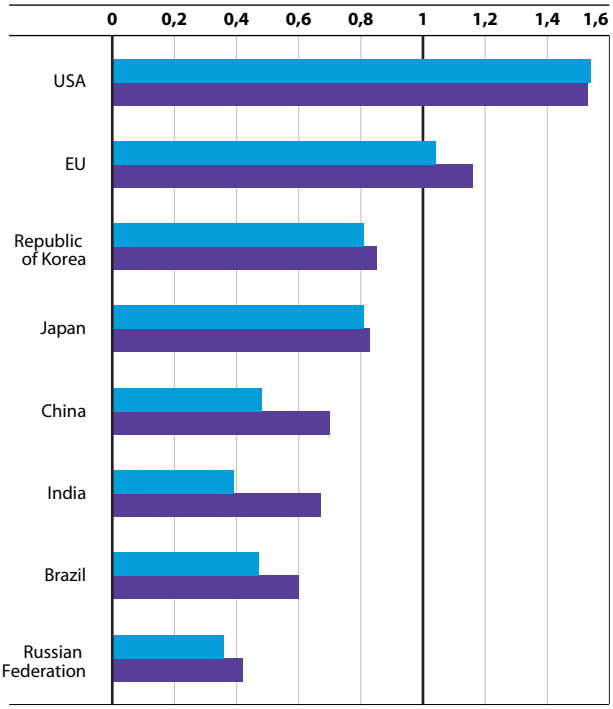
1
Total R&D expenditures as a percentage of GDP

Source: OECD *Main Science and Technology Indicators* 2012:2 and NIFU/SSB



2
Relative share of the 10 per cent most-cited publications worldwide

Source: European Commission: *Innovation Union Competitiveness Report: 2011 Edition*



1.2 Trends in international cooperation

The global research and innovation landscape is shifting. Emerging economies, especially the Republic of Korea and the BRICS countries (Brazil, the Russian Federation, India, China and South Africa), are devoting increasingly greater effort to becoming leading research nations, and are seeking to challenge the hegemony of the US, Europe and Japan. Figure 1 shows the development in total expenditures on research and development activity as a percentage of GDP in selected countries. From 2001

to 2011, China has increased its R&D expenditures dramatically compared with the other countries, while at the same time it has experienced the largest growth in GDP. Similarly, Figure 2 shows that investments by the BRICS countries also appear to have produced results, as their share of the 10 per cent most-cited scientific articles on a worldwide basis has increased during this period. The US and Japan show little or no increase during the period, whereas the EU shows a substantial increase. The figures have been normalised for the overall number of scientific articles published by the countries. Thus it appears that the BRICS countries will be playing a more important role in the future in the area of research as well, with the most rapid-paced change seen in China. Even so, it is only the US and the EU whose share of the most-cited publications exceeds their share of the total number of publications.

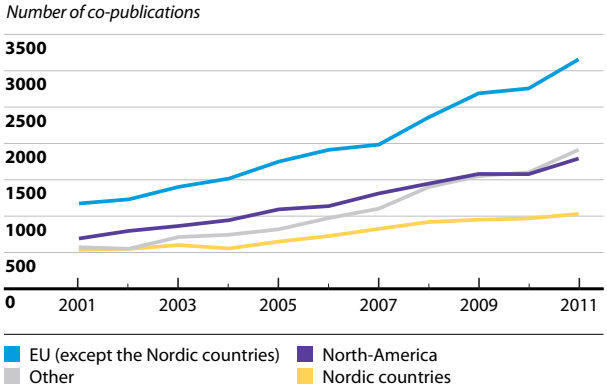
1.3 Research cooperation at the governmental and institutional levels

For many years international research cooperation has been characterised by individual researchers from different countries making contact with each other through scientific dialogue. However, the intensity, focus and substance of such cooperation may be influenced by government authorities, research institutions, companies and research-funding agencies. This may occur in several ways, for example: bilaterally, with two countries signing an agreement on research cooperation; or multilaterally, with several countries participating in and funding cooperation under joint research programmes such as the EU framework programmes; or through the establishment of multilateral research institutions such as the European Organisation for Nuclear Research (CERN) or the European Molecular Biology Laboratory (EMBL).

Bibliometric data indicate that the pattern of international cooperation is becoming increasingly complex and that researchers in Norway are cooperating with a growing

3
Norwegian articles with international co-authorship, grouped by four geographic areas

Source: Research Council of Norway: *Science & Technology Indicators for Norway 2012*



number of researchers from other countries who work in larger, more global networks. Figure 3 shows the development in the number of articles researchers in Norway co-publish with one or more authors from abroad. The largest increase is seen in cooperation between researchers in Norway and researchers from the EU, but the category of "Other", which includes the BRICS countries, rose substantially in the last part of the period. The reasons behind this development are multi-faceted. Rising international co-authorship is a trend found in many countries. An ever larger share of public R&D funding is also related to multilateral cooperation activities that either involve the establishment, development and use of advanced scientific infrastructure or programme cooperation across national borders. Figure 4 shows that Norway's expenditures related to membership fees for such multilateral cooperation through EU research cooperation, CERN, the European Space Agency (ESA), etc. have doubled from 2005 to 2011.

Participation in multilateral cooperation gives researchers in Norway access to advanced equipment and the exper-

Table 1.1 Overview of country-specific funding instruments under the Research Council of Norway

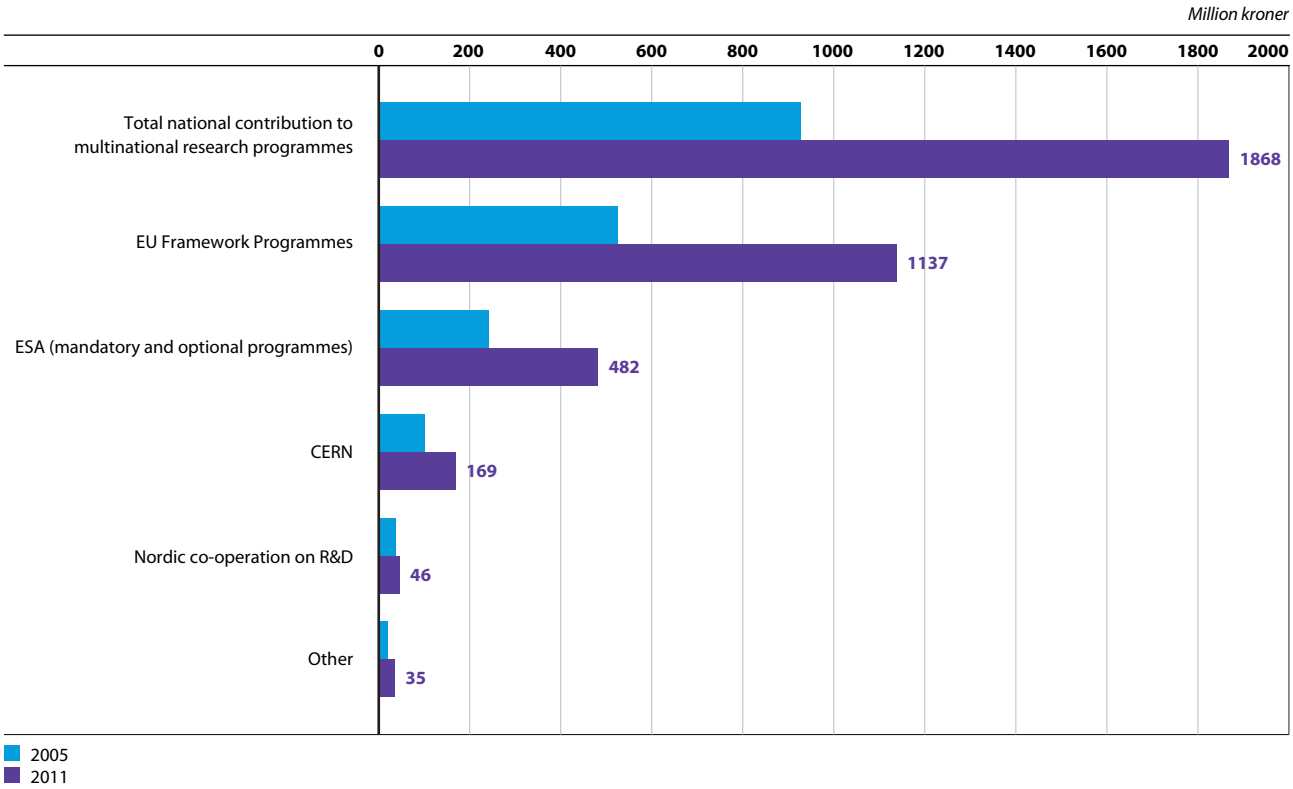
Country	*Programme*	*Period*	*No. of projects*[1]	*Budget*[2] *(in NOK mill.)*	*Thematic area*
India	INDNOR	2009–17	24	200	Climate, the environment, clean energy, welfare and society
China	CHINOR	2009–17	33	200	Climate, climate technology, the environment, welfare
South-Africa	SOUTHAFRICA	2006–11	27	40	Health, ICT, the environment, society, energy
	SANCOOP	2013–17	–	40	Climate, society, clean energy
The Rusian Federation	NORRUSS	2011–16	3	105	The High North, society

Source: Research Council of Norway

1. Projects that were in progress or concluded as of 31 December 2012.
2. Estimate for the entire period. The total per year may vary and the budget may change.

4
National contribution to multinational research programmes
Allocations in approved national budget

Source: NIFU



tise they need to become international leaders in their subject fields. In particular, participation in the EU framework programmes is becoming more important as research cooperation within the EU is expanding and becoming more integrated. Details about Norwegian participation in EU research cooperation are discussed in Chapter 2 of this document. Participation in the ESA also contributes to the development of a competitive space-related industry in Norway and to building space technology competence within Norwegian public administration and industry. Multilateral cooperation may help to establish researcher networks that are continued and further developed through cooperation at the research group level.

At the governmental level Norway has entered into bilateral research agreements with the US, India, China, South Africa and Japan and signed a letter of intent with Brazil. A separate research agreement is being negotiated with the Russian Federation. Bilateral agreements incorporating research cooperation as a component have been signed as well. In recent years Norway has drawn up cross-ministerial country strategies for Brazil, China and India in which research cooperation plays a key role. Government-initiated bilateral research cooperation is aimed primarily at developing cooperation with the BRICS countries, the US and Canada, whereas cooperation with European countries takes place mainly through multilateral cooperation. In Europe, Norway has a separate research agreement with France, and the research-related part of the EEA grants/Norway grants funding scheme entails bilateral research cooperation with Poland, Estonia, Latvia, the Czech Republic, Hungary and Romania.

A limited amount of funding has been earmarked for the follow up of government-initiated agreements. Thus, at the Research Council of Norway (RCN), efforts to promote international research cooperation primarily take place as an integral part of all activities. There are some exceptions, however. The EEA funding schemes have significant funding for developing cooperation with the countries involved. Country-specific programmes under the RCN have been established as a means of following up the country strategies for China and India, as well as the white paper on The High North. Table 1.1 provides an overview of these programmes, which appear to be vital to the development of research cooperation with the specific countries covered (see Section 1.4 for details). In addition, separate mobility programmes provide support for researcher exchange between countries. One example of this is the Leiv Eriksson mobility programme, which provides funding for researcher exchange between Norway and the US or Canada.

In addition to the efforts carried out under the auspices of the authorities, companies and research institutions, too, develop their own research cooperation. This comprises a large and important segment of international research cooperation, but it is not as easy to gain an overview of these activities. It is especially difficult to find out how much funding the companies or institutions use to follow up cooperation, in part because it is not reported in a systematic manner.

Therefore, in sum this report presents an overview of Norwegian international research cooperation by drawing on three different data sources:

1 cooperation through projects funded by the Research Council of Norway (RCN) as reported by researchers (Section 1.4);
2 bibliometric analysis of co-authorship (Section 1.5);
3 projects with third countries under the EU Framework Programme for Research (Section 1.6).

It is possible to extract information on international cooperation that takes place as part of research projects under the RCN . This is partly because researchers receiving funding from the RCN are required to submit an annual project report on how the funding was used. In these reports the project manager provides information about the countries involved in the project. This makes it possible to pinpoint the specific countries that the researchers cooperate with, the countries towards which the programmes under the RCN are targeted, and the research-performing sectors that are dominant within the various cooperating countries. It is nonetheless important to note that this does not give a complete picture of all cooperative activity. For instance, the project reports do not state what type of cooperation is involved or the level of activity. Moreover, each project will often involve cooperation with several countries, but the extent of the cooperation with the various countries is not specified.

The objective of this part of the *Research Barometer* is to identify the countries that researchers in Norway cooperate with most extensively, and to describe some features of this cooperation. However, since a great deal of the overall cooperation taking place is not encompassed by the RCN reporting system, these reports do not provide an adequate basis on their own.

Regardless of the type of institution and source of funding, scientific cooperation often results in articles that are published in international journals. Thus, it will give added weight to view the data from the cooperation reported under the RCN in connection with a bibliometric co-publication analysis, which is not based on any particular funding source. Furthermore, an important component of the *Research Barometer* is to compare Norwegian conditions with conditions in other countries. This can be achieved by employing bibliometric analysis.

E-CORDA, the European Commission's database of projects approved for funding under the EU framework programmes, makes it possible to obtain information about the number of EU projects involving cooperation with countries outside the EU, known as third countries. Projects of this type under the EU have a strong cooperative component in which all participants sign a contract obligating them to take part. This is different from cooperation reported by researchers to the RCN, which may be of a more informal nature. Chapter 2 provides more detailed information about the EU framework programmes.

1.4 Cooperation reported via projects under the Research Council of Norway

To explore international research cooperation reported via the RCN, 13 countries have been selected, of which seven are in Europe, three in Asia, two in the Americas and one in Africa. These countries do not represent Norway's 13 top countries for research cooperation. Many of the countries that researchers in Norway cooperate with extensively are not mentioned, but this does not imply that such cooperation is seen as unimportant. For example, a number of European countries and Canada are omitted.

Figures 5a and 5b show the development in cooperation reported for the 13 selected countries. All the countries show an increase in cooperation reported during the period. A general reason for this may be a trend towards the end of the period in which cooperation with several countries is incorporated into each project. It is also important to take into account that the method of data collection has changed somewhat during the period.

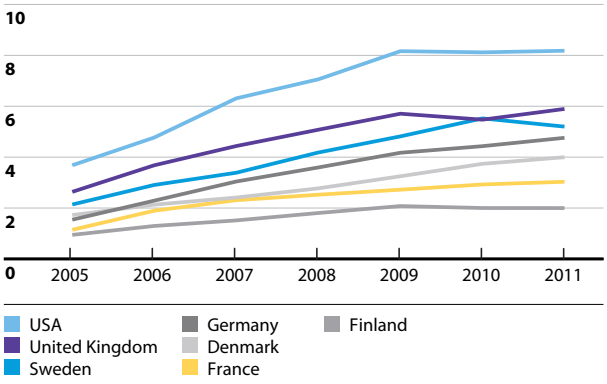
In 2005, the RCN launched a new funding scheme – Bilateral research cooperation – project establishment support (BILAT) – to expand cooperation with strategically important countries. From 2005 to 2007 this scheme provided funding for 321 projects designed to promote research cooperation with the US, Canada, China, Japan and India. This scheme alone may have led to an increase in cooperation with these countries. It is otherwise important to note that the proportion of projects not reporting any international cooperation is stable at 30 to 35 per cent during the entire period.

The 13 countries may be divided into two groups. Figure 5a shows the seven countries that have the most research cooperation with Norway: United States, United Kingdom, Sweden, Germany, Denmark, France and Finland. Significant cooperation with Italy and the Netherlands is also reported. In 2011, approximately eight per cent of all RCN projects involved some form of cooperation with the

5
Cooperation in projects funded by the Research Council of Norway (RCN), by country of collaborator
Percentage of total number of projects

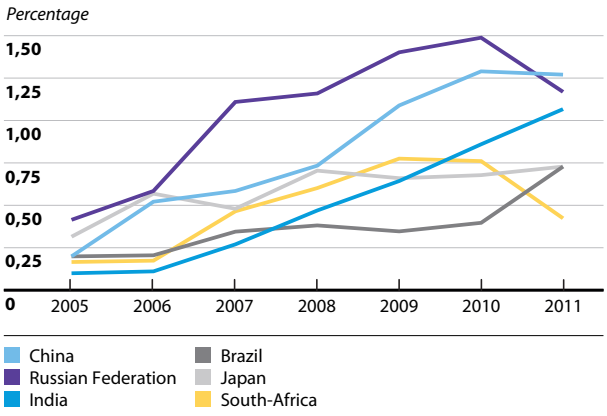
a)

Source: Research Council of Norway



b)

Source: Research Council of Norway

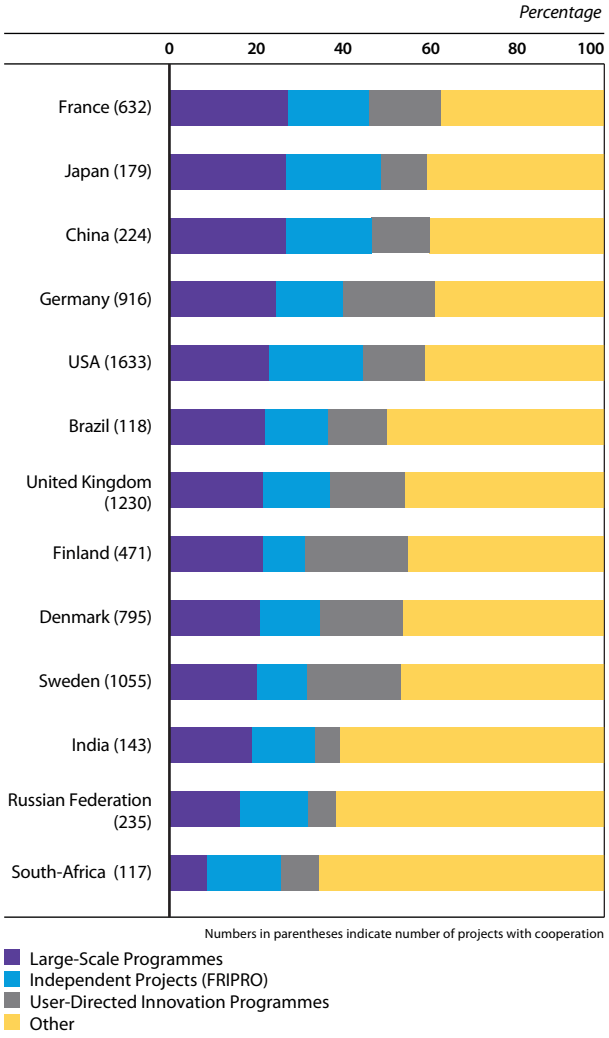


US. The overall increase for the European countries may be due to the greater integration of research cooperation in Europe, in part through the development of the European Research Area (ERA) and the increase in the size and significance of the EU framework programmes.

The other group, shown in Figure 5b, consists of China, the Russian Federation, India, Brazil, Japan and South Africa. While cooperation with these countries is shown to be less in terms of volume, the authorities regard it as strategically important. Figures 1 and 2 also indicate that several of these countries will play an increasingly vital global role in the future. In 2011, for example, only slightly more than one per cent of the projects reported cooperation with researchers in India. Even so, cooperation with these countries has shown a far greater rise than for the others, although there is wide variation between the various countries. Since the number of projects is small, the fluctuations from year to year are pronounced. It is nonetheless possible to find explanations for the various

6
Cooperation in projects funded by the RCN, by programme type
Percentage of projects per country for the 2005–2011 period

Source: Research Council of Norway



fluctuations. The country-specific programmes under the RCN (see Table 1.1) and the BILAT scheme mentioned above have most likely steered cooperation in a positive direction for the countries involved. In addition, cooperation with the Russian Federation escalated dramatically in connection with the International Polar Year (IPY) which began in 2007 and ran until 2009. A large amount of extra funding was set aside for this initiative, and a designated funding instrument was established under the RCN. A large proportion of the projects submitting reports in the 2007–2009 period were encompassed under this.

The RCN has had a dedicated programme to promote research cooperation with South Africa for over 10 years. Most of the projects from this programme were concluded in 2009 and 2010, so it is natural that the reported cooperation would decline towards the end of the period. A new programme on South Africa is being launched in 2013,

and cooperation can therefore be expected to increase in the future. Japan is the country with the least growth in reported cooperation. This may be related to the limited number of targeted stimulation measures for promoting collaborative activities with Japan.

Funding instruments under the Research Council of Norway

The RCN has a variety of programmes and activities through which research projects are funded.[3] Figure 6 shows how much, in percentage, the three largest funding instruments at the RCN (Large-Scale Programmes, FRIPRO and User-Directed Innovation Programmes) represent in relation to the total amount of cooperation in the 13 selected countries for the 2005–2011 period. Projects that run over several years are registered only once. The Large-Scale Programme initiative consists of seven thematically oriented programmes with sizeable budgets that address global societal challenges and areas in which Norway has special advantages.[4] The FRIPRO Funding Scheme for Independent Projects is an open competitive arena extending across all subject fields, with scientific merit used as the key criterion on which funding decisions are based. User-Directed Innovation Programmes are targeted directly towards companies seeking to develop their business activities. This funding instrument plays a key role in the RCN's activities to promote industry-oriented research and innovation. A large share of this category consists of projects funded under the Programme on User-Driven Research-Based Innovation (BIA). For South Africa, the Russian Federation and India, the percentage of projects in the category "Other" is considerably higher than for other countries. With regard to South Africa and India, the data show that a large share of the cooperation is tied to the country-specific South Africa-Norway Programme on Research Cooperation (SOUTHAFRICA) and the Programme on Research Cooperation with India (INDNOR). For cooperation with the Russian Federation, much of the cooperation comes from the research programme targeted towards the Northern Areas and the now concluded programme for the Norwegian part of the International Polar Year. France, China and Japan are the three countries in which cooperation is most closely tied to the Large-Scale Programmes.

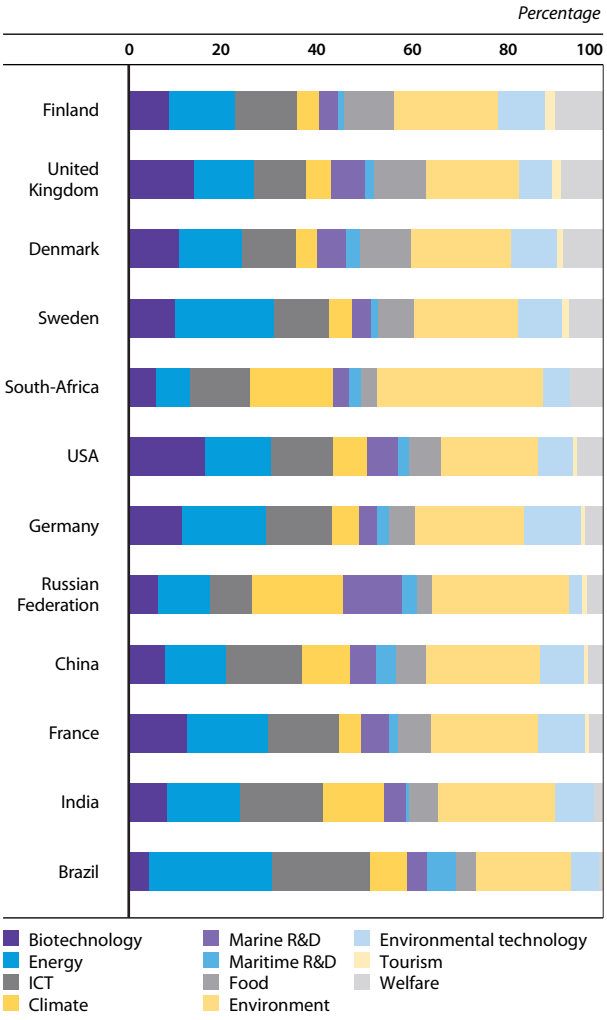
Thematic orientation

In general, thematic orientation is not indicated in the project reports, but the RCN has reviewed the funded projects and placed them into a set of pre-defined thematic areas. The projects are classified into 11 thematic categories that are not linked to academic disciplines. A project will often be assigned more than one thematic category. For instance, a project that employs biotechnological methods to develop new environmental technology could be assigned the categories of biotechnology, energy, environment, environmental technology and climate. The distribution by thematic category is shown in Figure 7. Not surprisingly, the broad thematic category of "environment" is largest for all the countries except for Brazil, where most of the cooperation falls under "energy". This corresponds well with the extensive cooperation on petroleum research between Norway and Brazil. It is important to emphasise that the figure does not provide a basis for comparing the degree of cooperation between countries. For example, overall cooperation in the thematic area of "energy" is far greater with the US and Germany than with Brazil.

7
Cooperation in projects funded by the RCN, by thematic area

Percentage of cooperation by thematic category per country for the 2005–2011 period

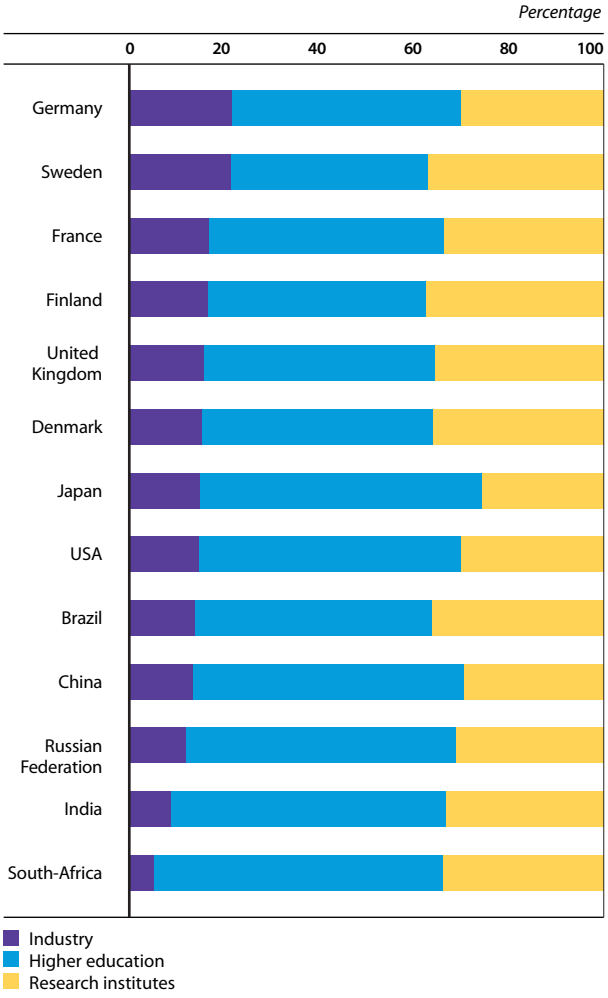
Source: Research Council of Norway



3. See www.rcn.no for a list of all the programmes funded under the Research Council of Norway.
4. The Large-Scale Programmes that were active in the 2005–2011 period are the Programme for Functional Genomics in Norway (FUGE), the Programme for Nanotechnology and New Materials (NANOMAT), the Programme for Aquaculture – An Industry in Growth (HAVBRUK), the Programme for the Optimal Management of Petroleum Resources (PETROMAKS), the Programme for Clean Energy for the Future (RENERGI), the Programme on Climate Change and Impacts in Norway (NORKLIMA) and the Programme on Core Competence and Value Creation in ICT (VERDIKT).

8
Cooperation in projects funded by the RCN, by performing sector
Project managers' sectoral affiliation for the 2005–2011 period, percentage

Source: Research Council of Norway



Distribution by sector

The sectoral affiliation of the responsible institution that has received project funding under the RCN is registered and may be linked to the cooperating countries reported by the project manager. Figure 8 shows in percentage how the projects are divided among the three major research-performing sectors. If the principal investigator's institution is a university hospital, the affiliated project is included in the higher education sector, whereas projects affiliated with other health trusts and private hospitals fall under the institute sector. The largest share of cooperation with these countries is found in the higher education sector, ahead of both the institute sector and industry. Of the RCN's total funding allocated to these sectors in the period, 44 per cent went to the institute sector, 39 per cent to the higher education sector and 16 per cent to industry. It is also important to keep in mind that many projects funded under the RCN are comprised of researchers from several sectors, but this fact is not captured in the figure. Also the figure only shows the share of the total projects and not the share of funding.

In general, there appear to be minor differences among the countries; however, South Africa and India stand out by having very few project managers from industry, but many from the higher education sector. The reason may be that many projects from these countries derive from the country-specific programmes, which have a generally low level of participation by industry. The largest participation by industry is found in projects involving cooperation with Germany and Sweden. The institute sector appears to have a somewhat low level of participation in projects involving cooperation with China and the US, but strong participation in projects involving cooperation with Brazil and the Nordic countries.

1.5 Bibliometric analysis of international co-publications

Scientific publication is often the end result of a research project. If two researchers from two different countries are co-authoring an article, this does not necessarily mean that they have cooperated extensively prior to publication. It is also possible for researchers to engage in active international cooperation without publishing articles together.

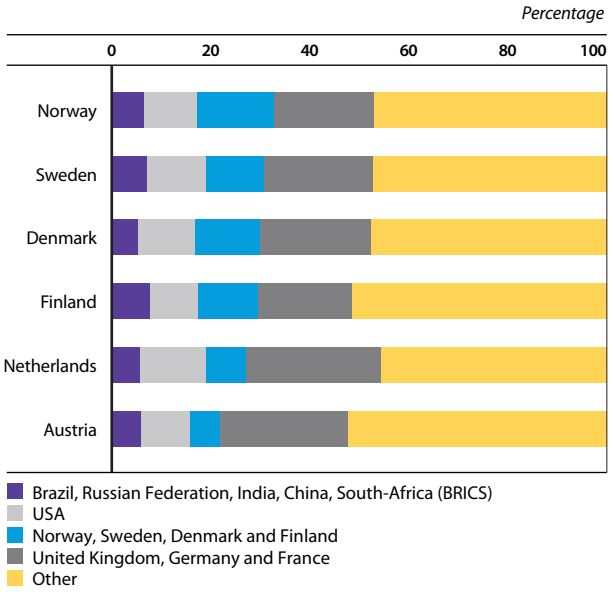
A review of the number of registered co-publications provides useful information about the key cooperating countries for researchers in Norway. In addition, it is possible to use publication data to compare the numbers for researchers in Norway with those of researchers in the other designated reference countries. Publication data are not based on the researchers' institutional affiliation or particular funding instruments, but rather on the scientific publication channels that are indexed in bibliographic databases. These databases are extensive, but they are not representative. Scientific publication is not a goal for researchers in industry, for instance, in the same way as it is for those in the higher education sector, nor do the databases cover all subject fields equally well.

Figure 9 shows the 13 selected countries with the most co-publications with researchers in Norway or one of the other reference countries in 2011. The countries are divided into groups for the sake of readability. The total number of published articles will of course vary considerably between each country; the Netherlands and Sweden are the two countries with the most co-publications with researchers in Norway.

All in all, the 13 selected countries comprise roughly 50 per cent of the total number of international co-authorship rela-

9
International co-authorship, by selected groups of cooperating countries, 2011, percentage

Source: Thomson Reuters/CWTS/NIFU



tions in all of the reference countries. Finland appears to have slightly less cooperation with these countries, whereas the Netherlands has slightly more. Relations between neighbouring countries appear to be a critical factor, as the Nordic countries publish many articles together. The same holds true for Germany and Austria. The differences between countries are otherwise relatively small.

Figure 10 presents a cooperation index which indicates the countries where cooperation is stronger or weaker viewed in relation to the amount of cooperation that is expected. When the various countries' overall cooperation activity is taken into account, the strength of Nordic cooperation becomes even more apparent. At the same time, the figure shows that Norway and South Africa have more cooperation than would be expected.

Comparable numbers for co-published articles in 2001 are not included in any figures, but they show that the percentage of articles published together with one of the BRICS countries has increased in relation to the total number of co-published articles from 2001 to 2011 in all the reference countries, whereas the percentage of co-published articles

10
Relative intensity of co-authorship between countries

Source: Thomson Reuters/CWTS/NIFU

	Norway	Sweden	Denmark	Finland	Netherlands	Austria
USA	0,82	0,91	0,89	0,75	1,01	0,74
United Kingdom	1,19	1,20	1,28	1,04	1,45	0,84
Germany	0,98	1,16	1,18	1,01	1,49	2,13
France	0,92	0,92	0,95	0,85	1,11	0,93
China	0,54	0,73	0,57	0,58	0,52	0,46
Russian Federation	1,05	0,97	0,60	1,83	0,65	1,06
Japan	0,62	0,71	0,57	0,75	0,62	0,65
South-Africa	1,54	1,04	0,86	0,48	1,04	0,69
Brazil	0,59	0,59	0,61	0,70	0,68	0,73
India	0,54	0,65	0,39	0,81	0,52	0,61
Norway		3,49	3,56	2,28	1,46	0,96
Sweden	3,49		3,00	2,91	1,35	1,06
Denmark	3,56	3,00		2,02	1,40	0,99
Finland	2,28	2,91	2,02		1,06	1,14
Netherlands	1,46	1,35	1,40	1,06		1,05
Austria	0,96	1,06	0,99	1,14	1,05	

Ratio of observed number of co-authorship links between the two countries and the total number of co-authorships links they have

with the US and the large research nations in Europe declined over the period.

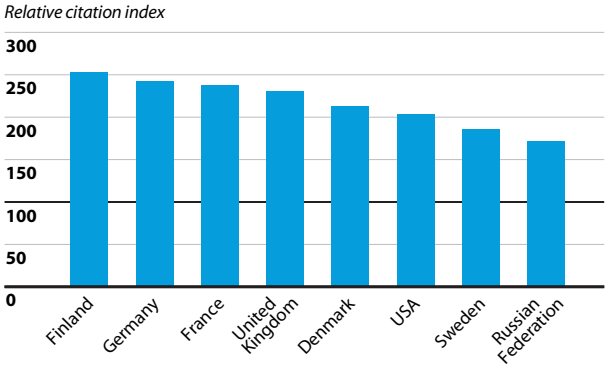
A citation index may be created by counting the number of times co-published articles are cited, thus giving an indication of the impact of these publications. Figure 11 shows a citation index for eight of the 13 selected countries in which the global average is set at 100. The index is weighted with regard to the individual country's relative distribution of articles in various scientific disciplines. Articles with international co-authorship are cited more on average than articles with only domestic authors. The values in the citation index for articles co-authored with researchers in Finland, Germany or France are almost twice as high as the Norwegian average value of 130. Publications co-authored with researchers in Sweden and the Russian Federation have the lowest values on the citation index of the eight countries with values of 160 and 170, respectively, but these are also considerably higher than the average for all Norwegian articles.

1.6 Research cooperation with third countries funded under the EU framework programme

The number of projects funded under the EU Seventh Framework Programme (FP7) with participants from countries outside the EU (third countries) provides a final reference to highlight cooperation profiles and differences between the countries that researchers in Norway and those in the reference countries cooperate with most extensively. This method of representing cooperation may be compared in many ways with the cooperation discussed above that takes place under the RCN (project cooperation). However, while the data from the RCN showed cooperation reported by the project managers themselves after the project had received funding, Figure 12 is based on EU projects in which researchers from various countries took part in the actual grant proposal. The figure shows the number of projects that the reference countries have with seven of the 13 selected countries as a percentage of the total number of projects for the respective reference countries. The level of active participation in the framework programme by third countries may also play a role here. For instance, the US participates much less in the framework programme relative to the volume of its R&D activity than does the Russian Federation. On this basis, researchers in Norway have the largest share of cooperation with the Russian Federation, South Africa, Brazil and Japan compared with the reference countries. Denmark participates in numerous projects with US researchers and has many projects with China as well.

11
Relative citation index for articles with Norwegian co-authorship by cooperating country

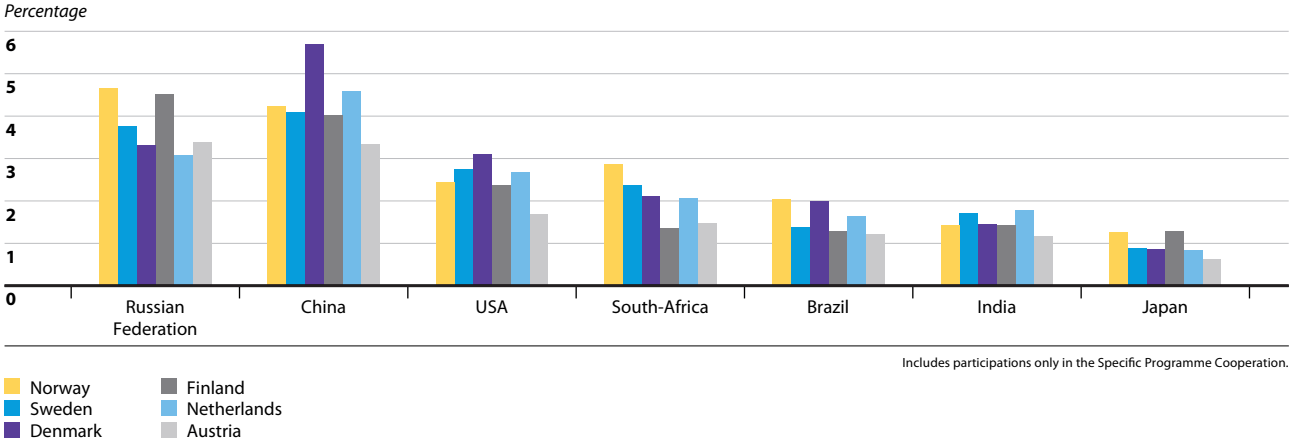
Kilde: Thomson Reuters/CWTS/NIFU



Cumulative citations up to and including 2011 for publications from the 2008–2010 period

12
Percentage of projects under FP7 with participation of reference country and third country

Source: European Commission: E-CORDA



Includes participations only in the Specific Programme Cooperation.

Participation in the EU framework programmes – a comparative perspective

2

Chapter 1 shows that research cooperation with a number of European and Nordic countries is extensive. Bibliometric data reveal a stronger increase in international cooperation between researchers in Norway and the EU compared with other parts of the world (see Figure 3). Although the factors behind this trend are complex, Norway's participation in the EU framework programmes appears to play a pivotal role. Expenditures in connection with the EU framework programmes also comprise a large proportion of the overall national expenditures for multilateral cooperation programmes and activities. These are good reasons to look more closely at the patterns of Norwegian participation in the framework programmes and to compare them with those of other countries. The new large-scale Framework Programme for Research and Innovation, Horizon 2020, will soon be launched, and it is important to analyse and reap experience from Norwegian participation in the current framework programme (FP7). What conclusions can be drawn about Norwegian participation today? In which areas are researchers in Norway most active? Which institutions participate the most? How successful is the Norwegian research community compared to research communities in other countries? This chapter seeks to shed light on these questions.

2.1 About the EU framework programmes

The Seventh Framework Programme of the European Community for research, technological development and demonstration activities (FP7) was launched at the beginning of 2007 and will run through 2013. It encompasses basic research as well as applied and industry-oriented research. FP7 seeks to achieve greater integration between European research policy and research funding and to forge strong ties between the most prominent research communities in Europe. The overall objective is to strengthen Europe's position as a leading research region and to enhance European competitiveness.

FP7 has a total budget of EUR 50.5 billion, which is administered via five Specific Programmes:[5]

1 Cooperation – ten large-scale thematic programmes for funding and promoting European research cooperation on health, food, energy, environment, information and communication technologies, and nanotechnologies, among others.
2 Ideas – a programme to support investigator-driven frontier research under the auspices of the European Research Council.
3 People – support for individual researchers to promote career development and researcher mobility via a set of Marie Curie Actions.
4 Capacities – support to strengthen research capacities in the form of research infrastructures, small and medium-sized enterprises, regional initiatives and international cooperation with third countries.
5 Joint Research Centre – the European Commission's in-house science service.

Table 2.1 provides an overview of how the budget is distributed among the Specific Programmes. Approximately eight per cent of the budget goes to cover the European Commission's administrative costs. If we subtract this plus the three per cent of the budget used to fund the Joint Research Centre (JRC) from the overall budget, there is approximately EUR 45 billion for allocation to researchers on a competitive basis.

The European Research Council (ERC) is an entirely new European research institution established in connection with the start-up of FP7 in 2007. The ERC's activities are part of FP7 and it primarily provides funding to researcher-initiated projects of the highest quality led by individual principal investigators. The ERC provides generous grants

5. Although the Euratom programme on nuclear research is not encompassed by the EEA Agreement, Norwegian researchers do participate in individual projects in the segment of the programme addressing radiation protection.

Table 2.1 Distribution of the budget among the Specific Programmes under FP7[6]

Name	Acronym	Budget (EUR m)	Percentage of total budget
I – Cooperation		*32 413*	*65*
Health	HEALTH	6 100	12
Food, Agriculture and Fisheries, and Biotechnology	BIO	1 935	4
Information and Communication Technologies	ICT	9 050	18
Nanosciences, Nanotechnologies, Materials and New Production Technologies	NMP	3 475	7
Energy	ENERGY	2 350	5
Environment (including Climate Change)	ENVIRONMENT	1 890	4
Transport (including Aeronautics)	TRANSPORT	4 160	8
Socio-economic Sciences and the Humanities	SSH	623	1
Security	SECURITY	1 400	3
Space	SPACE	1 430	3
II – Ideas	*ERC*	*7 510*	*15*
III – People	*MCA*	*4 750*	*9*
IV – Capacities		*4 097*	*8*
Research infrastructures	RI	1 715	3
Research for the benefit of small and medium-sized enterprises (SMEs)	SME	1 336	2
Regions of knowledge	REGIONS	126	0
Research potential	POTENTIAL	340	1
Science in society	SiS	330	1
Support for the coherent development of research policies		70	0
Activities of international cooperation	INCO	180	0
Non-nuclear actions of the Joint Research Centre	JRC	**1 751**	**3**
Total		50 521	100

6. Budget approved by the Council of Europe and the European Parliament on 18 December 2006.

to approved projects, so competition for funding is fierce. Today, an ERC grant serves as a strong indicator of quality, both for the researcher who has received it and for the researcher's institution.

FP7 is also a key instrument for developing the European Research Area (ERA), although the national authorities in the respective countries have primary responsibility for this. The long-term objective of ERA is to ensure the free movement of researchers and knowledge in Europe. ERA is to be realised by:

- more effective national research systems – increasing investment in research, using quality assessment as a basis for funding decisions and competition in open calls with peer review;
- optimal transnational cooperation and competition – jointly addressing grand challenges by implementing common research agendas with Europe-wide competition, and investing in and using research infrastructures effectively on a pan-European basis;
- an open labour market for researchers – removing barriers to researcher mobility, training and attractive careers;
- gender equality and gender mainstreaming in research – removing barriers to the recruitment and career progression of female researchers and strengthening the gender dimension in research programmes;
- optimal circulation, access to and transfer of scientific knowledge – increasing access to scientific information, implementing strategies to foster knowledge transfer between public and private sectors, and promoting a digital ERA with seamless access to digital research services and e-infrastructures;
- strengthening and targeting research cooperation with countries outside Europe.

Thus far Norway has taken active part in the development of ERA, primarily in its capacity as an associated country to the framework programme.[7]

FP7 co-finances a large number of activities designed to achieve ERA's objectives by integrating and targeting research initiatives within selected fields of research. In Norway, these are known as other, affiliated FP7 activities for promoting ERA. Examples of such activities include the European Strategy Forum on Research Infrastructures (ESFRI); Joint Technology Initiatives (JTIs) with industry: Innovative Medicines Initiative (IMI), ENIAC (nanoelectronics), ARTEMIS (Embedded Computing Systems), Clean Sky (aeronautics and air transport), and Fuel Cells and Hydrogen (FCH); development of a global navigation satellite system (Galileo); cooperation on earth observation (Copernicus); development of a joint European air traffic management system (SESAR); and research programmes funded by the participating countries and FP7 in defined thematic areas (such as ERA-NET Plus actions and Article 185 Initiatives including Ambient Assisted Living (AAL), Eurostars, and the European Metrology Research Programme (EMRP)). Approximately 10 per cent of the total FP7 budget is allocated to these activities.

The framework programmes have evolved from primarily industry-oriented, relatively modest initiatives in the 1980s and 1990s into large-scale, ambitious, strategic research initiatives that address a wide range of research and innovation policy needs and priorities.

Horizon 2020

A new Framework Programme for Research and Innovation, Horizon 2020, will soon be launched for the 2014–2020 period. Horizon 2020 will incorporate components of the Competitiveness and Innovation Programme (CIP) and the European Institute of Innovation and Technology (EIT). These changes reflect the EU's plans to achieve closer integration between research and innovation in the new framework programme.

In its proposal of November 2011, the European Commission proposed a budget of EUR 77.6 billion at 2011 values (equivalent to EUR 87.7 billion at current values) overall for Horizon 2020. The most recent developments on the EU budget front (as per April 2013) indicate that the total budget for Horizon 2020 for the 2014–2020 period will be roughly EUR 70 billion (at 2011 values).

While FP7 has been oriented towards priority research areas, Horizon 2020 will be directed towards achieving the overarching development targets of ERA and the Europe 2020 growth strategy, as well as towards tackling major societal challenges. The structure of Horizon 2020 has therefore been simplified, and consists of three main pillars:

- excellent science
- industrial leadership
- societal challenges.

The new structure will facilitate significantly more cross-cutting and multidisciplinary research activities than previously. ICT research, environmental research and research in the humanities and social sciences will be funded over several budget items under the new framework programme. The share of the budget to be allocated to SMEs will most likely be increased from 15 per cent under FP7 to 20 per cent under Horizon 2020. As has been the

7. For more information, please see the Norwegian-language version of Meld. St. 18 (2012–2013) *Long-term perspectives – knowledge provides opportunity*, white paper from the Ministry of Education and Research, Chapter 4.4.

case with FP7, a considerable share of the Horizon 2020 budget will also be used to develop ERA.

All in all, Horizon 2020 represents both change and continuity in relation to FP7. For instance, a sizeable amount of the activities under Horizon 2020 will still be implemented as collaborative projects involving researchers from several countries. Experience from participation in FP7 may therefore provide valuable information regarding the contours of potential Norwegian participation in Horizon 2020.

2.2 Norway and the framework programmes

Norway has taken full part in EU framework programmes since the beginning of the Fourth Framework Programme in 1994. Norwegian participation is set out in the EEA Agreement, and Norway participates on a par with the 40 other countries involved in this R&D cooperation (27 member states and 13 associated countries). FP7 is the most wide-ranging EU programme in which Norway has taken part, and approximately 70 per cent of Norway's overall contribution to programme cooperation under the EEA Agreement is used here (see Chapter 1, Figure 4). The total Norwegian contribution to FP7 is estimated at roughly NOK 10 billion.

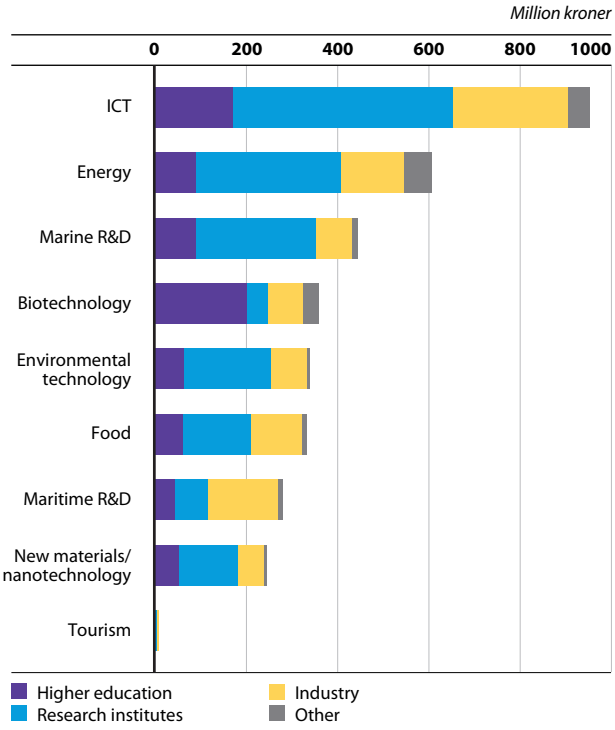
The total Norwegian contribution for full participation in Horizon 2020 is estimated to come to between NOK 13–16 billion (at 2011 values).[8] Although this sum would be paid out over a 12-year period, the contribution represents a significant investment in the internationalisation of Norwegian research and innovation.

Research activities funded under FP7 – relevance for Norway
At the overall level, most of the designated priority areas for Norwegian research are aligned with priority themes under FP7. The more detailed focus of these areas within each theme may not, however, always harmonise entirely with the issues given emphasis in Norwegian research policy. Petroleum research is one major thematic priority area in Norwegian research that is not addressed by the framework programmes. Marine and maritime research are not organised as specific themes under FP7; however, a great deal of marine and maritime research is funded under the themes on transport, the environment and food.

The Research Council of Norway (RCN) has examined the nearly 1 200 research projects involving researchers in Norway thus far under FP7, and has estimated the relevance of these vis-à-vis current Norwegian research-policy priorities in strategic areas. Figure 13 shows that FP7 allocates funding of nearly NOK 1 billion to Norwegian

13
EU contribution by priority thematic and technological area

Source: Research Council of Norway and the European Commission: E-CORDA



research organisations for ICT-related activities, NOK 600 million for energy research, NOK 500 million for marine research, NOK 280 million for maritime research, NOK 250 million for nanotechnology research, NOK 330 million for food research, etc.

As pointed out in Chapter 1, an EU project may be classified as relevant to several strategic areas and the RCN places the projects into a set of pre-defined categories. The categories in the figure are therefore not mutually exclusive and projects may be counted more than once. Nevertheless, Figure 13 does provide an indication of the significance of FP7 as an instrument for Norwegian research in selected prioritised strategic thematic and technological areas in Norway.

In comparison, in the period from 2009 to 2011 the RCN allocated NOK 2.4 billion for ICT research, NOK 3.4 billion for energy research, NOK 1.6 billion for marine research, NOK 930 million for materials technology/nanotechnology research, and NOK 2.2 billion for food research.

FP7 may therefore be considered an important instrument within prioritised strategic thematic and technological areas in Norway, even though the European Commission plays a smaller role as a funding source for Norwegian R&D expenditures. This is discussed in more detail in Section 2.4.

8. Based on a total budget for Horizon 2020 of roughly EUR 70 billion (at 2011 values), an exchange rate of EUR 1 to NOK 7.5, and the assumption that Norway's contribution will cover between 2.5 and 3.1 per cent of Horizon 2020's total expenditures.

Motivation factors that affect Norwegian participation
The main motivations for participation in research activities funded under the framework programmes reported are: networking, building reputation, knowledge acquisition, problem solving, methodology development, information about international developments and competitors, access to infrastructure and access to funding.[9] Motivation factors among researchers in Norway are generally the same as for researchers in other countries. The disincentives for participation are for the most part universal as well. The most frequently mentioned are: the demands of preparing grant proposals, low success rates, time-consuming project administration, complex rules for participation and lack of adequate protection mechanisms for intellectual property.

Disincentives relating more particularly to Norway that have been mentioned include:

- The level of quality in certain research fields in Norway is too low for researchers to compete successfully for funding.
- Good national funding schemes make researchers less inclined to seek support under the framework programmes.
- There is a lack of well-developed incentive systems at the researcher and research group level, particularly within the higher education sector. The scientific and career-related gains of participation in an EU project thus do not measure up compared to other alternatives.

2.3 Data on and indicators for participation in framework programmes

National participation in FP7 may be described with the help of selected indicators. In this section Norway's participation is compared with the participation of the designated *reference countries*. In addition to Austria, Denmark, Finland, Sweden and the Netherlands, which are the recurring reference countries in the *Research Barometer*, Switzerland is included among the reference countries in several contexts in this chapter. Like Norway, Switzerland is an associated country to the framework programmes; it also has a high rate of participation in FP7.

The indicators employed in this report are:

1 EU contribution under FP7 as a whole (in EUR million) during the 2007–2012 period and under Cooperation;[10]
2 number of participations in FP7 as a whole (2007–2012) and in Cooperation;
3 number of selected proposals under FP7 as a whole (2007–2012) and under Cooperation;
4 share of selected proposals as a share of all selected proposals under FP7 (2007–2012);
5 number of proposals submitted to FP7 (or to Cooperation) as a share of all proposals submitted to FP7 (2007–2012);
6 ratio between the number of proposals submitted to FP7 and the number of selected proposals (success rates) under FP7 as a whole and under Cooperation;
7 EU contribution received under FP7 as a whole divided by the number of participations (Indicator 1 divided by Indicator 3);
8 share of coordinators under Cooperation.

These indicators can also be applied at the level of the performing sector, at the level of the thematic areas and for individual participating institutions.

In addition, it is of particular interest to look at the share of EU contribution allocated to researchers in a country relative to the total amount of funding available for allocation on a competitive basis. This share is referred to as the country's *share of EU contribution*. Norway's share of the overall EU contribution under FP7 and what this comprises in relation to the contribution Norway pays for participating in the framework programmes is discussed in more detail in Sections 2.4 and 2.9.

The European Commission's database on participation in FP7, E-CORDA, is the central database for all indicators employed in this report. E-CORDA contains information on signed grant agreements/beneficiaries (the grant agreement/contract database) and applicants/proposals (the proposal database). The latter database is the most up-to-date because it can take up to one year from the time a proposal is selected for funding until it is registered as a signed grant agreement. However, information in the grant agreement database is more reliable, particularly with regard to information on individual R&D organisations. For the purposes of this report, the proposal database has as a general rule been used when comparing countries, while the grant agreement database has been used when comparing institutions.[11] The entire E-CORDA database is updated three times a year.

The analysis in this chapter is primarily based on the RCN's processed versions of the E-CORDA databases from November 2012.

There are two areas, however, in which the E-CORDA databases do not provide adequate information. First, there is no registration of participation in other FP7 activities for promoting ERA. Second, financial data on participation in

9. Findings from previous evaluations of Norway's and other countries' participation in the EU framework programmes. A qualitative analysis of motivation factors among Norwegian researchers for participating in EU research on health, ICT and the environment (motivation analysis) was performed in 2012 (Åström et.al. 2012). The report is the main source of information for this section.
10. The Cooperation programme accounts for approximately 65 per cent of the total budget for FP7 and provides funding to collaborative projects within thematic areas. (See also Table 2.1 above.)
11. Data on proposals is confidential at the detail level.

the People programme (Marie Curie Fellowships) is lacking in the proposal database, although it is included in the grant agreement database.

2.4 Data on results and impacts

While a large number of evaluations have been carried out under the auspices of the European Commission and the national authorities of the participating countries, few studies have been conducted on the long-term impacts of the framework programmes on the research systems in the participating countries. Norwegian participation in the framework programmes has been evaluated three times since 1994.[12] The evaluations show that participation has had an effect on both the competence and the organisation of the participating Norwegian researchers and research groups, but many of these impacts are difficult to quantify.

Quality in research

The European Commission has commissioned a large number of evaluations of both the overall framework programmes and segments of them, in addition to studies on the programmes' impacts. A key finding is that the research conducted under the framework programmes holds a high standard.[13]

Total costs – volume

Most projects funded under FP7 involve the participation of research organisations from many countries. Thus one measurable impact is that researchers in Norway are directly involved in a much greater volume of research activity than that made possible by the funding they receive. A Norwegian partner will often be the recipient of only a tenth or less of the overall funding allocated to the project, but will nonetheless in most cases have access to networks and research results from the project as a whole. The sum of the total costs for all projects with Norwegian partners (the Norwegian project portfolio) under FP7 thus far is estimated at roughly NOK 42 billion (EUR 5.5 billion).

Networks

Financing interdisciplinary, network-based activities is still the backbone of European research policy. The majority of the evaluations of national participation in the framework programmes therefore devote a great deal of attention to the quality and duration of the networks funded under the programmes. After nearly 20 years of Norwegian participation it will be possible in the future to find out which key collaborative relationships have been established with support from the framework programmes and how these have developed with an eye to incorporation of new members into the consortia (for example, collaboration with new SMEs or large companies).

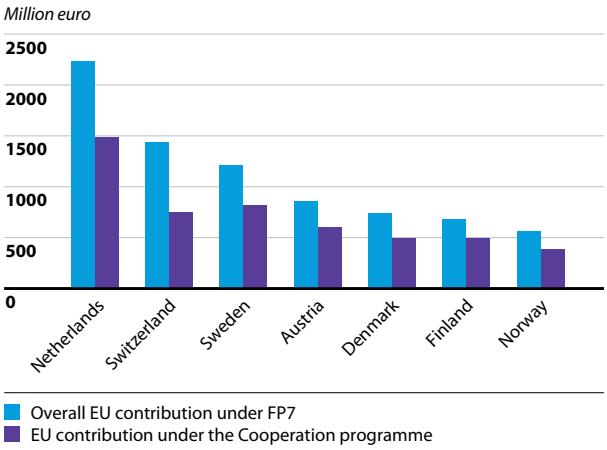
Other important impacts

Other impacts and results, such as the number of researchers involved in the projects, publications, patents, etc., are not registered in the E-CORDA database and must be documented in other ways. The European Commission is developing data systems for registering such results more systematically in the future.

12. NIFU and NTNU evaluated Norwegian participation in FP4 in 1998. NIFU, STEP and Technopolis evaluated Norwegian participation in FP5 in 2004. NIFU STEP (and its collaborating partners) evaluated Norwegian participation in FP6 and the first two years of FP7 in 2009.
13. See for example "What the evaluation record tells us about Framework Programme performance", Arnold (2005): "[Evaluation] panels are generally positive and endorse the Specific Programmes they evaluate. They regard scientific quality as high and are positive about 'intermediate' or first-order outputs: knowledge/skills acquisition and transfer; networking; and researcher mobility."

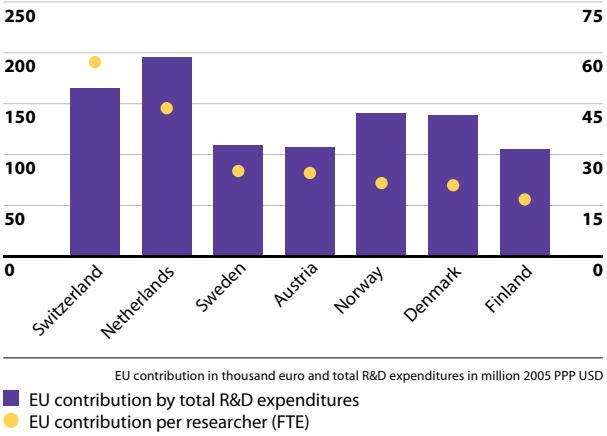
14
National participation in FP7
Total EU contribution to projects selected for funding

Source: European Commission: E-CORDA



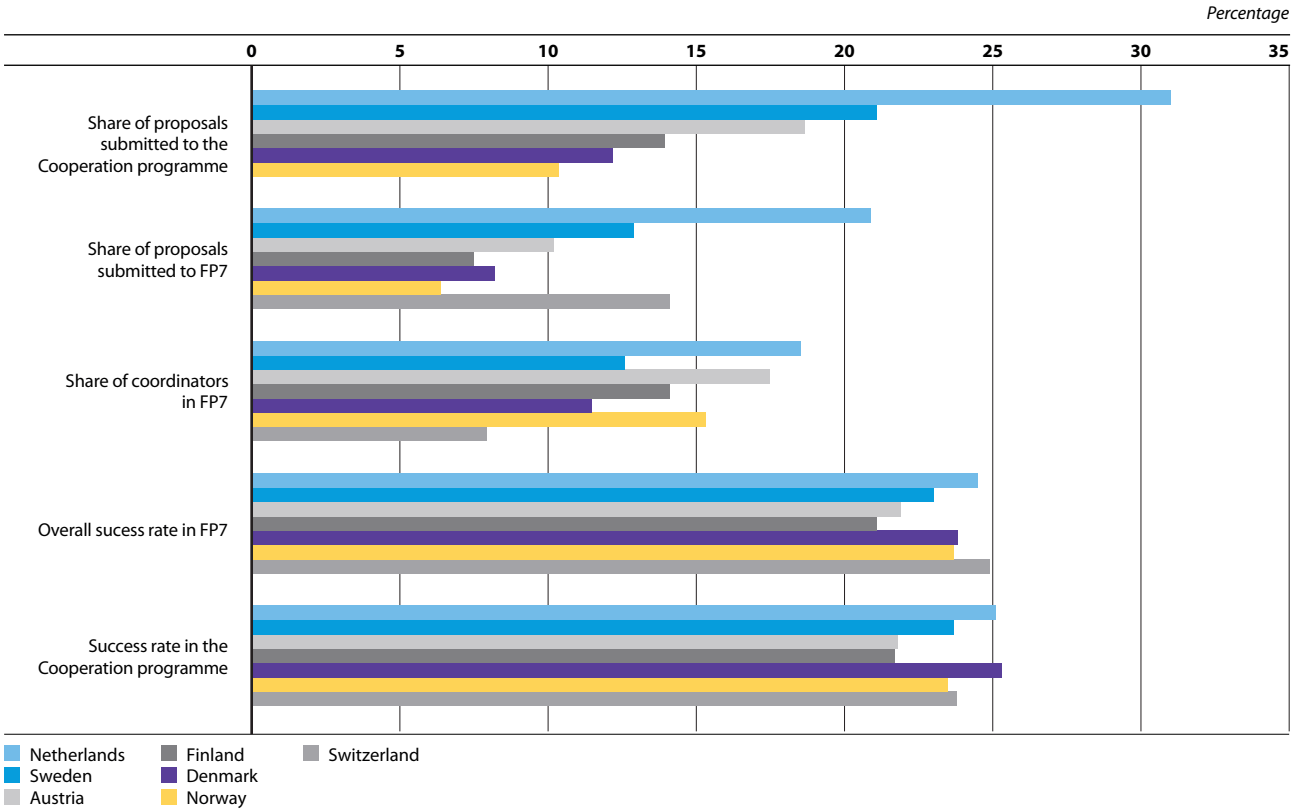
15
Normalised national participation in FP7
Total EU contribution under FP7 by total R&D expenditures and per researcher (FTE) (2007–2011)

Source: European Commission: E-CORDA and OECD *Main Science and Technology Indicators* 2012:2



16
Key indicators for national participation in FP7

Source: European Commission: E-CORDA



2.5 Overall picture of Norwegian participation in relation to the reference countries

The following analysis attempts to provide an adequately nuanced picture of Norwegian participation in the EU framework programmes as it stands towards the end of FP7. The analysis is based on a methodological framework that:

1 compares Norway's participation in FP7 with selected countries (the designated reference countries) using several key indicators (Section 2.5);
2 examines participation at several levels: country, thematic, performing sector, and institutional (selected institutions) (Sections 2.6, 2.7 and 2.8);
3 discusses economic factors relating to participation in FP7 (Section 2.9).

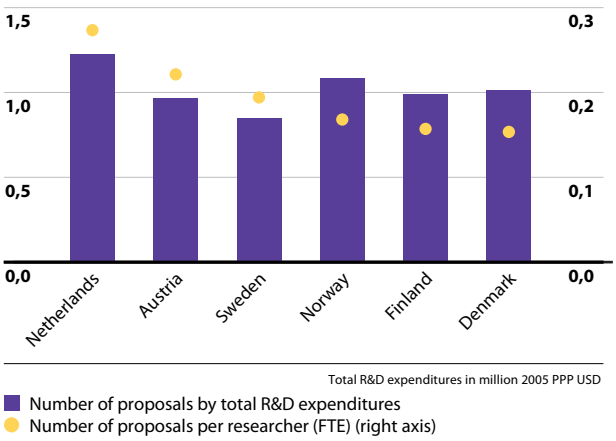
Figures 14, 15, 16 and 17 provide an overall picture of Norwegian participation compared with the participation of the reference countries.

Figure 14 shows that Norway receives the lowest EU contribution compared with the reference countries. This, however, is to be expected, given that the countries vary in size and Norway is the smallest (measured both in R&D expenditures and in number of researchers (full-time equivalents, FTE)).

It is necessary to normalise the differences between the countries to provide a better basis for comparison. Potential normalisation parameters include the countries' GDP, number of inhabitants, public R&D funding, total

17
Normalised proposals submitted to FP7
Total number of proposals submitted to FP7 by total R&D expenditures and per researcher (FTE) (2007–2011)

Source: European Commission: E-CORDA and OECD *Main Science and Technology Indicators* 2012:2



R&D expenditures and number of researchers (FTE).[14] Although population statistics and GDP statistics are reliable, they measure relative demographic and economic strength, which is not particularly relevant in relation to level of participation in the framework programmes. Seeing as it is researchers who submit proposals and participate in FP7, measures of research size (R&D expenditures and number of researchers) will most likely provide a better basis for normalisation.

These R&D indicators also provide internationally comparable data, as they are based on definitions and guidelines that have been followed and developed for more than 50 years (the *Frascati Manual*). Nevertheless, there are a number of methodological challenges relating to the use of R&D statistics for comparisons between countries because the standard allows for the use of a variety of measurement methods and because the countries have different research systems. Such variations may result in the under- or over-reporting of R&D figures in the various countries.

Figure 15 shows the EU contribution under FP7 per researcher (FTE) and per R&D expenditures, taking into account the countries' differences in size. Normalised on the basis of the countries' total R&D expenditures, Norway's participation (measured as EU contribution) is the highest of the Nordic countries, but is lower than that of the Netherlands and Switzerland. Looking at the EU contribution per researcher, Norway does not rank as high, but still ranks higher than Finland and Denmark.[15] However, this picture is not complete and needs to be broken down further.

Industry's share of FP7 funding is low compared with its share of total R&D in the various countries. This is true for all of the reference countries as well as Norway. There are, however, some major differences in this sector's share of the total R&D expenditures in the reference countries and Norway. Normalised participation indicators based on total number of researchers (FTE) or total R&D expenditures will favour Norway because the Norwegian business enterprise sector's share of total R&D is lower than that of the reference countries, with the exception of the Netherlands, whose share is approximately the same as Norway's. Alternatively, if participation indicators are normalised on the basis of R&D expenditures in sectors other than the business enterprise sector, Norway ranks in last place (together with Finland) among the reference countries. In 2011 Norway's R&D expenditures in sectors other than the business enterprise sector were as large as Finland's and Denmark's (measured in PPP USD).

14. See for example, Godø, Langfeldt, Kaloudis, et al. (2009): "In Need of a Better Framework for Success: An evaluation of the Norwegian participation in the EU 6th Framework Programme (2003–2006) and the first part of the EU 7th Framework Programme (2007–2008)", page 50.
15. In Figure 14, substituting the EU contribution with the number of participations results in the same picture.

The fact that the results differ so greatly when using two variants of indicators normalised for R&D size (including and excluding business enterprise R&D) is one of the reasons behind the claim that general comparisons of participation in FP7 among countries are too broad; they do not provide adequate insight into the differences in participation patterns among the countries. Therefore in the sections below, the participation indicators have been broken down by thematic area, R&D-performing sector and individual R&D actor.

Researchers in Norway have been involved in 10 per cent of all proposals submitted under the Cooperation programme (see Figure 16). They are also involved in 12.9 per cent of all projects selected for funding under Cooperation. The proportion of Norwegian researchers involved in all selected projects under FP7 as a whole is 6.4 per cent.

Norway has a high percentage of project coordinators under Cooperation (16 per cent). Coordinators lead the projects, and the coordinator role often entails significantly greater scientific influence than ordinary participation. Researchers in Norway are therefore playing key roles in establishing and implementing a large number of FP7 projects. Only the Netherlands and Austria have a higher percentage of coordinators than Norway (17 per cent).[16]

Norwegian success rates are clearly higher than the average for FP7. The success rates vary very little among the reference countries, however, and all have higher success rates than the average for FP7. Austria has the lowest success rate under Cooperation (21.8 per cent), while Denmark has the highest (25.3 per cent), followed by the Netherlands (25.1 per cent). Researchers in Norway have a success rate of 23.5 per cent. A high success rate primarily means that researchers in Norway on the whole participate in good consortia and high-quality proposals.

Looking at success rates alone is insufficient. While high success rates are a positive sign, they may mask a low level of proposal submissions within all or parts of the framework programme. Figure 17 compares the reference countries in terms of how active they are in seeking FP7 funding. An overview of the number of submitted proposals normalised for R&D expenditures provides the same picture as Figure 15 above: Norway ranks second-highest, after the Netherlands. When the number of proposals is normalised per researcher (FTE), Norway ranks lower, but still higher than Denmark and Finland. When excluding business enterprise R&D from the normalisation, Norway again drops to the bottom of the list.

16. Normally, participating countries with a high coordinator share score high in terms of EU contribution per participation. This is because coordinators receive a greater share of the EU contribution in collaborative projects than other participants.

The framework programmes as a funding source for Norwegian research

Norway's official R&D statistics show that roughly 1.5 per cent of the country's total R&D expenditures were financed by the European Commission in 2011. Most of this funding comes from FP7. In comparison, the R&D statistics show that the Research Council of Norway financed 12.5 per cent of Norway's total R&D expenditures in 2011. Distributing the EU contribution by sector, the European Commission funded 3.3 per cent of the total R&D expenditures of the institute sector, 1.6 per cent of the higher education sector and 0.4 per cent of industry in 2011. The statistics also show that from 2001 to 2011 the EU contribution measured at current values increased by an annual average of 8.6 per cent for the institute sector and 7.9 per cent for the higher education sector, while it fell by an annual average of 2.3 per cent for industry.

Given that the budgets of the framework programmes have increased from FP5 to FP6 and from FP6 to FP7, a steady increase in funding from the framework programmes over time is expected. The E-CORDA databases are probably a more accurate source of information for measuring revenues from EU framework programmes than the R&D statistics. Therefore, this report also examines the development in funding streams from the framework programmes using the grant agreement database. The development in research funding received by the reference countries under the framework programmes during the past 10 years has been examined using funding data from FP5 (1998–2002), FP6 (2002–2006) and FP7 (2007–2013).[17]

Figure 18 illustrates the funding streams from the framework programmes for the periods 2002–2004 and 2010–2012 for the reference countries (annual average).

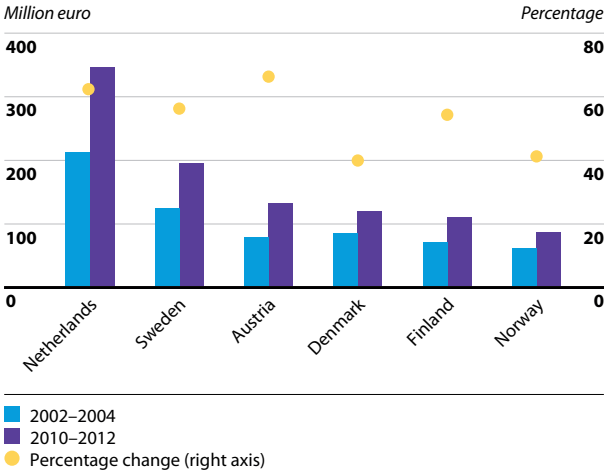
Figure 18 shows that the estimated annual EU contribution under the framework programmes increased by 42 per cent for Norway. The increase from one period to the next was lower for Norway and Denmark than for the other reference countries. Austria experienced the highest growth (66 per cent) among the reference countries, followed by the Netherlands (62 per cent).

The same analysis was carried out in relation to the research-performing sector. One major finding is that the EU contribution to industry in Norway for the 2002–2004 and 2010–2012 periods (annual average for the periods)

17. While R&D statistics are based on figures reported by the organisations or enterprises, the E-CORDA grant agreement database contains information on the total EU contribution to each participant in a given FP7 project as well as on project duration, making it possible to estimate the funding streams from FP5, FP6 and FP7 over time. Projects may continue for many years after the official conclusion of a framework programme. Thus, the framework programmes may overlap one another, and in any given year researchers in Norway may be receiving funding from both a concluded and an ongoing programme.

18
Estimated annual EU contribution for the 2002–2004 and 2010–2012 periods

Source: European Commission: E-CORDA (contracts)



rose by 129 per cent. However, this growth is clearly lower than for the reference countries. The EU contribution to Danish industry, for example, was three times higher in the 2010–2012 period than in the 2002–2004 period.

The evaluation of Norwegian participation in FP6 and the first two years of FP7 revealed that, on average, roughly 4.5 researchers were involved in each FP6 project.[18] If the same average applies to FP7 as well, an estimated 5 500 researchers have been involved in close to 1 200 FP7 projects. The actual number of participating researchers in Norway is in all likelihood lower, as there are a number of researchers who are involved in more than one FP7 project. The estimated 5 500 researchers comprise roughly nine per cent of the total R&D personnel in Norway.

Proposals involving researchers in Norway have a high success rate and these researchers play an active role in many projects. Norway scores the highest among the Nordic countries on several (normalised) participation indicators. However, it appears that the Netherlands, Switzerland and Austria have a higher rate of participation in FP7 than Norway. If these figures are adjusted on the basis of the size of the public sector segment of the R&D systems another picture emerges. In this context Norway ranks last. The EU provides funding for approximately 1.6 per cent of the R&D conducted in Norway, and less than 10 per cent of the researchers in Norway participate in EU projects. In addition, the analysis shows that Norwegian participation in the framework programmes is increasing at a slower rate than those of the reference countries (cf. Figure 18).

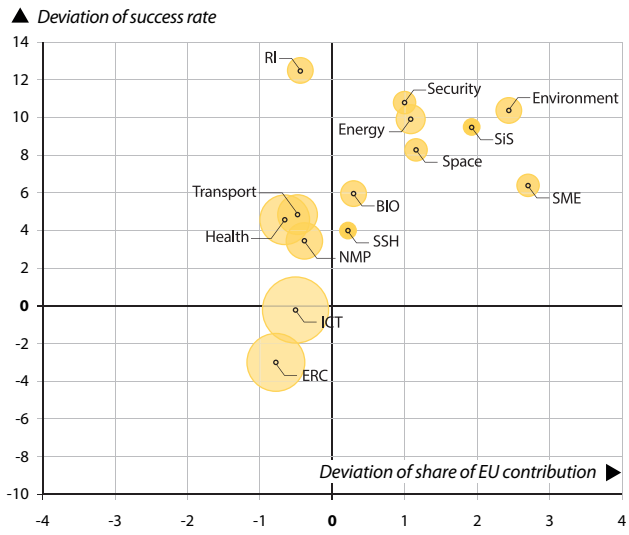
The sections below take a more detailed look at national participation profiles and provide greater insight into the

18. See Godø, Langfeldt, Kaloudis et al. (2009): pp. 81–82.

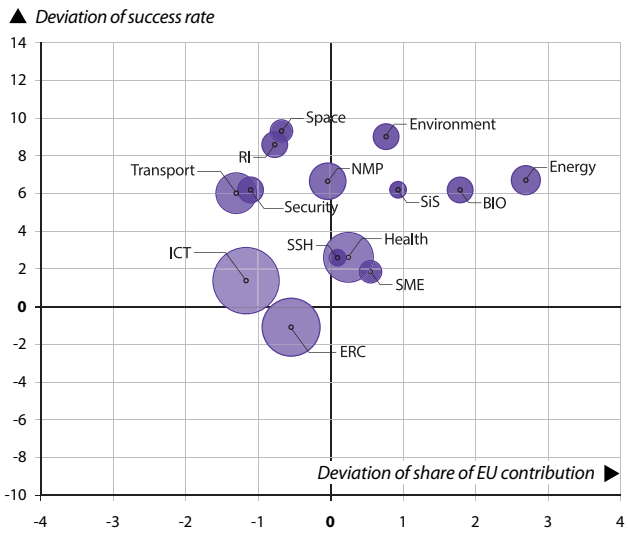
19 Share of EU contribution and success rates by FP7 theme

Source: European Commission: E-CORDA

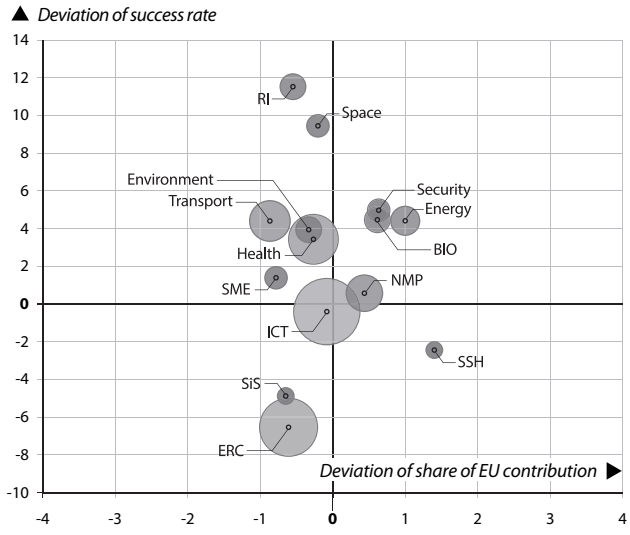
Norway 1.68 %



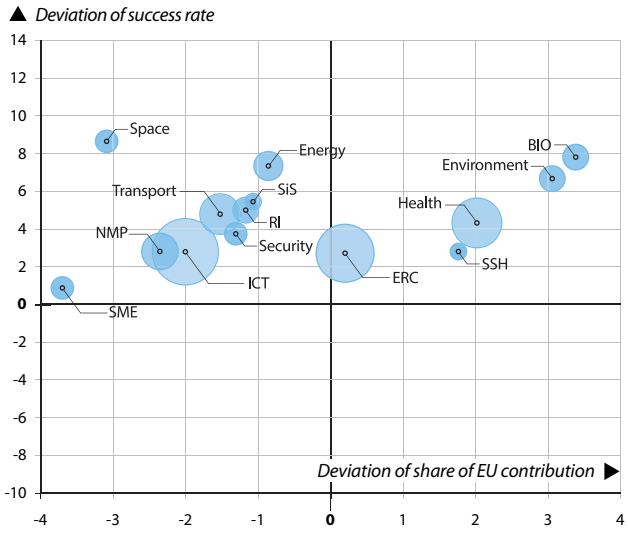
Denmark 2.21 %



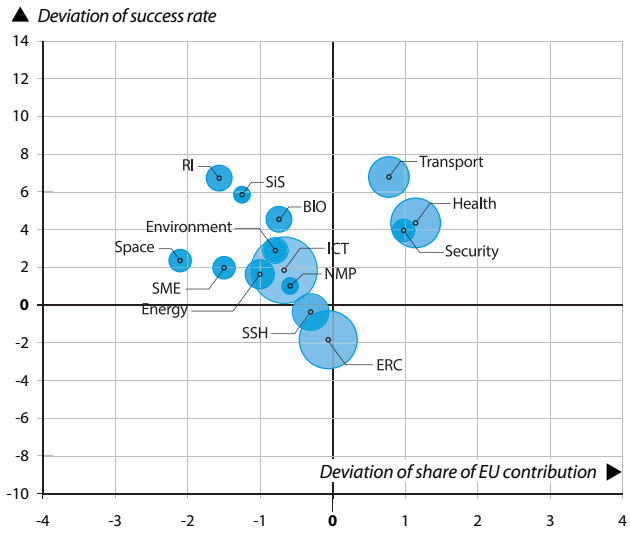
Finland 2.01 %



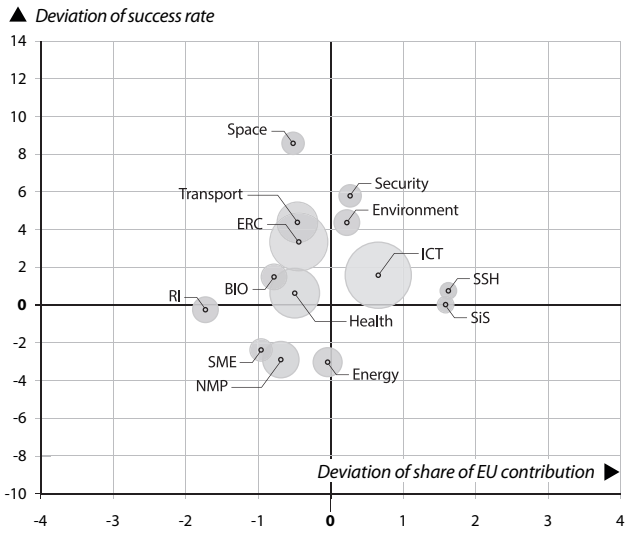
Netherlands 6.63 %



Sweden 3.60 %



Austria 2.54 %



The x-axis shows the difference in percentage points between the national share of EU contribution under the individual themes and the national share of EU contributions under FP7 as a whole.
The y-axis shows the difference between the national success rate by individual theme and the overall success rate for those themes.

nature of the participation of the various R&D-performing sectors and selected key institutions.

2.6 Similarities and differences in the reference countries' participation by theme

A look at participation in the various themes under FP7 reveals significant variation among the reference countries. Figure 19 illustrates success rates and shares of EU contribution (i.e. the EU contribution received by researchers in a given country in proportion to the total EU competitive funding available) by FP7 theme for the reference countries. The horizontal axis shows the national share of EU contribution under the respective theme as a deviation in percentage points of the national share of EU contribution under FP7 as a whole (the 0 point on the x-axis, and with percentage value specified in the subfigure titles). The y-axis shows the national success rates by theme as a deviation of the average success rate in the respective theme. The bubbles are sized according the individual theme's share of the FP7 budget (cf. Table 2.1).

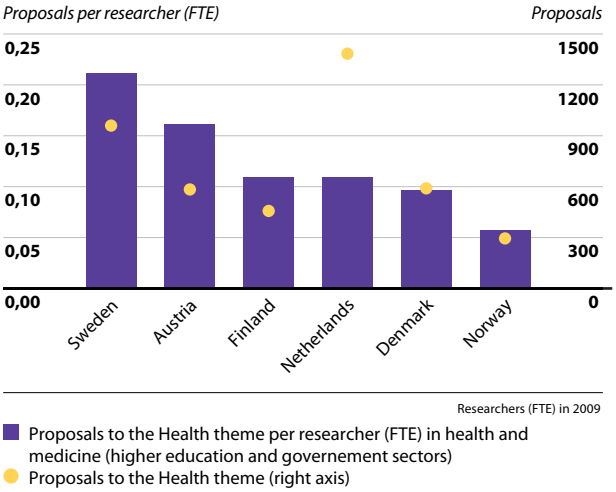
Where Norway is concerned, Figure 19 shows that the country's participation in the thematic programmes on environmental, security and space research and the social sciences (SSH and SiS) generates a higher share of EU contribution under these programmes than the national share of the overall EU contribution under FP7 (which is 1.68 per cent), as well as high success rates. This may indicate that Norway has active, high-calibre research groups in these fields. However, all seven themes in which Norway has high participation rates have relatively small budgets.

Norway's highest share of EU contribution is found in the SME theme. The SME theme has a special profile. It is a component of the Capacities programme and was developed to cultivate links between innovative SMEs and research organisations. The high level of Norwegian participation in the SME theme is due in part to the specific profile and orientation of the theme, which has been tailored to the knowledge needs of SMEs, and in part to the fact that certain actors, such as Teknologisk Institutt Norway, have successfully drawn in other Norwegian SMEs to collaborate on proposals. This model of cooperation is not easy to replicate in the more scientifically specialised segments of FP7 (e.g. Cooperation).

Norway achieves a lower share of EU contribution under the two largest themes (Health and ICT) and the ERC than its share of EU contribution under FP7 as a whole. With regard to the ERC, and to a certain extent the ICT theme, Norwegian success rates are also lower than the average for these programmes. The share of EU contribution under the People programme is the lowest. However, several national subject-specific evaluations have shown that

20
Proposals submitted to the Health theme
Absolute and normalised per researcher (FTE) in health and medicine

Source: European Commission: E-CORDA and OECD *Main Science and Technology Indicators* 2012:2



Norway has a number of dynamic research environments in the fields of health and ICT and that there is outstanding research being conducted in many other fields, including environmental and energy research. In other words, the relatively low rate of participation in these themes is not necessarily due to a low calibre of research in the relevant subject areas.

All of the other reference countries have a higher national share of EU contribution than Norway (cf. Figure 19). Shares of EU contribution under the individual themes, however, vary widely among the countries. Finland, Austria, and, to a certain extent, Sweden have a more consistent distribution than Denmark, the Netherlands and Norway. Finland, Norway and Austria demonstrate significant variation in success rates, while the Netherlands and Sweden have the most consistent success rates.

Viewed together, the number of proposals submitted by Norwegian actors under FP7 is not significantly lower than the number of proposals submitted by the reference countries, adjusted for research size (cf. Figure 18). Nevertheless, there are considerable differences under the individual themes. Figure 20 shows that, for example, the number of proposals submitted by Norway under the Health theme is considerably lower than the number submitted by the reference countries, even when adjusted for size. The same applies to Norwegian participation under the ERC (figure not shown).

2.7 Similarities and differences among the research-performing sectors

A wide variety of organisations participate in FP7. In addition to the four research-performing sectors (higher

education sector, institute sector[19], industry and health trusts), there are a large number of participating organisations affiliated with the public administration and the authorities. This latter group is referred to as "Other". Figure 21 shows the distribution of the EU contribution and the number of Norwegian participations by sector. Unfortunately, there is a lack of reliable information on the participation of the health trusts in FP7. This is due in part to variation in routines among researchers at participating university hospitals when stating their institutional affiliation in the grant agreements. For instance, there are indications that researchers at Oslo University Hospital list the hospital as their institutional address, while researchers at other university hospitals list the university as their institutional address.[20] As a result, participation on the part of the health trusts has been categorised either under "Higher education" (if they are university hospitals) or under "Other". The Norwegian Institute of Public Health, however, is categorised under "Research institutes".

Higher education sector

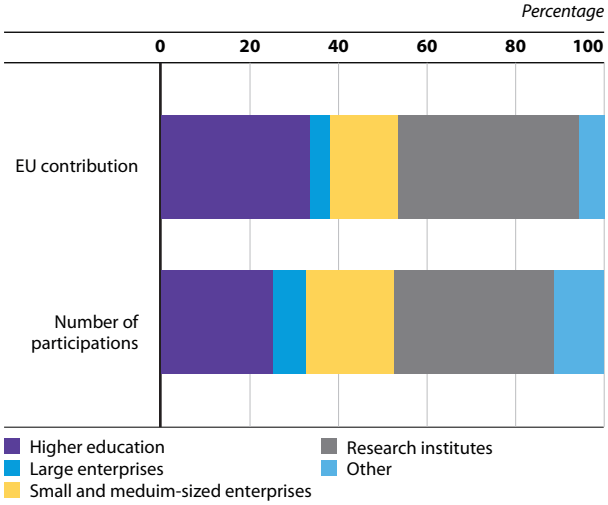
Figure 21 shows that higher education institutions account for 25 per cent of all Norwegian participations in FP7, and receive 33 per cent of the total contribution allocated to Norway. The Norwegian higher education sector's share is lower than that of the corresponding sectors in Denmark, Sweden and Finland. This may be due in part to the fact that Norway has a relatively large institute sector, compared to certain reference countries, e.g. Denmark and Sweden. The Finnish higher education sector accounts for a significantly higher share of participations in FP7 than the Norwegian higher education sector, and the size of the institute sector in Finland is more comparable to Norway's.

To adequately compare the countries, the indicators must be normalised in the same manner as in the section above, i.e. on the basis of research size (R&D expenditures and number of researchers (FTE) for the respective countries' higher education sectors). Figure 22 shows that

19. See the *Research Barometer* 2012 for a list of organisations defined as "independent research institutes". (Norwegian only)
20. The Ministry of Health and Care Services is currently carrying out a statistics project in cooperation with the Research Council and NIFU to clarify the actual participation of the health trusts in FP7 (particularly under the Health theme).

21
Norwegian participation in FP7 by R&D-performing sector

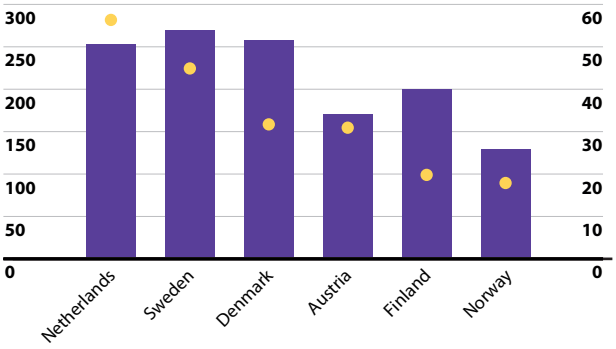
Source: European Commission: E-CORDA



22
Normalised EU contribution under FP7 to the higher education sector

Overall EU contribution to the higher education sector by higher education R&D expenditures and per researcher (FTE) (2007–2011)

Source: European Commission: E-CORDA (contracts) and OECD *Main Science and Technology Indicators* 2012:2



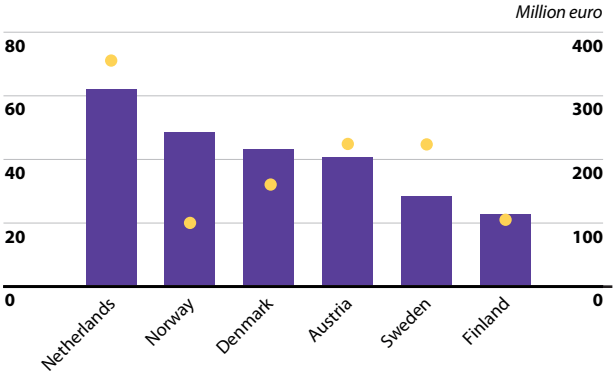
EU contribution in thousand euro and R&D expenditures in million 2005 PPP USD

- EU contribution to the higher education sector by R&D expenditures in the higher education sector
- EU contribution to the higher education sector per researcher (FTE) in the higher education sector (right axis)

23
EU contribution under FP7 to industry

Overall EU contribution to industry and normalised on the basis of business enterprise R&D expenditures (2007–2011)

Source: European Commission: E-CORDA (contracts) and OECD *Main Science and Technology Indicators* 2012:2



EU contribution in thousand euro and R&D expenditures in million 2005 PPP USD

- EU contribution to industry by business enterprise R&D expenditures
- EU contribution to industry (right axis)

Norwegian universities and university colleges participate relatively little compared with their counterparts in other reference countries, even when adjusted for size (measured in R&D expenditures or number of researchers).

Industry

Figure 21 shows that industry accounts for 27 per cent of all Norwegian participations in FP7. Industry's share of the total EU contribution allocated to researchers in Norway is 20 per cent: 15 per cent goes to Norwegian SMEs and five per cent to large companies. DNV is the Norwegian company that participates the most actively in FP7.

Figure 23 shows that Norwegian industry has a high rate of participation in FP7 compared with the reference countries, when normalised for R&D expenditures (or number of researchers, not shown in Figure 22). This confirms findings from previous studies. Norwegian companies have taken active part in the framework programmes since FP4. The challenge is that the development in the Norwegian industrial sector's participation over time is weaker than that of the reference countries. Denmark's industrial sector in particular has intensified its participation during the past 10 years.

As mentioned above, the SME theme involves a large number of Norwegian actors. Approximately 1 000 Norwegian participations in a total of 513 proposals have been registered under this theme. Teknologisk Institutt Norway is involved in 25 per cent of these proposals. Nortek AS participates in nine per cent of the Norwegian proposals submitted under the theme. The SINTEF Group, Akvaplan-niva AS and other private sector actors (e.g. DNV) collaborate actively with Norwegian SMEs as well. Teknologisk Institutt Norway and Nortek act as a sort of magnet, drawing in Norwegian SMEs to collaborate on proposals, which may be the main explanation for Norway's high share of EU contribution under this theme. Norwegian SMEs have also participated successfully in the Eurostars programme, which is an affiliated FP7 activity that provides support to high-technology projects at SMEs, with proposals submitted by individual companies.

Table 2.2 shows that Norwegian SMEs participate less intensively compared with the general participation of SMEs under Cooperation. It is worth noting that Cooperation makes up 64 per cent of the FP7 budget, while the SME theme accounts for less than three per cent. Norwegian SMEs receive 15 per cent of the EU contribution allocated to Norwegian participants under the ICT and food research (BIO) themes, but only three per cent under the space research theme, eight per cent under the environmental research theme and 10 per cent under the energy research theme.

Table 2.2 Percentage of EU contribution to SMEs by theme, for Norway and for FP7 as a whole

Themes under Cooperation	*Percentage of contribution to all SMEs*	*Percentage of Norwegian EU contribution to Norwegian SMEs*	*Norwegian deviation from the average, in percentage points*
HEALTH	15.0	5.4	–9.6
BIO	14.7	15.0	0.3
ICT	15.2	15.5	0.3
NMP	22.7	13.3	–9.4
ENERGY	18.9	10.2	–8.7
ENVIRONMENT	12.1	8.2	–3.9
TRANSPORT	17.7	20.0	2.3
SSH	5.1	1.1	–4.0
SECURITY	21.7	14.5	–7.2
SPACE	14.1	2.6	–11.5
Total Cooperation	16.3	11.6	–4.7

Source: European Commission

Participation on the part of large Norwegian companies is lower under FP7 than under previous framework programmes. Only five per cent of the EU contribution under FP7 allocated to Norway is provided to large companies. Compared with participation in FP5 and, to a certain extent, FP6, this indicates that large Norwegian companies have participated less in FP7 than was previously the case. This applies to Telenor, Hydro, Statoil and KONGSBERG, among others. The main exception here is DNV, which has been involved in 75 proposals thus far, of which 36 have been selected for funding. MARLO AS is the Norwegian SME that has participated most actively in FP7 and is among the 20 most active SMEs in the reference countries. MARLO AS is the Norwegian branch of an international company specialising in technology development and consulting services in maritime transport and logistics.

All in all, the participation of industry in FP7 (normalised for R&D size) is still high in Norway compared with the reference countries. The SME theme and the Eurostars programme are examples of outstanding participation results on the part of Norwegian industry. These programmes are, however, small. There are clear indications that large Norwegian companies have demonstrated less interest in participating in the framework programmes than previously, and that Norwegian SMEs are participating less in the more scientific components of FP7 than SMEs in other countries.

Institute sector

Independent research institutes receive roughly 40 per cent of the total contribution allocated to Norwegian research environments under FP7 (cf. Figure 21), and

thus comprise the largest R&D-performing sector under FP7. This also represents a large share of the EU contribution compared with Sweden and Denmark, but the institute sectors in those countries are small. Compared with Finland, whose institute sector is approximately the same size as Norway's, independent research institutes show an essentially equal share of the EU contribution. At the same time, there is wide variation in participation.[21] Many of the roughly 60 independent research institutes in Norway do not participate at all, or participate only to a limited extent, in FP7. The SINTEF Group is by far the largest Norwegian actor in FP7. The Institute of Marine Research, Nansen Environmental and Remote Sensing Center, the Norwegian Institute for Air Research (NILU), the Norwegian Institute of Food, Fishery and Aquaculture (Nofima), the Norwegian Institute for Agricultural and Environmental Research (Bioforsk), the Norwegian Institute for Water Research (NIVA), the Norwegian Institute for Nature Research (NINA) and Peace Research Institute Oslo (PRIO) have all received more than EUR 4 million in FP7 funding.

21. It is difficult to compare the institutes' participation across the countries on the basis of R&D size because of major variations in the structure of the institute sector among the indicator countries and Norway and because of the general challenge of classifying the technical-industrial institutes in the R&D statistics. For a discussion of these issues, see Solberg et al. (2012).

Other

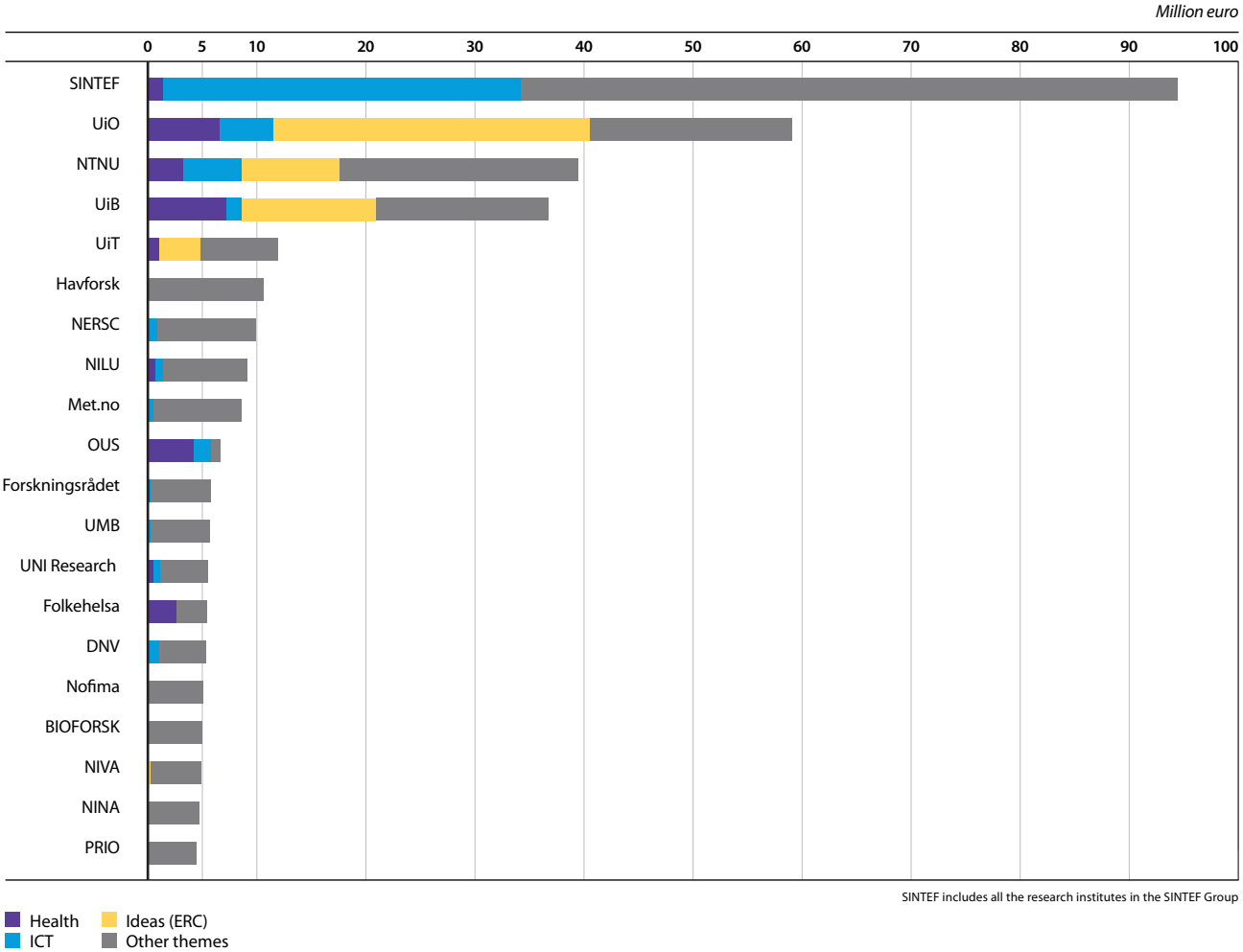
A range of other organisations from the institute sector as well as public agencies and public organisations also take part in the framework programmes. The Research Council of Norway, for example, participates in a large number of projects under the ERA-NET scheme. The objective of these projects is to develop and fund joint research programmes in cooperation with other countries in selected thematic areas and subject fields.

2.8 Participation of individual institutions

This section looks at the research organisations with high participation rates in FP7 as a whole or its individual

24
EU contribution to the 20 most active Norwegian actors under FP7

Source: European Commission: E-CORDA (contracts)



SINTEF includes all the research institutes in the SINTEF Group

themes. No *official international statistics* are available on the amount of research carried out across national borders at universities (measured in R&D expenditures or number of researchers) for the individual institutions included in the R&D statistics.[22] For this reason, the comparison of the EU contribution allocated to the various institutions is presented, for the most part, without normalisation for size.

Over 370 different Norwegian organisations receive funding under FP7. The four most active institutions receive a total of 48 per cent of the overall EU contribution to Norwegian researchers under FP7. Approximately 80 organisations (primarily SMEs, government agencies and municipalities) are registered as having received less than EUR 100 000 under FP7. Many research institutions have not participated at all.

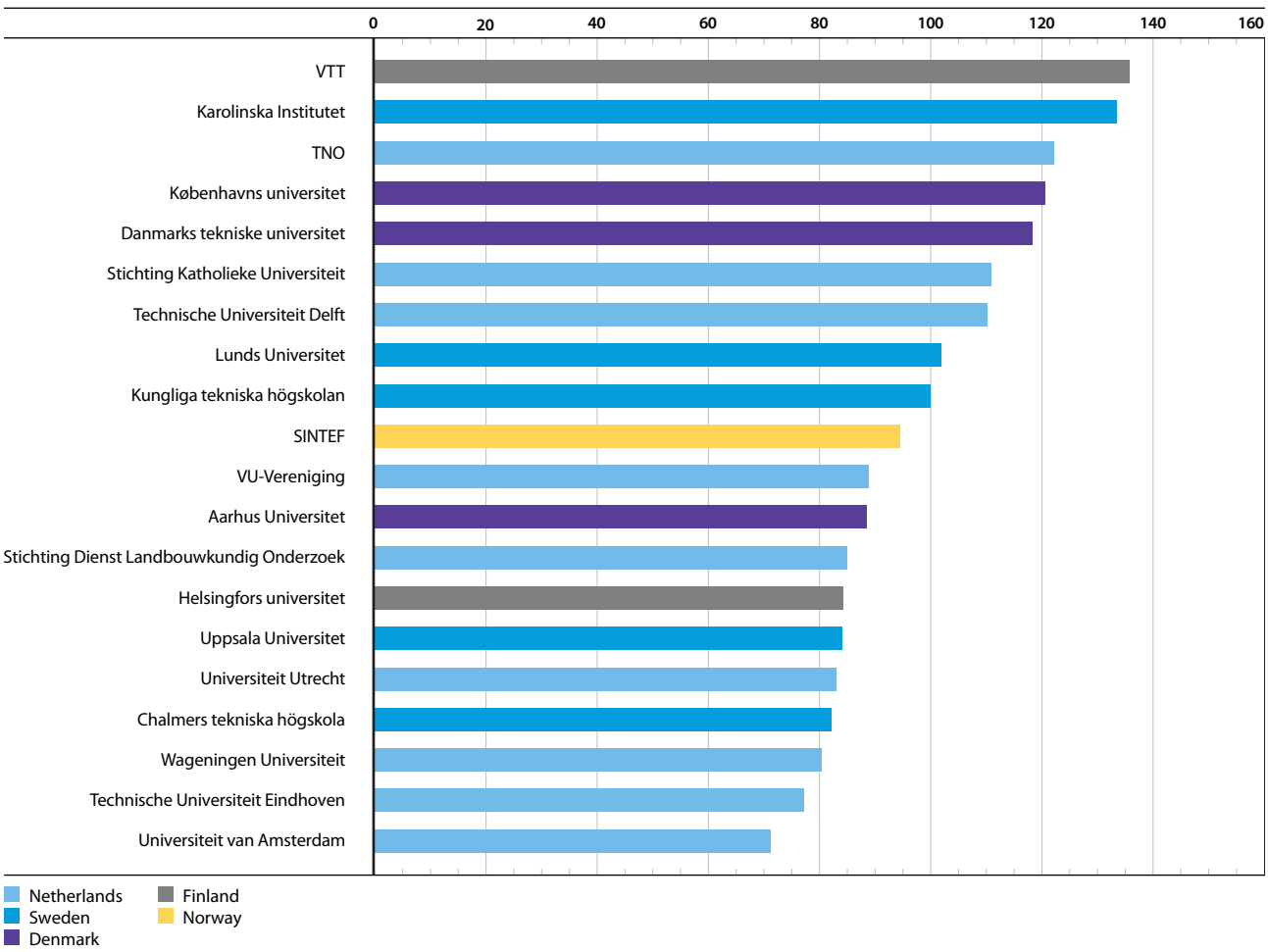
22. Statistics on R&D expenditures and R&D FTEs for Norwegian universities and university colleges are available to the public on the NIFU website.

Most of these largest R&D performing companies in Norway have only participated in FP7 to a very limited extent.

Figure 24 shows the distribution of FP7 funding among the 20 most active Norwegian actors by the Health theme, the ICT theme, the Specific Programme Ideas (ERC), and other FP7 themes. The SINTEF Group accounts for 20 per cent of the entire FP7 contribution to Norwegian actors. Of this, a total of 35 per cent was allocated under the ICT theme. SINTEF is otherwise an active participant under the Specific Programme Cooperation. The University of Oslo (UiO), the Norwegian University of Science and Technology (NTNU) and the University of Bergen (UiB) are the three universities that receive the most funding under FP7. UiO receives close to 12 per cent of all FP7 funding to researchers in Norway while NTNU and UiB account for approximately eight per cent each. UiT The Arctic University of Norway, the Institute of Marine Research (*Havforsk*), the Norwegian

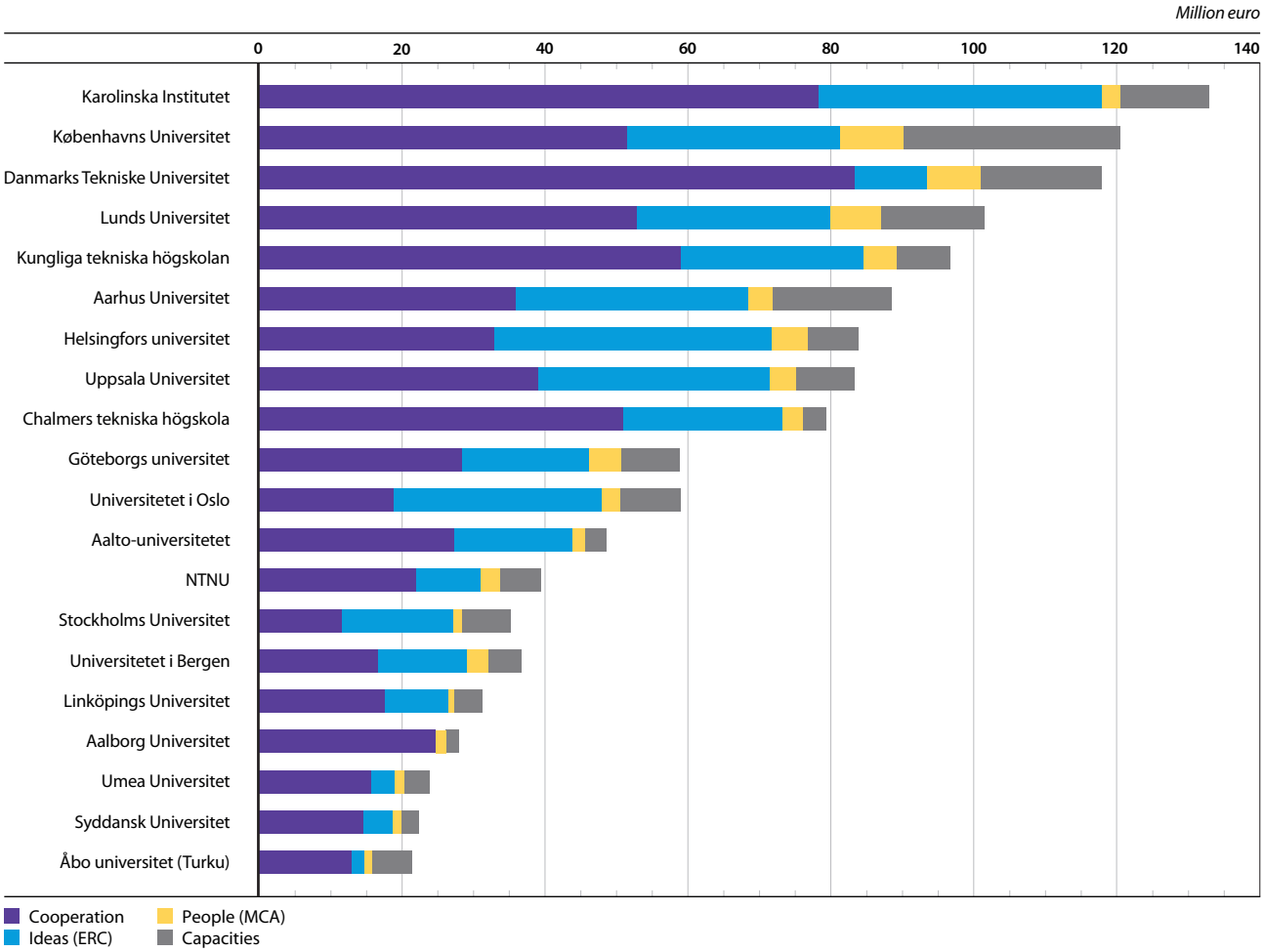
25
EU contribution to the 20 most active actors in the reference countries

Source: European Commission: E-CORDA (contracts)



26
EU contribution to 20 selected Nordic universities by Specific Programme under FP7

Source: European Commission: E-CORDA (contracts)



Meteorological Institute (met.no), Oslo University Hospital (OUS), the Research Council of Norway (*Forskningsrådet*), the Norwegian University of Life Sciences (UMB), Uni Research, the Norwegian Institute of Public Health (*Folkehelsa*), Nofima, Bioforsk, NIVA, NINA and PRIO are also involved in a large number of EU projects.

The Nansen Environmental and Remote Sensing Center (NERSC) is the research institution in Norway that receives the most funding per researcher (FTE), ahead of Gjøvik University College (HiG) (not shown in Figure 24). Other Norwegian research institutions with the highest share of the EU contribution per researcher include NILU, PRIO and SINTEF.

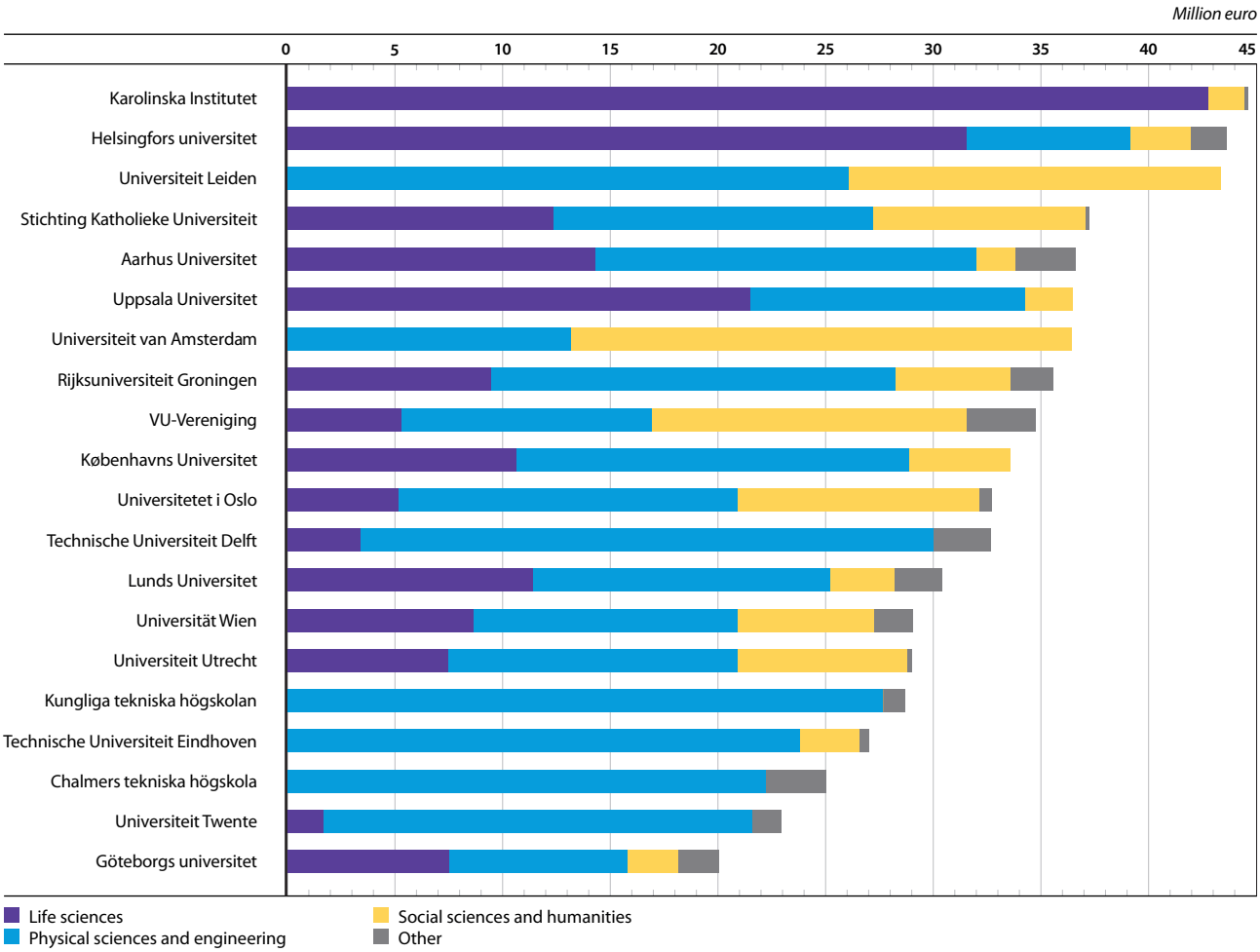
Figure 25 shows the top 20 recipients of FP7 funding in the designated reference countries. Only one Norwegian actor (SINTEF) figures among them. VTT Technical Research Centre of Finland heads the list, followed by Karolinska Institutet and the Dutch institute TNO at numbers two and three, respectively. Karolinska Institutet is a very active participant in the Health theme as well as in the ERC under FP7. Three Danish universities are among the top 20, listed fourth, fifth and twelfth. Eight Dutch universities are also included in Figure 25.

Figure 26 shows the 20 Nordic universities that receive the highest EU contribution under FP7 by participation in the Specific Programmes. UiO is eleventh on the list; NTNU is number 13 and UiB number 15. A major portion of the FP7 funding allocated to UiO comes from the ERC (50 per cent). The University of Helsinki (ranked seventh in Figure 26) is the only actor with a share of the EU contribution under the ERC (46 per cent) approximately equal to UiO.

As stated previously, no official data on the amount of research carried out in universities across countries are available. The European Commission has funded a pilot project (the European University Data Collection (EUMIDA)) that has generated harmonised information and data for some 2 000 European institutions of higher education. The dataset is available online and contains

27
EU contribution to the 20 most active actors in the reference countries under the ERC

Source: European Commission: E-CORDA (contracts)



figures for categories such as the number of academic personnel per institution in 2008. Danish higher education institutions are not included in the EUMIDA dataset. Using these figures, a comparison of the participation of the universities listed in Figures 24 and 25 above has been carried out, controlled by number of academic personnel. However, it is important to note that in the absence of an official international database on R&D size at the institutional level, the following comparison of the institutions' participation in EU programmes may contain flaws.

Chalmers University of Technology is the institution receiving the highest EU contribution per academic personnel of the 34 universities included in the comparison. NTNU receives a lower share of the EU contribution per academic staff compared with other technical universities. The EU contribution allocated to Chalmers University of Technology per academic personnel is over three times greater than for NTNU. Measured in this manner, the Technical University of Denmark (ranked fifth in Figure 25) also appears to receive a much higher share of the EU contribution than NTNU.

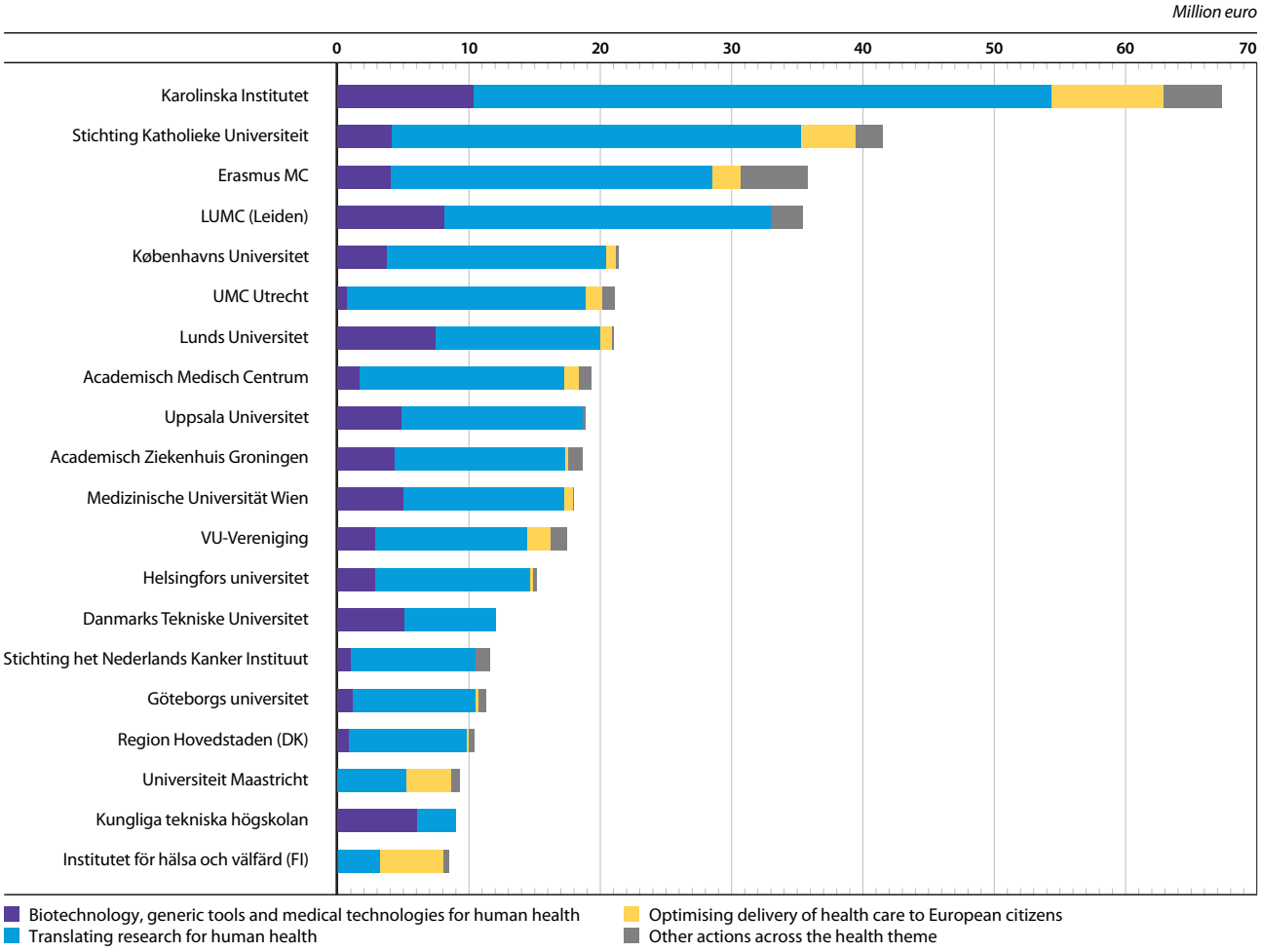
The differences between the general universities are not as pronounced. Uppsala University, Lund University and UiB receive an approximately equal share of the EU contribution per academic personnel and rank at the top among the Nordic general universities. UiO receives roughly 30 per cent less than Uppsala University per academic personnel. However, UiO appears to receive as much of the EU contribution per academic personnel as the University of Copenhagen (number two in Figure 26). Wageningen University, a Dutch university oriented towards health, food and the environment, is an active participant in FP7. Wageningen University receives four times as much of the EU contribution per academic personnel as UMB.

As previously indicated, the largest themes under FP7 are ICT and Health and the ERC. It is interesting to examine which research organisations in the reference countries have the highest participation in these themes.

Figures 27, 28 and 29 show that Karolinska Institutet tops the list of the 20 actors receiving the most funding under

28
EU contribution to the 20 most active actors in the reference countries under the Health theme

Source: European Commission: E-CORDA (contracts)



both the ERC and the Health theme among the reference countries. UiO is ranked eleventh among the top 20 receiving the most funding under the ERC, and the SINTEF Group is third among the top 20 receiving the highest contribution under the ICT theme. Philips, Ericsson and Volvo are three examples of companies with large research budgets that participate actively in the ICT theme. There are no Norwegian companies listed among the top 20 recipients of funding under the Health theme.

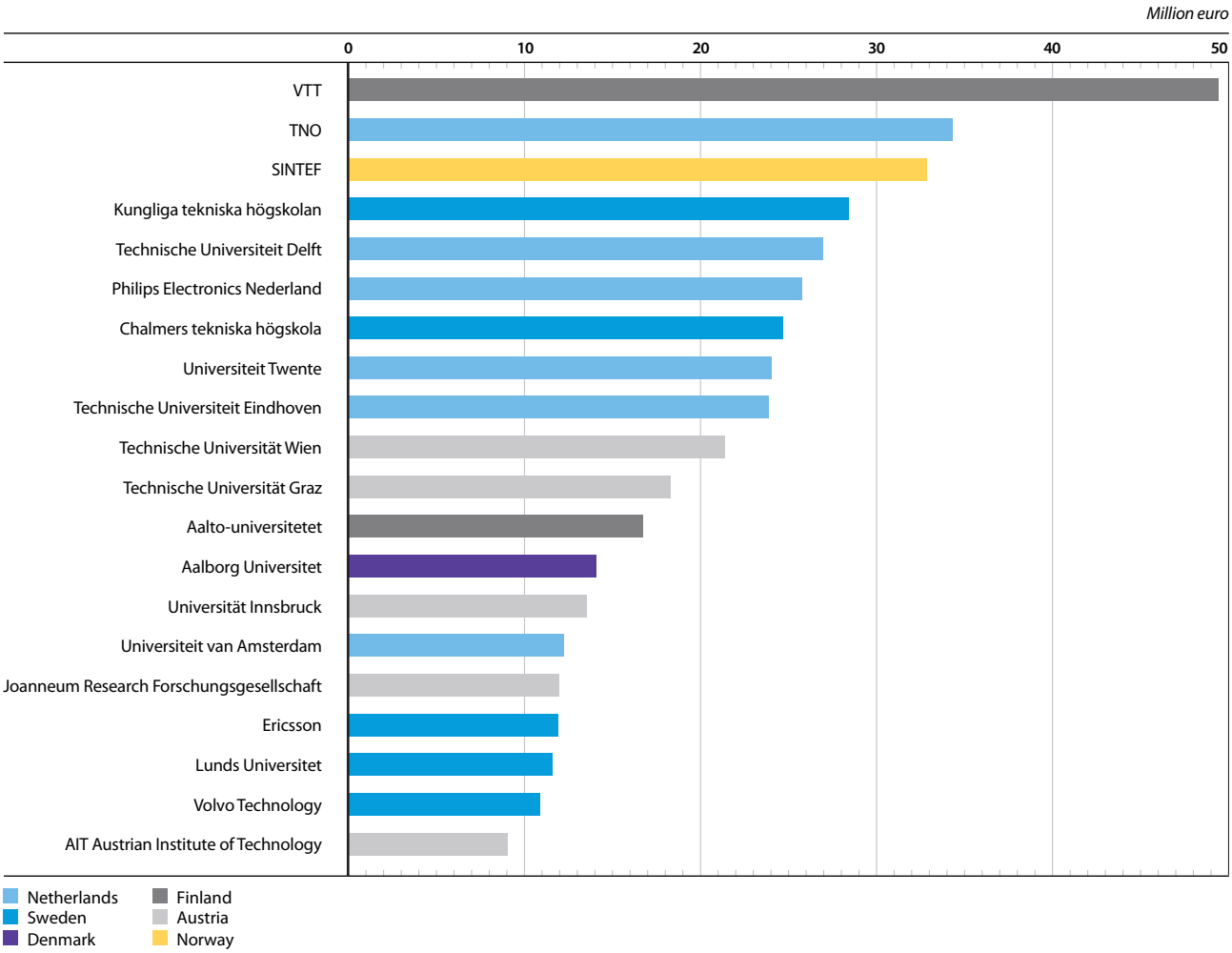
Figure 30 compares the FP7 participation of five selected technical-industrial institutes. These five independent research institutes are large technical-industrial institutes in the reference countries. The SINTEF Group is the largest Norwegian actor among them, with a turnover of EUR 359 million in 2011. VTT is a well-known technical-industrial institute in Finland, with a turnover of EUR 278.5 million. TNO is a similar institute in the Netherlands, with a turnover of EUR 577 million. The Austrian Institute of Technology (AIT) and Joanneum Research are two Austria-based technical-industrial institutes. AIT's turnover in 2010 was EUR 128 million, while Joanneum Research had a turnover of EUR 38.8 million in 2011.

The participation profiles of these five independent research institutes are comparable, but certain differences are worth noting. Funding under the ICT theme constitutes a significant proportion of the EU contribution under FP7 for all five of the institutes (approximately 35 per cent of the overall EU contribution under FP7), but is largest for Joanneum Research (65 per cent). Compared with the other four institutes, the SINTEF Group has the highest participation in the Energy theme, receiving an EU contribution equal to that of the four other technical-industrial institutes combined (roughly EUR 20 million).

At the same time, Figure 30 shows that the EU contribution allocated to the SINTEF Group, relative to turnover, was smaller than for VTT and Joanneum Research, but slightly larger than for TNO and AIT. Both VTT and TNO have a significantly higher level of basic funding measured

29
EU contribution to the 20 most active actors in the reference countries under the ICT theme

Source: European Commission: E-CORDA (contracts)



as a share of total turnover (approximately 30 per cent) than SINTEF (seven per cent).

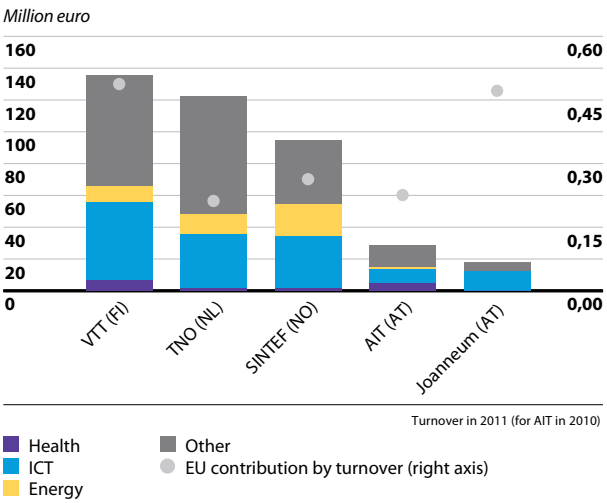
Figure 31 illustrates the participation level and profile for each of the five largest Norwegian universities. Adjusted for size (R&D expenditures), UiB receives the highest EU contribution.[23] Of the five largest Norwegian universities, UiO has the highest participation under the ERC, also when adjusted for size.

Figure 32 shows that Gjøvik University College has the highest FP7 participation among all the universities and university colleges in Norway, both in terms of absolute numbers and adjusted for the size of the institutions (the scale on the right axis in Figure 32 is comparable to the scale in Figure 31). The FP7 participation among all the remaining university colleges is relatively minor. This may be explained in part by the fact that the research profile of

23. This also applies if the Health theme is excluded, cf. "Overall FP7 excluding Health" in Figure 31. Projects in the field of health vary somewhat in terms of institutional placement – in health trusts or universities.

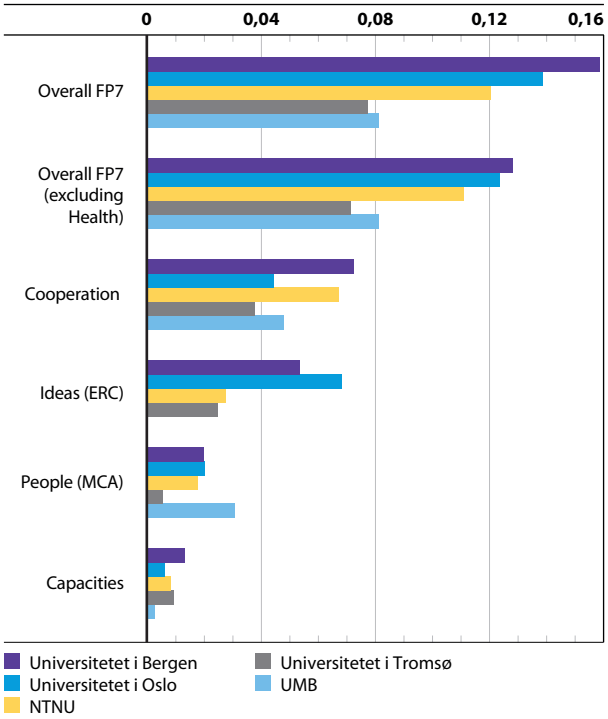
30
EU contribution to selected technical-industrial institutes in the reference countries
By selected FP7 theme and normalised on the basis of turnover

Source: European Commission: E-CORDA (contracts) and Erawatch



31
Normalised EU contribution to selected Norwegian universities
Overall EU contribution under FP7 by total R&D expenditures in 2011, by Specific Programme

Source: European Commission: E-CORDA (contracts)

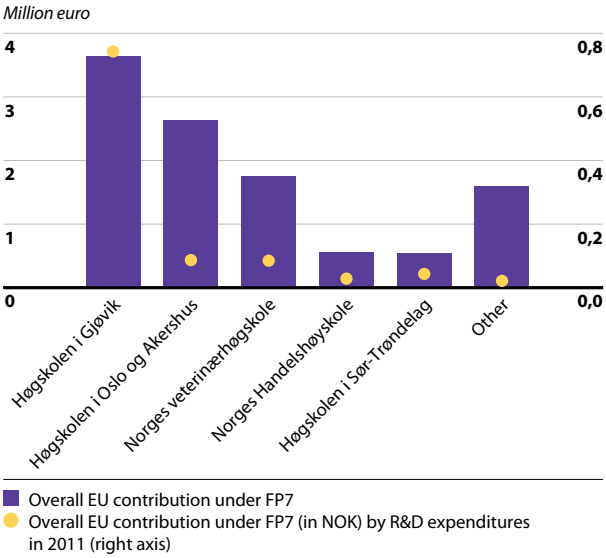


university colleges is largely focused on the professions, and FP7 does not fund much research of relevance to this. Figure 33 shows the development of the EU contribution allocated to the SINTEF Group, UiO and NTNU (the figure may be compared with Figure 18). The estimated growth in the annual EU contribution from the framework programmes between 2002–2004 and 2010–2012 was 225 per cent for SINTEF, 86 per cent for UiO and 74 per cent for NTNU.

SINTEF, UiO, UiB and NTNU account for roughly one-half of the EU contribution to Norway under FP7. When R&D size is taken into account, however, institutions such as the Nansen Center, Gjøvik University College, NILU, PRIO and SINTEF emerge as the most active Norwegian participants. UiB has the highest participation among the five largest universities, adjusted for R&D size. UiO has a high degree of participation under the ERC, whose focus is on frontier research and scientific excellence. In a comparison between actors in the other reference countries, the SINTEF Group is the only Norwegian institution ranked among the 20 largest actors.

32
Participation in FP7 by Norwegian university colleges
Overall EU contribution and normalised on the basis of R&D expenditures

Source: European Commission: E-CORDA and NIFU



2.9 Financial aspects of Norway's participation in the framework programmes

Financial returns refers to the difference between the overall EU contribution researchers in Norway receive under a framework programme and the contribution Norway pays to participate in the framework programme. The *balance of contributions* is defined as the ratio between the EU contribution and the contribution paid by Norway for its participation in the programme. It is important to monitor the development of the financial returns and the contribution balance on an ongoing basis during the programme period. For reasons described below, this is no easy task. To understand why this is so, it is necessary to first explain how the Norwegian contribution is calculated and thereafter look at various methods of calculating how much EU contribution has been allocated to researchers in Norway.

How is the Norwegian contribution calculated?
Article 82.1 (a) of the EEA Agreement provides the basis for calculating Norway's financial contribution to the EU framework programmes. Norway's contribution in a given year corresponds to a share of the *payments appropriations* entered in the general budget of the framework programme that same year. This share corresponds to the ratio between Norway's GDP and the sum of the total GDP for the EU and Norway, at market prices from two years previously. This is referred to as the *proportionality factor*. For example, the proportionality factor for the Norwegian contribution in 2013 (2.68 per cent) is based on the GDP ratio between Norway and the EU from 2011.

The EU budget contains two types of appropriations: *commitments* and *payments*. The *commitment amount* in a given year is the sum of all expenses that the EU has committed to pay that year or in the future. All commitments must be entered into within the course of a programme period (2007–2013 for FP7). *Payments* on the other hand may be disbursed for several years after a programme has officially been concluded.

The Norwegian contribution is therefore determined by the budget of the framework programme's payments appropriations for the individual year, by the proportionality factor and by the Euro exchange rate at the time of payment.[24] Since the payments period is considerably longer than the programme period, the total allocation on the national budget for a given year typically comprises the sum of the contributions to two framework programmes.

In addition to financing research projects, the framework programmes' budgets cover funding for related activities, for the operation of the EU's research institutes (the Joint Research Centre (JRC)), and for the administration of the framework programmes. Administrative costs make up roughly eight per cent of the budgets. Expenses relating to the JRC account on average for approximately three per cent of FP7's overall budget (see Table 2.1), and are also not part of the available competitive funding.

The total Norwegian financial contribution to a given framework programme can thus first be ascertained after the final payments have been made, which may be five to six years after the programme period has ended. The total Norwegian contribution to FP7 will therefore not be known before the sum of all commitments undertaken during the programme period has been disbursed, most likely in 2018 or 2019.

Figures are, of course, available for the annual contributions Norway has made thus far under FP7. However, because the profile of the payments by FP7 in the years following 2013 is as yet unknown, as are developments in the proportionality factor and Euro exchange rate, Norway's annual contributions in the years to come and its overall contribution to FP7 can only be estimated.

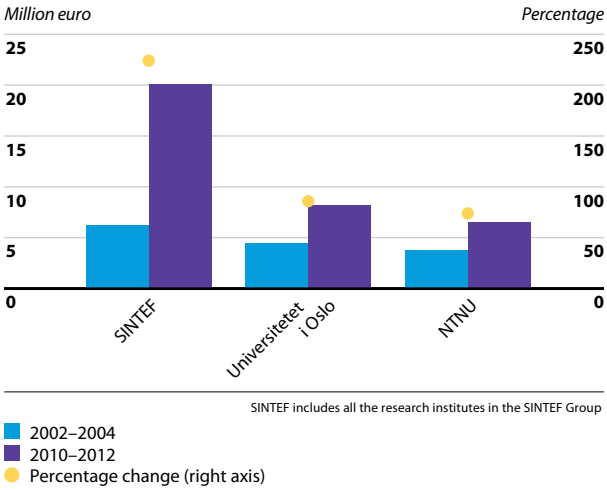
Methods for calculating financial returns

All EU contributions allocated to research actors in the participating countries for projects selected for funding are registered in the E-CORDA database. This provides a good overview over contractual *commitments* to Norwegian partners under FP7. The allocated EU contribution, however, is not disbursed in full at the time the grant agreement is signed, but rather as smaller payments over the course of several years, depending on the progress and duration of the project. The development of Norway's financial returns under FP7 can therefore not be measured by comparing the sum of the Norwegian contribution to FP7 (payments) at a given point in time with the EU contribution allocated to Norwegian partners as registered in the E-CORDA database (commitments) at that same point in time.

24. Any difference between the budgeted payments and the payments recorded in the accounts will lead to adjustments to the Norwegian contribution, which will be made two years later.

33
Estimated annual EU contribution to Norwegian institutions in the periods 2002–2004 and 2010–2012

Source: European Commission: E-CORDA (contracts)



Changes in the distribution of project funding may arise after the grant agreement has been signed. In addition, there is no central registry of *payments* to the various partners. The European Commission pays a sum to the responsible project coordinator, who distributes the funding internally in the project. The payments themselves are not recorded in the E-CORDA database, only the budgeted commitments. It would be *helpful* to have information on the total amount of EU contribution *disbursed* to Norwegian partners over a specific period, as this would make it possible to compare it with the total Norwegian contribution in that same period. Because these figures are unavailable, alternative methods must be used for estimating the development of the financial returns and the balance of contributions. Three different methods are presented below.

Method 1: Share of EU contribution divided by the proportionality factor

A country's *share of EU contribution* is the ratio of the funding allocated to partners in that country and the total amount of funding available for allocation. This is calculated on the background of information in the E-CORDA database. The share of EU contribution under the core activities of FP7 can be calculated rather accurately and

its development can be monitored on a quarterly basis. The share of EU contribution under other FP7 activities for promoting ERA is more difficult to calculate. However, the RCN has estimated it with the help of available (but not necessarily exhaustive) data. As discussed above, the Norwegian share of EU contribution under the core activities of FP7 as per 31 December 2012 (i.e. other FP7 activities are not included here) was 1.68 per cent (cf. Figure 19).

The relationship between the share of EU contribution and the proportionality factor provides a good estimate of the balance of contributions. If the balance is greater than 1, this means that researchers in Norway are repatriating a proportionally greater amount of the EU contribution from the competitive funding than the amount Norway contributes. Conversely, if the balance is lesser than 1, researchers are receiving less support under the framework programme than the amount Norway contributes.

The advantage of estimating the balance of contributions in this manner is that it provides an *indicator of financial return* that can be monitored on an ongoing basis from the start of the programme period. It is also important to follow the development of the shares of EU contribution under the various segments of the framework programme to identify areas that require special follow-up.

The disadvantage is that the indicator only measures the balance of contributions on the basis of the amount of competitive funding that Norway has an overview over, i.e. excluding funding for the JRC, administrative costs and other FP7 activities that Norway does not have insight into. The current contributions balance for FP7 is estimated at 0.67, based on a proportionality factor of 2.5 per cent and a Norwegian share of EU contribution of 1.68 per cent. The use of this method requires the calculation of adequate estimates of the proportionality factor for the entire payment period.

Method 2: EU contribution divided by a "fabricated" Norwegian contribution calculated on the background of budgeted annual commitments

As discussed above, the Norwegian contribution is calculated on the basis of payments from the framework programmes and thus cannot be compared with figures from the E-CORDA database. However, given a hypothetical situation in which Norway (like Switzerland) pays a contribution based on commitments, a "fabricated" contribution can be calculated which can then be compared with figures from the E-CORDA database and for the other FP7 activities over which Norway has an overview.

The advantage of this method is that it can be used from the start of a framework programme (like Method 1) and that it includes both competitive funding and non-competitive funding (unlike Method 1). This estimate will therefore be a bit lower than the estimate derived using Method 1. This provides a control to determine whether the estimate derived using Method 1 is relatively accurate and can help to indicate whether Norway's overview over other relevant FP7 activities is deficient. The disadvantage of this method is that there is often a discrepancy between the actual and the fabricated Norwegian contribution due to changes in the proportionality factor after a framework programme has been concluded.

This returns indicator for FP7 is currently estimated at 0.66 (including the EU contribution from other FP7 activities).

Method 3: Deviation from estimated total Norwegian contribution for the framework programme

The total budget of a framework programme is known when the programme is launched. The overall Norwegian contribution can be estimated by calculating an average proportionality factor for the entire *payments period* of the framework programme. It is possible to monitor the development of the EU contribution allocated to researchers in Norway with the help of the E-CORDA database, and thus to have an overview of the discrepancy between the total EU contribution and the estimated total Norwegian contribution at any given time. The advantage of this method is that it provides a continual overview of the exact development of the financial returns. The disadvantage is that this method is not productive to apply in the initial years of a framework programme, particularly those with a seven-year programme period, such as FP7 and Horizon 2020. Thus far, researchers in Norway have received NOK 4.7 billion under FP7: NOK 4.2 billion for the core activities of the framework programme and NOK 500 million for other FP7 activities. Given an estimated total contribution of NOK 10 billion (based on a proportionality factor for the entire duration of FP7 of 2.5 per cent), this currently results in a negative financial return of NOK 5.3 billion.

However, a number of proposals submitted in response to FP7 calls have not yet been fully processed. During the remainder of 2013 and the course of 2014, the E-CORDA database will be updated with new projects in which researchers in Norway hopefully make up a significant share. In addition, there was an exceptionally large amount of competitive funding available for allocation in 2013. While it is certain that Norway will have a negative overall financial return from FP7, it will be significantly less than the NOK 5.3 billion mentioned above.

The three methods for monitoring the development of the financial returns and the balance of contributions described above are all valuable and should all be employed in the future. Financial return is an important

aspect of Norwegian participation and should be used actively. However, it must be noted that financial return is *not* an accurate measure of the quality – whether good or poor – of the Norwegian participation in the framework programme. Norway's positive development in GDP in relation to the EU's GDP will have a major impact on the contribution balance, and in combination with the relatively small size of the Norwegian research system, this will result in a negative financial return from the framework programmes.

Development of the Norwegian contribution

In the 2007–2013 period, Norway will have paid a contribution totalling roughly NOK 6.5 billion to FP7 (cf. Table 2.3 below), meaning that the country will have a remainder of approximately NOK 3.5 billion to pay after the programme period has ended in 2013.

As a result of the growth in Norway's GDP, the proportionality factor has increased from 2.15 per cent in 2007 to 2.68 per cent in 2013 and to 2.92 per cent for 2014. Should the growth in Norway's GDP continue to be higher than that of the EU's, the proportionality factor will continue to rise. With regard to FP7, the increase in the proportionality factor has comprised a significant portion of the increase in Norway's estimated total contribution from the NOK 8.9 billion stipulated in Proposition No. 48 (2006–2007) to the Storting[25] to approximately NOK 10 billion in 2013.

Comparison with the reference countries

Unlike Norway and Switzerland, the other reference countries do not pay an annual contribution. While the method for calculating the Norwegian contribution is set out in the EEA Agreement, the method for calculating the Swiss contribution is stipulated in a separate bilateral agreement between Switzerland and the EU. Although the methods are fairly similar, there is one important difference: Switzerland's contribution is calculated on the basis of the annual budgeted commitments and not on the basis of the annual budgeted payments, like Norway's contribution.

Figure 34 is based on a scenario in which all of the reference countries and Switzerland pay a contribution calculated in the same manner as Norway's, and shows how the ratio between the share of EU contribution and the proportionality factor would look (the numerator and the denominator for the balance of contributions, respectively; cf. Method 1 above). Norway's GDP is larger than Finland's, Denmark's and Austria's, and somewhat smaller than Sweden's. However, the countries participate in the framework programme on the background of the size

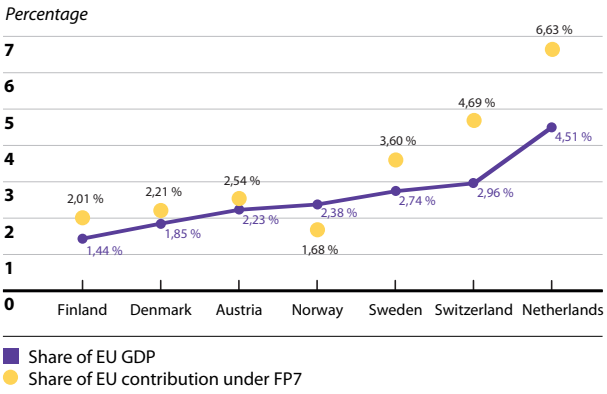
25. Proposition No. 48 (2006–2007) to the Storting, on acceptance for participation in an EEA committee regarding the incorporation into the EEA Agreement of the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007–2013), Ministry of Foreign Affairs. (Norwegian only)

Table 2.3 Annual contribution payments to FP7

Year	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
NOK mill.	192	677	912	891	1010	1167	1694

34
National share of EU GDP and share of EU contribution under FP7

Source: European Commission: E-CORDA (contracts) and Eurostat



of their national research systems. As mentioned above, Norway has the smallest research system of the reference countries. The difference between the relative *financial size* and the relative *research size* (measured in total R&D expenditures or number of researchers) explains in part why Norway, unlike the reference countries, has a negative financial return.

The point is that the proportionality factor (and contribution payments) are governed by factors that are outside the Norwegian research system but that play a key role in the development of Norway's financial returns and balance of contributions. Calculations show that given a proportionality factor of 2.2 per cent for FP7 as a whole, researchers in Norway could achieve a contribution balance of 1 (calculated on the basis on Method 1) from repatriating NOK 682 million less of the EU contribution than if the proportionality factor were 2.5 per cent.

The share of EU contribution is affected by factors related to features of the Norwegian research system and may (to a certain extent) be influenced by research policy. Normalised shares of EU contribution and other normalised indicators used earlier in this section are therefore better suited to give a comparative picture of the level (high or low) of Norwegian participation in the framework programme.

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