Chapter 6.

Improving science, technology and innovation system governance in Norway

This chapter discusses the state-of-the-art and potential of the science, technology and innovation system governance framework to provide strategic orientations and ensure the necessary co-ordination to achieve the three overarching objectives of the government's Long-Term Plan. It begins with an overview of the historical evolution of science, technology and innovation governance and policy in Norway. It then examines the main current policy actors and governance arrangements, before assessing the added value of the LTP as a strategic plan and co-ordination instrument. The last section synthetises the achievements to date and remaining challenges in improving science, technology and innovation system governance in Norway.

The history of science, technology and industry governance and policy in Norway

Norway gained its full sovereignty only in 1905, after being joined in a union with Denmark for three centuries and then, for nearly a century, in a union with Sweden. In both cases, Norway enjoyed a high degree of autonomy but was not fully independent. Industrialisation in Norway arrived late by comparison with the larger continental economies, and it came only in a few regions. The economy was long dominated by shipping, agriculture, forestry, fisheries and mining. These industries and the sectors that supplied them tended to be local and limited in scope. Today, however, building on these industries and on the recent development of the oil and gas industry, Norway today is among the richest countries in Europe, with a unique financial capacity in reserve to face challenges in the future.

A three-stage industrial development path

The historical development of Norway can be described as an evolution of three developmental paths that co-exist even today in the Norwegian innovation system (Wicken, 2009a).

The small-scale decentralised path was driven by the needs of agriculture, forestry and fisheries, and provided incremental growth and learning opportunities for smaller scale industrial development, e.g. in shipbuilding. This path was embedded in local communities and of low capital intensity, and was financed through communal savings banks and gradual innovation. Many Norwegian companies today grew out of such environments; in addition, Norway still has a tradition in regional communities of protected spaces and of companies serving local needs. Over the decades, centralised distribution and financing channels have evolved, helping to preserve decentralised smaller producers that still play a major role. Newer developments, like the expanding fish-farming sector, started with hands-on experience and gradually turned into more organised R&D activities. These involved universities and research institutes and subsequently transformed into a more mature industry that requires ever more scientific expertise to allow for environmentally friendly growth (Wiig Aslesen, 2009).

The large-scale centralised path has evolved along with industrialisation and the management of national resources. The large-scale use of hydropower allowed for the processing of basic materials for the production of metals, alloys, pulp and paper, fertilisers and other energy-intensive basic industries like aluminium smelters. These industries were capital-intensive, influential in politics, increasingly knowledge-intensive and in part state-owned. This led to large investments – often of foreign capital – in the decades around 1900, based on some of the largest hydropower installations in Europe. Drawing on the power sources, industrial companies were created in different parts of the country. A small number of (academic) innovators were part of this development from the outset. Later, these companies relied more on R&D capacities of Norwegian higher education (HE) and public research (PRI) institutes for product and process innovations (Moen, 2009). Some were at the heart of the creation of the first industrial clusters.

The development of the offshore oil and gas sector was also part of this second development path. State companies, private national and, in particular, foreign countries were granted concessions to exploit the Norwegian Continental Shelf. In cities like Bergen, Stavanger or Trondheim, specific scientific and technical clusters emerged, resulting in specialised engineering clusters and the highly specialised shipbuilding

industry serving the oil and gas industries (Engen, 2009). Oil and gas has remained a key sector, even when oil prices were low (see Chapter 2).

Finally, an R&D-intensive network-based path developed from the 1960s onwards. Knowledge producers, with the pervasive force of information and communications technology (ICT), began to play an increasing role in the economy and in society. Research and development became a greater part of the production process, with labs integrated into production settings. Companies with strong ICT competences became important nodes in these large industry networks. This development was coupled with an active innovation-oriented industrial policy approach (Wicken, 2009b).

The three developmental paths – each with their own path dependencies – co-exist today in Norway's innovation system. Some industries, like shipbuilding, which was once local and decentralised, have since become large-scale and specialised (Wicken, 2009a). In the post-World War II era of active industrial policy, the influence of corporatist, collaborative elements favourable to research grew (Gulbrandsen and Nerdrum, 2009). Later, knowledge producers co-evolved with industries in, for example, the marine, maritime or oil and gas sectors.

The emergence of innovation policy

During this process, innovation has been vital in allowing Norway to seize opportunities, drawing upon and co-operating with a system of higher education institutes (HEIs) and public research institutes (PRIs). These were built gradually, evolving out of different origins (Gulbrandsen and Nerdrum, 2009; Fagerberg et al., 2009). The state was instrumental in guiding these developments, using different policy approaches during the different developmental stages.

The big wave of institution building came in the post-war period. The first university was founded only in the early 19th century, followed by a few others at the turn of the 20th century. The first PRIs were created by sector industries before World War II. Regional economic and societal needs (Cooke, 2016), as well as conservatism and the dominance of the "consensus principle," appear to be among the reasons why the organisational R&D landscape developed late and then resulted in multiple and rather small institutions.

Science, technology and industry (STI) policy in the earlier phases of development had a strong focus on regulatory and investment incentives. Hydropower and the rights to exploit waterfalls led to specific regulatory instruments, which were then adapted to other industries, like oil and gas. These concession laws were developed in the early 1900s to allow for large-scale investments, while at the same time requiring that the non-public owners return ownership of their sites to the state after 60 years. They also provided incentives for Norwegian (co-)ownership in industrial investment (Wicken, 2009a; Moen, 2009). This helped boost the state share of industrial ownership, which is still very high (NOU, 2016, Figure 1.20). At a later stage, some of these companies, for example, Norsk Hydro, attempted to expand and diversify, with mixed success. The concessions were coupled with specific tax instruments, most notably the requirement to invest part of the returns in Norwegian technological capacities. This has helped to develop a local/national knowledge base, in contrast to other North Sea oil and gas industries, for example in Denmark or the United Kingdom (Fagerberg et al., 2009).

Norway's economic development was also marked by periods of active technology-based industrial policies in the post-war era. These were mainly led by the so-called modernisers, an influential fraction of the Social Democrat party. These policy makers

combined two goals: first, they aimed to strengthen the capacity of Norway to defend its territory with the help of a robust armaments industry;[1] second, they actively supported the development of companies, mainly in the information and communications technology (ICT) sector, through a research-driven strategy for industrialisation (Wicken, 2009b). This led to a few remarkable national champions. Some of them were brought to an abrupt end in the 1980s and early 1990s, as a result of a mix of risky strategies, the small size of Norway's home market and the emergence of a few US and Asian global champions of ICT (Sogner, 2009). This shock weakened the dynamics of active industrial policy in Norway. A positive result of this top-down policy approach, however, was the major build-up of high tech, or ICT, capacity for civil and defence purposes.

Collaboration between public and private actors increased in the 1960s and 1970s, together with the creation of a strong national support structure, including grants, loans, tax deductions and regulation favourable to innovation. On the funding side, the Royal Norwegian Council for Scientific and Industrial Research (NTNF) was created as early as 1946, under the auspices of the ministry in charge of industry. In 1949, the Norwegian Research Council for Science and the Humanities (NAVF) was added, a funding organisation for basic research, with some sub-councils. A further proliferation of actors with different funding roles ensued, whose limited performance and ability to interact and manage cross-cutting issues were repeatedly criticised (Arnold et al., 2001). This led in 1993 to the creation of the Research Council of Norway (RCN) as a singular council to cover all scientific fields and most of the application-oriented research funding, with special responsibilities for the PRI sector and a role as advisor for the government. The portfolio of the council has not changed significantly since. It is still the dominant operational actor in innovation policy.

RCN was supplemented in 2004 by Innovation Norway (IN), an innovation funding agency with a pronounced regional mission.[2] IN traces its history to the first real estate loan bank, Hypotekbanken, started 150 years ago to support rural development. It was followed by specialised financial instruments like Industribanken before World War II and the Regional Development Fund in the post-war period, and then by the Industry Fund and other instruments. These all were merged into IN as a single organisation. The Industrial Development Corporation of Norway (Siva) was founded in 1968, focusing on physical infrastructure.

Main policy actors in science, technology and innovation policy

The overall policy landscape and its guiding principles

Overall policy principles

Norway is a constitutional monarchy with a parliamentary democracy. The legislation and overall budgeting is decided in the single-chamber Norwegian parliament, the Storting. It enacts legislation, approves the national budget, authorises plans and guidelines for state activities and votes on bills and proposals by the government.[3]

The annual budget proposal to the Storting is subject to extensive negotiations within the government. For individual policy initiatives, plans and strategies, the government and individual ministries can formulate white papers and submit them to the Storting. Although of a different form and scope than previous white papers on research, the 2014 Long-Term Plan for Research and Higher Education 2015-2024 (LTP) itself is a white paper.

Norway can be described as a centralised state, most of whose policy fields and budgets are governed at the central government level (for the regional level, see Box 6.1). Public R&D spending almost exclusively comes from central government budgets. The government, led by the prime minister, includes 15 ministries, and each, under the Norwegian constitution, is quite independent in terms of policy formulation and execution.

Box 6.1. **Regional innovation policy in Norway**

Norway has three levels of government: the central government (NUTS1), 19 counties (at the NUTS3 level) and 426 municipalities (at the NUTS5 level; currently some mergers are under way). The Ministry of Local Government and Modernisation (KMD) is responsible for regional development. Since the administrative reform of 2010, the county councils have had greater responsibility for regional economic development and innovation, for instance in the Regional Research Funds and the regional VRI R&D programme, to facilitate collaboration between regional industries, R&D and public institutions on innovation. The counties are also developing regional plans central to strategies related to innovation policy. Below the county councils, municipalities are responsible for business planning and land use, but do not receive funds directly to support innovation-oriented activity (Dahl Fitjar, 2016).

Innovation Norway (IN) has regional offices in all county administrations, and regional boards to encourage co-ordination with other regional actors. Its regional apparatus is well developed, giving it considerable insight into regional business environments (Oxford Research, 2016). The RCN, IN and Siva, the Industrial Development Corporation of Norway, also jointly operate the Norwegian Innovation Clusters, an agency that finances regional business clusters through the Arena, Norwegian centres of expertise (NCE) and global centres of expertise (GCE) programmes.

A recent report by Oxford Research (2016) evaluated the interface between Innovation Norway, Siva, RCN and the county authorities. It concluded that, despite the overlapping objectives in support of knowledge-based innovation, there is good communication between the different actors involved. The division of roles between the agencies is, it argues, clear and well delineated, with successful co-operation between the actors at the national level in all overlapping areas of policy. However, the study argues that the roles and division of responsibilities are less clear at the regional level, particularly in relation to activities associated with needs assessment and mobilisation (e.g. VRI, the regional R&D and innovation programme). This also applies to counselling and mentoring support activities for entrepreneurs and firms, and in the context of innovation companies, for which there seems to be a lack of unified responsibility.

Sources: Dahl Fitjar, R. (2016), "Towards a regional innovation policy?"; Oxford Research (2016), *Simpler and Better? Interfaces Between Innovation Norway, the Research Council, Siva and County Municipalities*.

Science, technology and industry policy

The Norwegian science, technology and industry (STI) policy landscape has some unique features. One of its main structuring elements is the sector principle, with the consensus principle as an underlying approach to policy making. The sector principle is a constitutional principle that gives each ministry a great deal of independence in terms of policy formulation and execution within its policy portfolio, including for matters of research and innovation. Each ministry decides, for instance, how much resources it will devote to research and innovation (Solberg, 2016; OECD, 2008). This can generate issues with horizontal co-ordination.

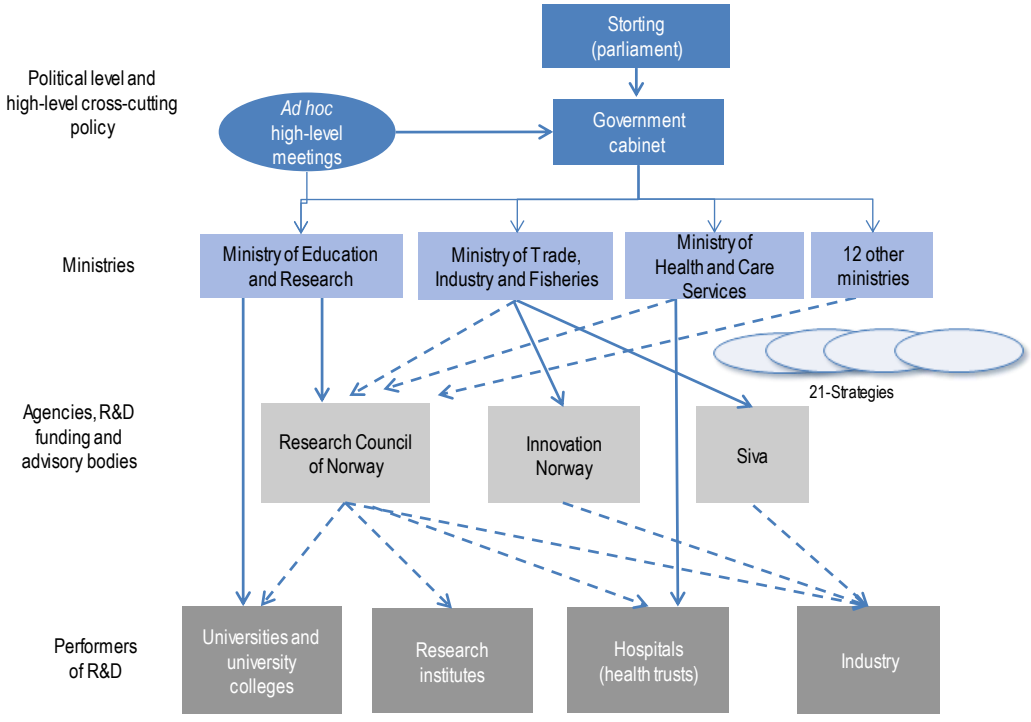
As a result of the sector principle, nearly all ministries have research budgets. Three of them (the Ministry of Education and Research, the Ministry of Trade, Industry and Fisheries and the Ministry of Health and Care Services), however, account for 75% of the appropriations in 2016. This alleviates to some extent the challenge of co-ordination in a highly sectorial policy set-up. However, while R&D budgets are the most visible parts in STI policies, the mobilisation of other resources, like regulatory power, human resources and other "qualitative" and "technical" policy measures, can be even more important for successful cross-departmental policy delivery, e.g. in health, transport or other public sector innovations.

As a member of the European Economic Area, Norway is required to follow EU R&D state aid rules, which govern the types of innovation and industry-oriented measures the government can support. These rules stipulate what types of activities are eligible for support, which costs relating to these activities may be covered in part or in full, and the maximum aid intensity that may be granted for the various activities.

Main actors on the ministry level

Figure 6.1 shows the most important actors and the relations between the different policy levels, with the central role of RCN and the specific advisory and co-ordination structures.

Figure 6.1. **Main science, technology and innovation policy actors and governance relations**



Source: MER (2016a), "Background report: OECD Innovation Policy Review of Norway".

The Ministry for Education and Research (MER) is responsible for universities, university colleges, a small section of the institute sector and for co-ordinating general research policy within the limits of the sector principle. It allocates half of all government budget allocations for R&D, including the block funding for HEIs and a large share of the

RCN budgets. MER's respective departments for research and department for higher education are responsible for the governance of RCN and of the HE sector. Within this scope, MER employs both hard and soft governance and co-ordination instruments, albeit within its own sector (see Chapter 3). Hard measures include performance-based funding or university legislation; softer measures consist of a mix of incentives and pressure in the case of university mergers.

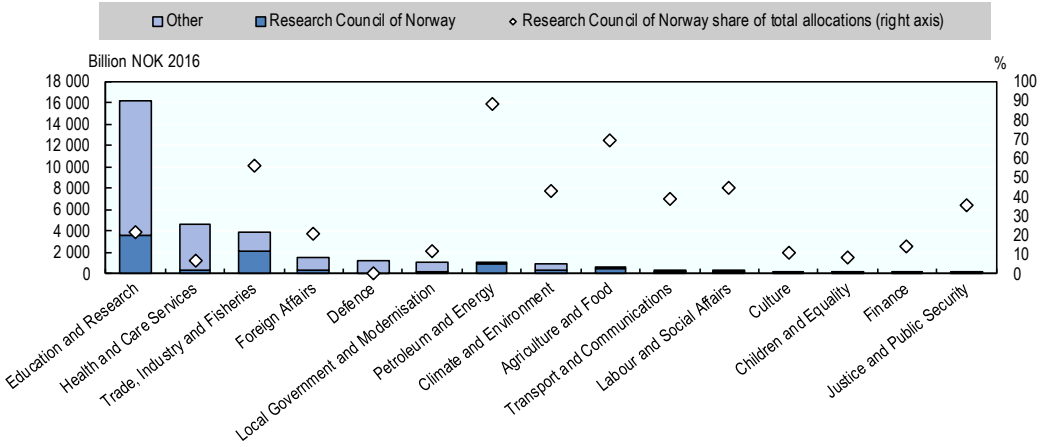
The Ministry for Trade, Industry and Fisheries (MTIF) is the result of a merger in 2014 of the Trade and Industry and Fisheries portfolios. It commands the third-largest R&D budget after MER and the health ministry. It has overall responsibility for industrial and innovation policy and its own research and innovation department. It is the authority governing IN, with 51% ownership shares, while 49% belong to the county authorities. Siva is also owned by the ministry. It also provides a quarter of RCN funding and is responsible for the technical-industrial public research institute (PRI) sector.

The Ministry for Health and Care Services is the second-largest provider of public R&D spending after MER. This is due to considerable budget growth in recent years. This ministry takes a special role, as a large percentage of its budget is not channelled through RCN programmes.

Other ministries with considerable R&D portfolios include the Ministry of Foreign Affairs, the Ministry of Petroleum and Energy, the Ministry of Climate and Environment, the Ministry of Local Government and Modernisation and the Ministry of Agriculture and Food. The Ministry of Defence also can dispose of a considerable funding budget, which in part is reserved for its own sector Research Institute, the Norwegian Defence Research Establishment (*Forsvarets forskningsinstitutt*, or FFI).

Figure 6.2 shows the pattern of R&D allocation per ministry and how much goes through RCN. This RCN percentage share varies widely.

Figure 6.2. **Government budget allocations for R&D by funding ministry and recipient, 2015**



Source: MER (2016a), "Background report: OECD Innovation Policy Review of Norway", based on NIFU and RCN data.

The Research Council of Norway

Structure, positioning and responsibilities

The Research Council of Norway has been the dominant intermediary actor in Norwegian STI policy since 1993. It has a unique position and mandate among OECD countries,[4] since it combines funding for basic research as well as for applied, industry-oriented and collaborative research. The council's role (RCN, 2015a) is among other things, to "promote an integrated R&D system that supplies high-quality research, develops knowledge for dealing with key challenges to society and the business sector, fosters dynamic interaction within the R&D system nationally and internationally, and creates a framework for learning, application and innovation".

RCN is also responsible for co-ordination tasks across different policy sectors, for research and policy evaluations, for strategic and financial steering of the institute sector and for providing strategic advice to the government on science and technology (policy) matters. This is a combination almost unique by international standards. The reasons for its comprehensive mandate originated in the major co-ordination problems of Norway's council and funding system before 1993, as well as in the sector principle.

RCN is government agency reporting to MER with special extended authority. Its funding comes from nearly all ministries (MER provides 40% and MTIF 25%). Its overall budget was NOK 8.5 billion (about EUR 950 million) in 2015, quite substantial for a country of 5 million people (see Box 6.2), although it includes some block-funding elements for PRIs. About 25% of all public R&D funding is channelled through RCN (Solberg, 2016). It has more than 470 employees, and in 2015, awarded grants to about 5 000 projects, from large-scale funding of scientific centres to small individual grants to small and medium enterprises (SME).

RCN has a three-layered board structure, consisting of an Executive Board, its highest authority, four division research boards and 60 specific programme boards and committees. Each of these boards includes members from different walks of life (universities, UCs, institutes, industry, etc.). The two top layers are staffed with Norwegian representatives. Of 512 programme board members, 38 are not Norwegian. A large majority of the external experts reviewing RCN applications and serving on panels for proposal evaluation is recruited from abroad.

The RCN's operations are run by the chief executive, plus four executive directors responsible for the four topical divisions (science; innovation; society and health; energy, resources and the environment), complemented by a fifth division for administrative tasks and a few horizontal units, including a unit responsible for international activities.

The council has adopted six main objectives for the period 2015-2020 under a new strategy (RCN, 2015a): 1) increase investment in breakthrough research and innovation; 2) enhance research for sustainable solutions in society and the business sector; 3) cultivate a more research-oriented, innovative business sector; 4) promote a public sector that initiates and implements research in reform and renewal efforts; 5) increase international co-operation and participation in EU initiatives; and 6) serve as a strategically oriented research council to promote coherence and renewal in the research system.

With this strategy, RCN has also made a first step to incorporate the LTP priorities, a plan the Council welcomes, since it states to have been instrumental in its design process. Some concrete activities are linked to the LTP and its budget appropriations to RCN, including young research talent and increasing EU participation.

Box 6.2. The Research Council of Norway's scope and budget in a four-country comparison

The Research Council of Norway (RCN) has a substantial budget. It is difficult to compare it directly with other countries' innovation agencies, as it is more than simply the combination of a research council and an innovation agency; other countries have much more diversified funding structures. Sweden has more than half a dozen potentially comparable organisations and Denmark at least three.

Small countries that allow for an easier comparison include Switzerland, Finland and Austria; however, the goals are different: In Switzerland, over 80% of third-party funding is allocated via the Swiss National Fund (SNF) to fund academic research and only 20% via the "applied" Commission for Technology and Innovation (KTI). In Austria, applied research funding dominates. Over 70% goes to the "applied" Austrian Research Promotion Agency (FFG) and only 30% to the Austrian Science Fund (FWF). In both countries, this ratio has remained stable for a long period. In Finland, the Academy of Finland (AKA) funds academic grants and TEKES, the Finnish Funding Agency for Innovation, funds applied research and innovation. The relation is more balanced, but has changed considerably: in 2008, the TEKES budget (then EUR 530 million) had been more than 75% higher than the AKA budget (then EUR 300 million).

Table 6.1. **Research funding in selected small advanced European countries**

Country	Inhabitants (millions)	"Basic" research funding (million EUR)		Applied research funding (million EUR)		Total (million EUR)	Budget per capita (million EUR)
Norway	5	RCN (estimated 2/3 for "applied" research funding)			**850**		170
Austria	8.5	FWF	200	FFG	520	720	85
Finland	5.5	AKA	440	TEKES	380	820	149
Switzerland	8	SNF	800	KTI	150	950	119

Note: All numbers are approximate and refer to the years 2014/2015.

Sources: Websites of the organisations.

RCN is exceptional in organisational terms. Its funding budgets are high (namely for more applied research, and given the additional opportunities for Norwegian companies provided by the Skattefunn tax incentive scheme). The overall amount is nevertheless comparable to what countries like Finland offer as a funding base.

Main RCN programmes

One of the particularly important actions within the current RCN strategy for the period 2015-2020 is to strengthen activities aimed at providing knowledge-based advice and simple-to-use, readily accessible funding instruments (RCN, 2015a).

The RCN is now running a three-digit number of distinct programmes and initiatives. As a result of rationalisation efforts in the years before 2012, it reduced the number of funding programmes or schemes from 229 to 178 over the 2000s (Arnold and Mahieu, 2012). In recent years, the number fell even further, to nearly 130 individual initiatives, including about 30 larger programmes.[5] Although much progress has been made, this is still a considerable number, by comparison with other, larger countries.

The funding programmes and schemes can be clustered into different categories (see Table 6.2).

Table 6.2. **Main RCN funding programmes related to societal challenges**

Type of research programmes	Programme purpose
Research programmes	Creation of new knowledge in thematic areas addressing public sector interest, or industry branches through user-directed innovation programmes. Depending on the research area and recipients, projects are either 100% government financed, or, in the case of user-directed programmes, on a shared cost basis with private actors.
Large-scale programmes	Long-term knowledge to identify solutions to societal challenges. Funding through a wide variety of actors from industry, academia, the public sector and the civil society, including: – BIOTEK2021: Agriculture, marine, industry and health – HAVBRUK – Sustainability, marine – NANO2021 – Nanotech and advanced materials – KLIMAFORSK – Climate change research – PETROMAKS2 – Petroleum research – ENERGIX – Energy research – IKTPLUSS – Increasing ICT relevance.
Independent projects	Individual independent academic research with funding in three pillars, according to scientific area, and top-up funding for young researcher programmes.
Infrastructural and institutional measures	Comprehensive funding according to institutional measures: – Basic funding (with performance-based element) for 48 PRIs. – R&D support for groups outside government framework. – Funding equipment and database creation.
Centre schemes	To support "critical mass" mainly in HEIs and PRIs. Supporting networks, research excellence and organisational capabilities. Supporting specific goals that need a certain size, funding and visibility. Current centre schemes run by RCN are: – SFF (centres of excellence) – Enable larger research communities for long-term, basic research. – SFI – linking academic and industrial partners for industrial research. – FME – research programme on green energy challenges. – NCE (together with IN) – Encourages regional industrial innovation.
Networking measures	Soft measures, including funding networks that constitute approximately 5% of the overall annual budget.

Sources: MER (2016a), "Background report: OECD Innovation Policy Review of Norway"; Solberg, E. (2016), *RIO Country Report 2015: Norway*, https://rio.jrc.ec.europa.eu/en/library/rio-country-report-norway-2015, and RCN homepage: www.forskningsradet.no/en/Funding_schemes/1138882212929.

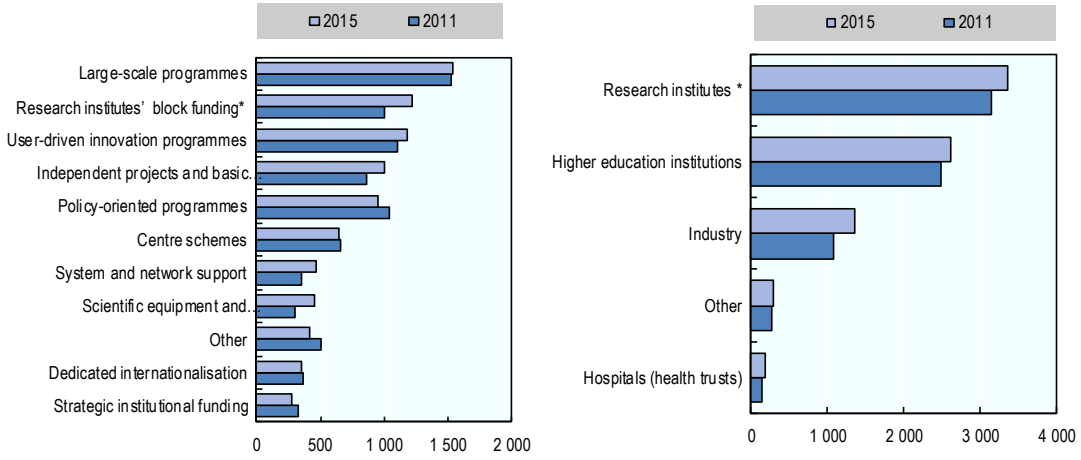
Analysis of the allocation of RCN funding to the different instruments in recent years shows that budgets for bottom-up projects, infrastructure and PRI block funds have increased, but other funding lines have stagnated (Figure 6.3).

Innovation Norway

Innovation Norway (IN) is the second major provider of public support for innovation. It was created in 2004 as a merger of different public business support banks and agencies, including agricultural, industrial growth and export-funding instruments. The agency is co-owned by the MTIF (51%) and the county authorities (49%), with 700 employees all over Norway. The agency is governed by a board of directors, which appoints 15 local boards to steer its regional offices. Its overall budget is NOK 3.4 billion (about EUR 380 million). NOK 2 billion is provided by the Ministry of Trade, Industry and Fisheries, NOK 716 million by the Ministry of Agriculture and Food (reflecting IN's important role in this sector) and NOK 471 million by municipalities. The rest comes from the Ministry of Foreign Affairs for internationalisation matters, and from the Ministry of Local Government and Modernisation (Innovation Norway, 2016).[6]

Figure 6.3. **RCN funding by type of instrument and recipient, rounded, 2011-15**

Million NOK



* The public research institute (PRI) percentage is in fact higher, as it also receives RCN funds indirectly through collaborative industry projects.

Source: MER (2016a), "Background report: OECD Innovation Policy Review of Norway", using RCN data.

The agency describes its task as a "broad and complex social assignment", with the support of private sector value creation at the core of its activities (Innovation Norway, 2015). IN's mission and activities have a global as well as a regional dimension. It has international offices, technology sourcing and promotion activities, export promotion and tourism marketing. IN also carries out its regional mandate through offices across Norway, with a focus on less industrialised and less central regions, which receive most of its funding.

While RCN has a unique comprehensive mission, IN is focused on more downstream and regional innovation activities. Innovation Norway's current strategy[7] has six priorities for 2020, to: 1) prioritise areas where Norway has international competitive advantages; 2) elevate the challengers with global growth potential; 3) strengthen entrepreneurial and co-operative culture to fuel the jobs of the future; 4) develop a strong national brand, to increase competitiveness; 5) encourage value creation based on regional advantages; 6) advise and provide knowledge on future-oriented innovation and industry policy. The five cross-cutting priorities are digitisation, sustainability, "Brand Norway", innovation policy (including innovation policy analyses and advisory services and developing an innovation policy think-tank) and competence building. "Green thinking" is also a common denominator of the IN strategy, including areas like clean energy, the marine environment, bio-economy and smart society.

The agency's chief areas of action are defined functionally:[8] start-ups; growth companies; clusters and business environments. Internationalisation and sustainability are the two main cross-cutting activities. The four main tools are internationalisation assistance, funding through loans and grants, cluster services and advisory services (Innovation Norway, 2016):

- Start-ups: The main goal is to support entrepreneurs. IN works on quality and growth potential with financial and nonfinancial instruments. IN directly funds companies through pre-seed, seed and early growth funding, and also supports

intermediaries like technology transfer offices (TTOs) or investment companies with special loans.

- Growth companies: Main support activities are grants and loans for company investment and growth, with an emphasis on innovation loans. This area is also linked to IN's internationalisation and export support.
- More innovative business environments: This area includes local services as well as cluster initiatives and business networks. The cluster initiative, managed in co-operation with RCN and Siva, has three layers (and a new initiative, called "Clusters as vehicles for transformation"):
  - arena: 22 comparatively smaller cluster projects
  - Norwegian centres of expertise (or NCE, also in co-operation with RCN): 14 mixed centres as the core of a cluster, each with an important regional component
  - global centres of expertise: 3 large clusters with a global reach.

Nearly half of IN's budget is allocated to the agricultural and the marine and maritime sectors. All other sectors, including tourism, industry, oil and gas, ICT and services, each receive around 10% of the agency's financial support. This is a reflection both of the traditional mission of IN and the regional structure of the Norwegian economy (Cooke, 2016). The portfolio includes both R&D and non-R&D-related innovation support mechanisms, with a focus on the latter. For a general overview, see Table 6.3.

Table 6.3. **Main Innovation Norway instruments**

Main instrument	Detailed instrument/sectors	Appropriations, million NOK (2015)[1]
Low-risk loans	Industry and services	720
	Agriculture	410
	Fishing vessels and quotas	830
Innovation loans and guarantees	Industry, services and agriculture	960
Grants	Regional development	360
	Start-up grants	370
	Environmental Technology Programme	340
	R&D contracts	360
	Clusters and networks	140
	Agriculture	690
	Other	300

1. Approximate numbers for IN spending, from authors' calculations based on the regional budgeting table in IN Annual Report 2015 (www.innovasjonnorge.no/aarsrapport/2015/assets/hovedtabell_en.png).

Source: Innovation Norway (2015), *Annual Report 2014*.

Innovation Norway's intervention has a considerable leverage effect. While a small percentage of its budget is used to provide a service structure, the rest is used for loans and grants in roughly equal amounts. Due to the nature and structuring of the loans, IN can annually provide overall financial support of over NOK 6 billion. This is further leveraged with another NOK 10 billion, provided mainly by commercial banks and equity financing as part of the financing packages (Innovation Norway, 2016). IN reports a high additionality of its funding: funded companies grow faster than non-funded ones, and IN

funding has been highly influential in helping the companies start projects or invest (Innovation Norway, 2015; 2016).

Other actors

Siva, the Industrial Development Corporation of Norway, based in Trondheim,[9] is a MTIF-owned public innovation investment company that was founded in 1968 with 40 employees. It complements its policy portfolio by investing in and owning physical infrastructure that can host promising individual companies that want to grow or to relocate. The agency has full or partial ownership of more than 40 real estate companies and a number of incubators. In addition, it has equity in more than 100 innovation companies and offers them advice, space, networks and, some cases, funding. Siva also receives funds from the Ministry of Local Government and Modernisation for its role in the three-agency cluster programme. In total, Siva is invested in 150 buildings of more than 600 000 m² and around 40 incubators housing many start-ups (MER, 2016a).

The Norwegian Industrial Property Office (NIPO) is the national intellectual property rights authority, including patents, trademarks and designs, acting under the auspices of MTIF.

Statistics Norway, established as an independent entity in 1876, and is Norway's national statistical institute and its main repository of official statistics.

Overall governance: Agenda setting, co-ordination and evaluation

Governance and co-ordination on government level

The existing co-ordination mechanisms

Government co-ordination and agenda setting is particularly challenging in the context of the sector principle, under which 15 ministries maintain their own objectives and research budgets. MER is the dominant actor in research policy, but its role as "first among equals" is achieved on the basis of the sheer size of its budget, using soft co-ordination mechanisms and lengthy negotiations. The sector principle itself is well-established and accepted. It yields a number of advantages, most notably the inclusion of all ministries in R&D policies and tasks. It comes with a price, as horizontal policy approaches are more difficult to employ.

A number of interministerial co-ordination processes soften the practice of the sector principle (see Box 6.3), mainly at the operational, rather than strategic, level. The first main instrument is an extensive weekly Cabinet meeting to discuss ministry initiatives and drafts of white papers (these are prepared through memos that are circulated among the different ministries to seek consensus). The annual negotiation of the national budget is also a crucial stage in the co-ordination of research and innovation policies. The Norwegian government uses a well-structured annual process to agree upon the financial framework and the overall ministry budgets. The process includes two large budget conferences, with negotiation rounds in between. In some years, an interministerial negotiation process is held to distribute an exceptional small "common pot" for research and innovation funding.

The Interministerial Committee on Research Policy (*departementenes forskningsutvalg*, or DFU) is a committee staffed by civil servants whose monthly meetings deal with LTP-related and other research policy issues. Last but not least, the

RCN, given its wide scope, large number of principals and its role as government advisor, acts as a *de facto* co-ordination institution.

MER has a distinct, if soft, co-ordination function in the practical operation of most of these co-ordination mechanisms. It plays a special role in the DFU civil servant committee for day-to-day government research policy co-ordination. The views of the Minister of Education and Research are solicited for all research matters in the Cabinet discussions. MER gives the Ministry of Finance advice on distribution of the common pot.

The LTP process has introduced a few additional tools to manage what has been defined as "weak co-ordination" (Arnold and Mahieu, 2012), mainly in the form of various forum and high-level meeting formats. For instance, when the LTP is prepared (and revised every four years), high-level co-ordination is required to agree on STI priorities. In its implementation, the LTP also influences interministerial negotiations in general (for instance during annual budget conferences) and within priorities (via the LTP interdepartmental groups and the annual "high-level LTP workshops"). The LTP process has also "activated and given new energy" to the DFU (MER, 2016a).

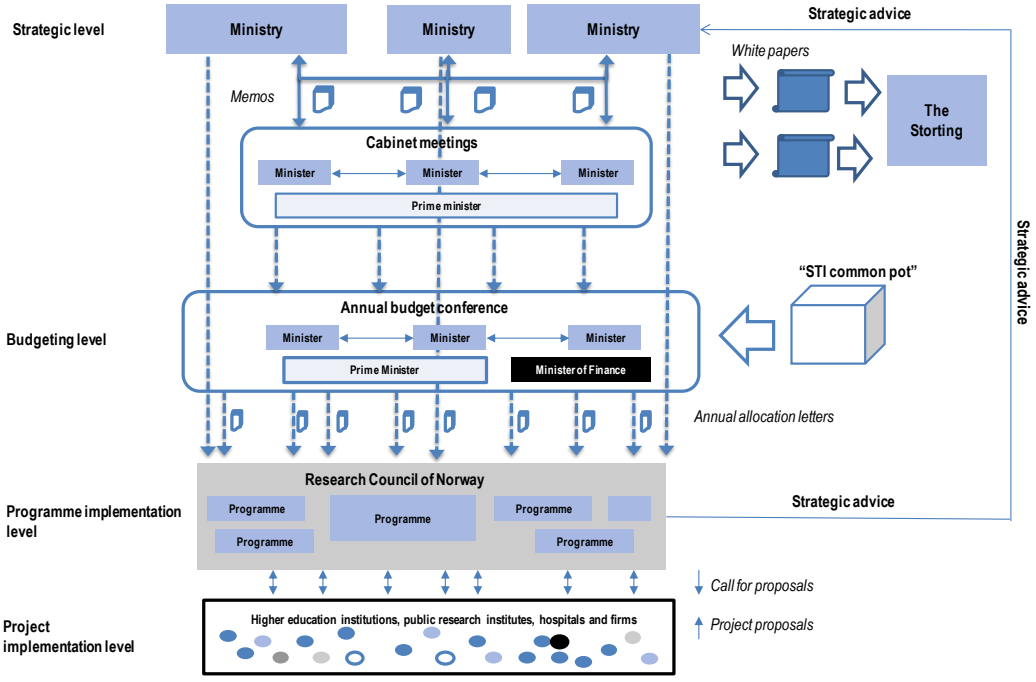
All these instruments deal with horizontal co-ordination (see Box 6.3 and Figure 6.4), but Norway's STI system is dominated by the vertical sector principle.

Box 6.3. **Main instruments and mechanisms for supporting interministerial co-ordination**

1. The discussions of science, technology and innovation policy issues in the Cabinet, supported by the work of DFU.
2. The negotiation of Science, technology and innovation (STI) budget in the context of the annual budget conferences.
3. The "STI common pot", distributed during the annual budget conferences.
4. The Research Council of Norway (RCN) as a co-ordination institution.
5. RCN activities and programmes: RCN has designed some of its funding instruments to allow for more synergies between areas (joint calls, specific provisions in calls to increase synergies, specific programmes to incentivise transfer of skills.
6. As it is drafted on a four-year cycle, the Long-Term Plan calls for some high-level co-ordination to agree on STI priorities.
7. When it is implemented, the Long term plan (LTP) influences interministerial negotiations overall (for instance during annual budget conferences) and within given priorities (via the LTP interdepartmental groups and the annual "high-level LTP workshops").
8. The "21" strategies are documents setting priorities in key Norwegian sectors. In a few cases (oil and gas, energy, health), permanent platforms support and monitor their implementation.

Until 2014, the Cabinet Research Committee (RFU) co-ordinated research policy initiatives and budget allocations. It was composed of the ministers most relevant for research policy and was headed by MER. Without formal authority, the influence of this committee was in practice limited by sectoral interests (Solberg, 2016) and it was abolished after the creation of the LTP.

Figure 6.4. **Main instruments and mechanisms in place to support interministerial co-ordination**



Vertical co-ordination

The vertical relations in Norwegian STI policy appear to be simple but numerous. There are only two major agencies on the national level. Moreover, in contrast to other countries like Belgium, Austria, Germany, Spain and Switzerland, regional policy makers have rather weak competences and act only as subsidiary actors in the STI arena. Most action is taken at the national level. There are many relations because 15 ministries place their orders with RCN and there are so many funding programmes. Meanwhile, the consensus principle (see also OECD, 2008) requires that numerous actors must to agree on potential changes in the system.

These processes are described as trust-based and "cordial", a reflection of the consensus principle. This may not reflect the full picture, since, at a higher level, trust in principle may be complicated for the following reasons:

- RCN cannot act freely, given the numerous detailed earmarks and steering processes coming from the ministries.
- The ministries, as principals, may not trust their main agent to operate without tight control. Their funding might otherwise be spent in other ways.

Horizontal co-ordination by the RCN

Bridging the gap between political decision making and the institutional logic of performing actors requires intermediary organisations. According to principal-agent theory (Braun and Guston, 2003), the principals, for example government ministries, install agencies with more operational specialisation to better serve the performing actors, to install competent negotiators for the expert communities in the policy field (Pichler, 2014) and also to minimise fraud and to provide precise incentives.

The Norwegian setting is unusual in that the agent, RCN,[10] serves the whole innovation system actor set, composed of 1+14 principals. The principals, within their sectorial realms on the "top floor", steer RCN through the annual "allocation letters" of the ministries (*tildelingsbrev)*, sent as instructions together with the sector ministries' budget allocations, as well as other instructions.

The numerous Norwegian principals thus delegate the main tasks of horizontal co-ordination to an agent on the "ground floor". This leads to operational complexity and an extensive annual budgeting process, with multiple interactions between ministries and the related communities of research actors. Another consequence is the large number of programmes that respond to the different demands.

Box 6.4. **Useful, dissolved for a reason, but leaving a gap: The Fund for Research and Innovation**

The Fund for Research and Innovation (FFN) was a special allocation instrument to ensure stable funding for RCN, with a weaker link to ministry earmarking. Set up in 1999, it received a substantial annual inflow of capital. While formally a distinct source of funds, the FFN in fact increased the Minsitry of education and research (MER) budget, mainly for the RCN to help overcome fragmentation. According to Arnold and Mahieu (2012), FFN funding streams to RCN empowered both the council and MER. The ministry could reinforce its co-ordination role. Some FFN funds were also used for activities outside RCN's scope. In the late 2000s, FFN made up 15% to 20% of RCN's budget and was used as a major source for newer instruments like centres and infrastructure; bottom-up basic research was also increased. FFN was terminated in 2011 because of low interest rates. Instead of FFN, MER's "normal" budget was increased, which, however, might "run[s] counter to the original reason for creating the fund: namely, the need for long-term and cross- or inter-sector resources in the research and innovation funding system" (Arnold and Mahieu, 2012).

As in many other innovation systems, the tendency is to respond to new challenges or demand by creating new funding programmes, rather than by directly solving structural problems, for example by governance reforms and priority setting in the PRI or HE sectors (Öquist and Benner, 2014). In Norway, the multiplicity of principals with their individual demands has resulted in a large number of such programmes. Considerable efforts have been made at the RCN level to reduce the overall complexity of the current configuration. To add flexibility to this process, the council has adopted a matrix-style portfolio of instruments, where many types of measures can be used for different sectors and principals and a broad array of criteria are available for many kinds of programmes (MER and MOF, 2017). Another strategy in recent years was to reduce the number of the programmes it runs.

The transaction costs of the current system are considerable, although they are not apparent, since they are mainly absorbed within RCN. The RCN evaluation documented the high costs associated with the sector principle and the "ground-floor" co-ordination model (Arnold and Mahieu, 2012).[11] This resulted in increasing administrative budgets and unwieldy co-ordination tasks that consumed more time than the actual programme management. Some progress has been made in recent years on overhead, task allocations and manpower. The external spending review, however (MER and MOF, 2017), has proposed further streamlining the portfolio and cutting overhead by 10%.

The consensus principle prevents any harsh confrontations, and bolder decisions need the acceptance of all those involved. Moreover, the steering by ministries is again operational rather than strategic. The RCN evaluation noted that the unit of analysis in the

steering dialogue tends to be programmes or other activities, rather than high-level objectives, and that both ministries and RCN ask for detailed, operational instructions. This does not align with the Norwegian goals of management by objectives and New Public Management.

Another concern relates to the impact of this system on RCN's excellence agenda, the time it has available to deal with the outer world and on its reactivity. RCN has to balance a demanding policy setting, which might at times collide with the mission to apply more dynamics, risk and track-change in the Norwegian system. This situation creates a "considerable risk for 'over-stretching' and 'over-planning' of RCN, where programmes are too many and too complex, intended to serve too many purposes with the risk of diluting quality demands" (Öquist and Benner, 2014).

On the other hand, the Norwegian set-up also has clear advantages: consensus fosters a robust policy setting with broad acceptance on each step taken. The learning feedback loops are numerous and lead to evolving programmes and policy initiatives.

Strategic orientation and priority setting

The multiplicity of science, technology and innovation-related strategies

Norway has a plethora of strategies, white papers, steering mechanisms and high-level groups for *ad hoc* advice. The RCN alone has 15 strategies in place for different policy issues (MER, 2016a). There are "21" strategies for all kinds of sectors, while the LTP also quotes other strategy papers. Öquist and Benner (2014) as well as the Background Report, list many high-level commission reports and other papers. This is at variance with the slow, cautious (albeit constant) policy shifts and reform processes, which can take decades. Some sector strategies, for example "OG21" for the oil and gas sector (RCN, 2012) have a very clear link between longer term goals and operational tasks, as well as RCN programmes, RCN budget allocations and the ministries' *tildelingsbrev*, and have strongly influenced the LTP. Priorities are formulated by the main stakeholders, including industry and research organisations. They are based on long-term business concerns and list a number of R&D challenges.

More generally, the evidence base is very well developed, with many evaluations, white papers and strategy forums. This is a traditional Norwegian strength (OECD, 2008). As a result, sectoral priorities are abundant (Öquist and Benner, 2014). Each of the 15 ministries has its priorities, translating into a large number of RCN programmes. RCN and IN support many thematic cluster initiatives. The LTP is also broad and quite encompassing in its priorities. There is no explicit strong mechanism at the national level for prioritisation. Norway of course may be rich enough to set a multiplicity of priorities in parallel, a view that is quite common in the Norwegian STI policy landscape. The 2008 OECD review noted contradictions between the creation of critical mass in many priority fields and regional (policy) ambitions, which aim at decentralised structures. This tendency was found to be of a piece with micro-management of ministries and their sometimes narrow priority fields (OECD, 2008). At a more granular level, priorities appear to be missing. In engineering science, for instance, no meaningful research priority-setting activities were reported, despite the importance of this field for Norway's economy. Quite the contrary, financial and human resources for research are evenly distributed over the whole field (RCN, 2015b).

The absence of a strong referee at the highest level

There is no single referee or strong external voice at the top level of Norway's policy arena to complement the interactions between MER and the other ministries. 1) The Prime Minister, due to her constitutional function, does not have a co-ordinating role, and there is no research advisory council in the Prime Minister's Office. The Ministry of Finance is in a stronger position through the budgeting process but does not act as co-ordinator. 2) RCN has co-ordination tasks but, as an operational agency below government level, is focused on keeping the multi-customer, multi-requirement system stable. 3) No external government advisory council exists, because this is RCN's role. 4) Finally, influential lobbying groups with an overall generic STI policy agenda are less visible than, for example, in Sweden, where organisations like the Royal Engineering Academy have always played an important role.

Unlike other (Nordic) countries, Norway has not established a high-level Research and Innovation Advisory Council. Finland has had such a council since the 1990s, including the prime minister and other ministers as well as high-level experts from industry and academia. In Sweden, the recently created Innovation Council includes the prime minister, four other government members and ten experts who are responsible for deal with cross-cutting innovation policy matters. Austria has established an STI policy council consisting of both local and international external experts. Such councils provide for advice, contribute to prioritisation and can play a referee role. Norwegian policy actors have been hesitant to consider such an option. They refer to RCN's as government advisor, to the (operational) co-ordination mechanisms at the Cabinet level and to general resistance: "Committees to advise government on research and/or innovation policy in Norway have had a troubled and uncomfortable history, during which few have had strong influence" (Arnold and Mahieu, 2012).

The question remains as to how to incorporate an external strategic element into the Norwegian policy making system. Given the very specific governance model, there is no obvious best practise, but there are functional needs for an external voice, for support in strategic co-ordination and also for a referee. The role of RCN as a "policy advisor from below" does not solve this issue, because the constant quest for consensus is demanding enough and because of the mere fact that the advice comes from below. This matters, as RCN is not an independent or high-level body, but closely steered by a number of ministries. For RCN the priority is to balance the various ministry demands and to get sufficient funding without too much earmarking. The advisory function is valuable, but also leads to a considerable double bind: The advisor is the main funding agency. These are colliding functions even in a consensus-based system.

The use of foresight and evaluation to support priority setting

The structure of Norway's STI policy governance implies that research policy is guided not *ex ante* by strategic decision making but is the *ex post* result of the balance between the different elements of the system. Elements of better forward planning are more typical within the individual priorities, as some of the "21" strategies show, rather than at the higher, overall level.

While smaller scale foresight exercises do exist in the Norwegian STI landscape, a more strategic and comprehensive foresight element is missing. While a Norway 2030 foresight exercise was conducted in 1998-2000 and government is using long-term overall forecasting methods, the lack of such a foresight study is remarkable. The last OECD review (OECD, 2008) already recommended conducting a national foresight exercise.

Given the many parallel priority areas in Norway, such an instrument would fit well into the overall portfolio of instruments and could be coupled with revolving use of the LTP. The policy discourse is now dominated by the question how to optimise the existing sectors. The transition challenges, however, call for a broader approach, to identify new opportunities, as well as to take a holistic view of the current Norwegian portfolio. Proper foresight activities can inform future revisions of the LTP; with one larger exercise every ten years and clear links between foresight and strategic decision making.

The government has evaluated the RCN every decade since its creation (Arnold et al., 2001; Arnold and Mahieu, 2012). These comprehensive exercises are complemented by initiatives like the RCN Spending Review 2016 (MER and MOF, 2017), or broader initiatives such as the Productivity Commission report (NOU, 2016).

Overall, Norway's evaluation culture can be characterised as typically Scandinavian, learning-oriented, open and comprehensive. Research evaluation is rooted in the Norwegian system (OECD, 2009). Within this architecture, RCN is both the main organiser and customer of evaluations. The evaluation system is professionally organised, employing well-known Norwegian evaluation groups and international policy and domain experts. It is also highly prolific, with over 100 such studies in the last 15 years, including evaluations of research disciplines, programmes and PRIs/sectors (MER, 2016a). The RCN evaluation has criticised the underuse of such evaluations, their often conservative approach and less than optimal placement within the policy cycle (Arnold and Mahieu, 2012). RCN has reacted with an appropriate new evaluation strategy. The combination of the two roles of RCN as main funder and main evaluator could in principle be criticised. However, there are no signs that this has led to overly positive evaluations. On the contrary, evaluations are frank, to the point and often critical. Many evaluations are conducted by Norwegian experts, but peer-based activities often involve international scientists. Innovation Norway uses a number of mostly quantitative evaluation exercises to prove the added value and leverage effect of its funding.

The Long-Term Plan and the Norwegian science, technology and innovation policy system

History and process of the Long-Term Plan

The LTP has the official status of a white paper (*Meld. St.*) as did previous strategic documents. Its origins trace back to the former (social democrat) government, which already had tried to build greater consensus around long-term planning in Norway. Their white paper "Long-term perspectives – knowledge provides opportunity" paved the way for a long-term plan that would include priorities for research and higher education on a ten-year perspective (MER, 2012). A key objective, as set out in this early document, was also to develop a structuring document to guide investments in this policy field and to push further structural reform in the HE sector, with three overarching objectives: 1) larger and more robust research entities and HEIs; 2) stronger regional development and increased specialisation; and 3) more efficient use of resources. The conservative successor government adopted some of these ideas and presented a Long-Term Plan for Research and Higher Education 2015-2024 (MER, 2014) in October 2014.

The planning process for the LTP officially started in summer 2013, with a number of preliminary consultation steps in spring 2013. Through a first call for input from various stakeholder and institutional actors, the MER received 150 contributions. In the following winter, high-level government meetings and summits took place, followed by intense

interactions between MER and the other ministries in a number of working groups and other negotiations and hearings. These consultations fed into the strategy process and allowed for the formulation of thematic priorities. This process led to a government decision and its presentation to the Storting in October 2014 (MER, 2016a).

The process for developing the LTP is deemed a success by many actors in the Norwegian research and innovation system, including other ministries. MER and the other stakeholders managed to accomplish the first long-term planning process in Norwegian STI policy in an expedient fashion, and with broad actor inclusion. Difi, the Norwegian Agency for Public Management and e-Government, monitored the LTP process and assessed it positively (Difi, 2015).

The Long-Term Plan as a governance tool

The LTP has some specific built-in features that differentiate it from former STI strategic documents. It aims to adopt a long-term perspective, to serve as a plan and not only a strategy, and to cover a broad policy spectrum, not confined to the policy fields in the remit of the MER. In reality, these initial expectations have been only partially fulfilled:

- Despite its formal title, the LTP is not a ten-year planning document. It has a ten-year perspective for designing longer term avenues in broad terms, but it is in practice conceived on a four-year rolling basis, with the first revision to come in 2018.
- Although the government expressed a commitment to follow up the long-term plan in the annual fiscal budgets (MER, 2014), it is not a multiannual research bill, of the kind adopted by Sweden or Switzerland. The ministry itself sees it as a new approach to make prioritisation politically more acceptable and to increase commitment for some priorities across government as a whole. Financial predictability has been increased almost exclusively in the remit of the MER. The only three concrete funding activities are all in the field of research. In other areas, actions are more broadly defined, without clear financial commitment.[12]
- The LTP employs an "asymmetric budgeting" approach, under which several ministries have provided priorities, but only MER has earmarked budgets. This can be seen as a first step towards more ambitious and broader commitments. With the first LTP, the MER set an example for the next LTP round, which, given its rolling timetable, is only a few years away. Ideally, in the next planning period, more ministries will use the LTP as a tool that entails financial commitments.
- A further limitation of the LTP is that its title does not accurately reflect its content. The Long-Term Plan for Research and Higher Education does not in practice cover HE issues in detail. MER launched another white paper dedicated to HE policy issues in January 2017 to make up for the missed opportunity. This white paper will be discussed in the Storting in June 2017.

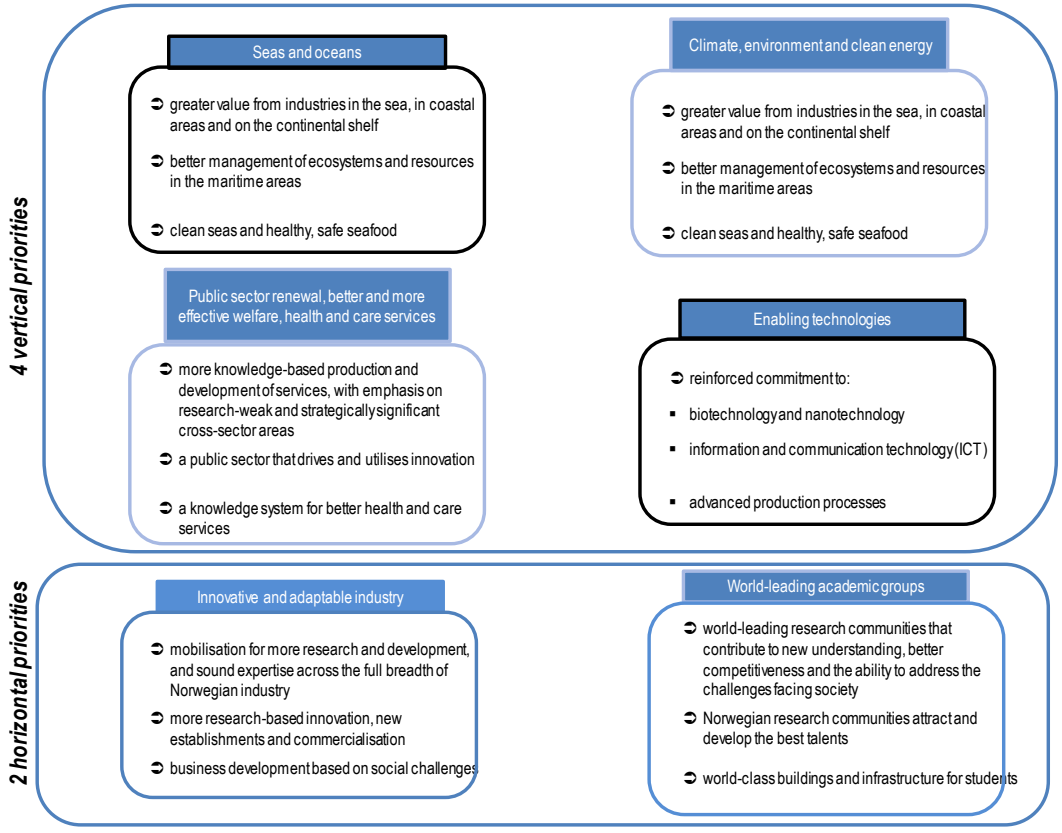
Priority setting in the Long-Term Plan

The LTP aims to increase the predictability of the Norwegian research and innovation system through a number of topical and structural priorities (see Annex B). They are embedded in a framework of three overarching government objectives for STI policy,

consistent with those of the European H2020 framework programme: enhanced competitiveness and innovation, tackling major societal challenges and developing research communities of outstanding quality (MER, 2014).

At a slightly more granular level, the Plan lays out six priority areas, four thematic and two horizontal (Figure 6.5).

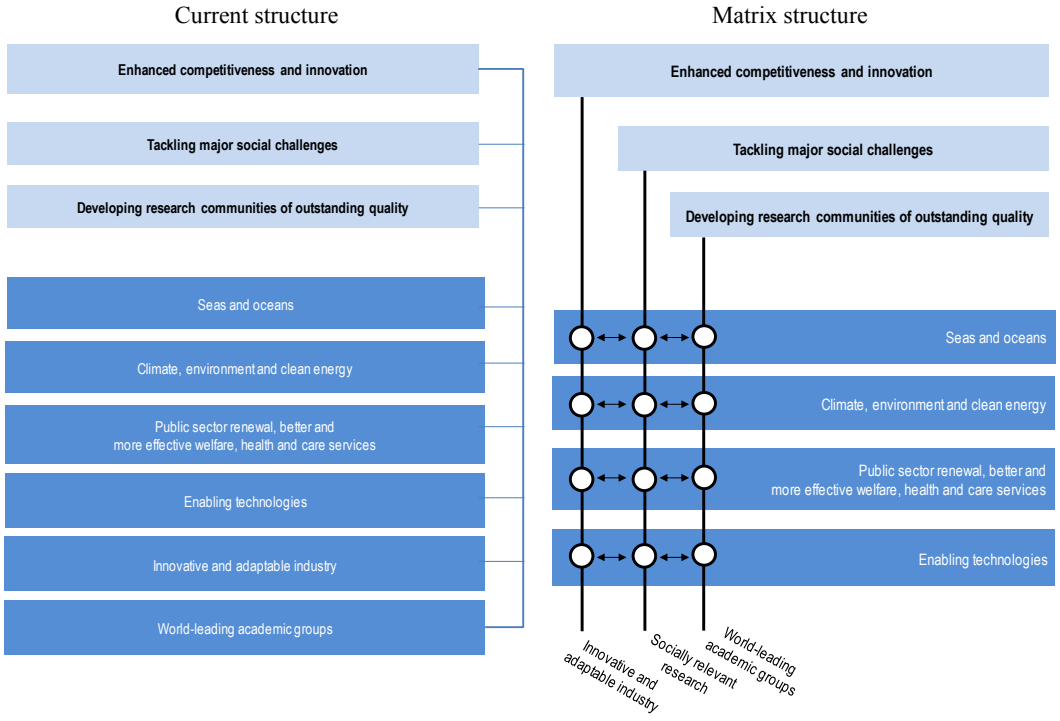
Figure 6.5. **The Long-Term Plan'ssix priority areas**



Source: MER (2014), "Long-term plan for research and higher education 2015-2024", https://www.regjeringen.no/en/dokumenter/meld.-st.-7-2014-2015/id2005541.

Although the LTP marks significant progress, the design of its priorities is strategically less than optimal. The two horizontal priorities, respectively, industrial innovation and academic research, correspond largely to two of its overarching objectives, giving the plan a somewhat intricate structure. This mix of horizontal and vertical priorities at the same level precludes a matrix-like approach allowing for systematic consideration of the research (and higher education), innovation and societal dimensions in each of the four broad thematic priorities. An approach of this kind could also have improved the co-ordination, in each of the themes, of the three dimensions themselves. As it stands, the LTP juxtaposes the research and business innovation dimensions, although experience has shown that the interface between these two is among the most critical drivers of performance in an innovation system. It is also one of the most challenging areas to co-ordinate, since, in most countries, Norway included, these two policy fields fall under different ministries.

Figure 6.6. **Example of a matrix-like approach applied to the Long-Term Plan**



The choice and scope of the priorities of the LTP also reflect the well-established tradition of the consensus principle. The LTP makes strong statements about its priorities, but their range is broad, and the LTP's approach is agglutinative rather than selective. The four thematic priorities cover very broad areas, with many sub-areas, which – remarkable for priority planning – leave few policy fields excluded. Topics like social sciences and humanities are covered in form of horizontal activities.

The LTP's priorities do not renew the portfolio of previous priorities. They are mainly linked to the "21" sector strategies and draw on existing priorities. Some even date back decades,[13] either because of the long trajectories and path dependencies of sectors like oil and gas and marine/fish farming, or because of the areas of conflict, like governance and excellence in the HE sector. This is epitomised by the significant apparent effect of the LTP priorities on the RCN programme structure and priorities, as depicted in the new RCN strategy. However, this strategy is mostly about the arrangement of existing RCN activities around the headlines and six major areas of the LTP.

A certain inertia over priorities is typical of strategic plans in many OECD countries and beyond, but the LTP seems to devote even less space to new areas, apart from the ones that might emerge from developing world-class expert environments.

However, the plan has succeeded in establishing a new approach that makes prioritisation politically more acceptable and increases commitment for some priorities across the government. It is a step in the direction of more ambitious goals in the future.

Co-ordination in the Long-Term Plan

The plan has also taken an initial step away from the "ground-floor" co-ordination model. The government seems willing to do more co-ordination work at its level. However, this structuring effect still seems superficial at this stage, even on the actions of the RCN, the key LTP implementation body. Its 2015-20 strategy, launched later, lists many goals and activities in lofty language and appears to be an effort to harmonise the LTP structure with the many ongoing RCN activities. The strategy mentions the LTP only once, stating that the RCN "will help to follow (it) up" (RCN, 2015a). For external observers, the link could be made much clearer.

The LTP has already had some effect on horizontal co-ordination, including the high-level meetings chaired by the prime minister, Cabinet discussions on STI issues, the installation of some interdepartmental steering groups at the administrative and political level, alignment work in RCN and other soft co-ordination questions (see above).

Conclusions on science, technology and innovation system governance

Co-ordination mechanisms have been instituted on an operational level, through various mechanisms and processes, but little co-ordination exists at a higher level. RCN has to deal with most of the co-ordination activities in Norway, since horizontal co-ordination tends to take place on the "ground floor" within the national policy architecture. RCN receives ministry-specific allocation letters and answers by 1) employing complex operational co-ordination and budgeting mechanisms and by 2) designing a large array of funding programmes.

One solution to these issues is to design multi-ministry sponsored programmes. This has the advantage of somewhat offsetting the sector principle, but could entail co-ordination costs. The RCN has already introduced a number of such programmes. Another option would be to increase the agency's room for manoeuvre, with fewer earmarks and a more flexible budget. Funding organisations in other countries receive their budgets with different degrees of freedom (see Braun, 1997).

The current Norwegian STI policy set-up, dominated by the sector and the consensus principle, also raises questions about its strategic governance and orientation. The sector principle gives each ministry considerable leeway to defend its budgetary and policy interests both for their own and for cross-government initiatives. They have a very strong position in Cabinet discussions and in interactions with the RCN. The consensus principle allows for common viewpoints and practices once an agreement is set in place. However, the process has high transaction costs, results in many parallel priorities, and leaves little room for experiments and bold, disruptive, innovations. The current setting allows for consistent incremental steps in development, while a long-term, overarching view might attract less attention.

While the need for a holistic and horizontal approach in research and innovation policy has been widely documented, support for an encompassing innovation policy seems to have lost prominence in recent years (Solberg, 2016). In the 1990s and 2000s, there had been efforts for such a holistic innovation policy, including a strategy plan from 2004, a white paper in 2008 (OECD, 2008; Solberg, 2016) and a short-lived Innovation Board in the mid-2000s, chaired by the Minister of Trade and Industry (OECD, 2008), but these efforts have not continued. The 2008 strategy was an ambitious white paper with an emphasis on industrial needs and broad sustainability goals (Fridholm et al., 2012).

The development of areas like health or the green economy (see Chapter 5) would particularly benefit from the continuation of a broader approach. Instead, individual issues like entrepreneurship or specific industry policies have become more important. The current 2015 MTIF Entrepreneurship plan (see Chapter 4) has been described as "at present the most central policy document in terms of innovation policy in Norway" (Brorstad Borlaug et al., 2016).

The prioritisation process also indicates the relative lack of a comprehensive approach to STI policy making. Despite the stable core of priorities in recent decades, discussions of priorities have only increased the number of such priorities within the policy portfolio. These are typically agglutinative, individually decided upon without a clear strategy, and insufficient attention has been paid to the interfaces between the individual priorities. The LTP and the RCN portfolio are examples of this approach, although in the case of the RCN, a number of initiatives have been launched to cross-link individual priorities and programmes.

This policy setting only imperfectly allows Norway to fulfil its transition challenge, since the prevalence of a soft and consensual co-ordination of sectorial interests at operational level draws attention to preserving existing solutions. This is thus not conducive to the radical and systemic innovations necessary for the transition. Alternative and challenging options more frequently emerge at the frontier between disciplines or areas, rather than within the silos of established trajectories. This is particularly, if not exclusively, the case for innovation that aims to address societal challenges, which call for new interdisciplinary and trans-disciplinary research environments that bring together a variety of natural and social scientists (OECD, 2015). This is also true, almost by definition, for the development of converging and enabling technologies, whose potential has been widely documented.

Furthermore, new/external voices and actors may find it difficult to contribute to the Norwegian STI policy in this setting, which favours established actors' positions in the system. This can impede the search for new viewpoints, the inclusion of new actors and the development of alternative approaches. Elements of inertia and lock-in exist to a certain extent in every innovation system, but the characteristics of the Norwegian system make these elements particularly pervasive.

The LTP has allowed significant, but rather piecemeal, progress in terms of co-ordination and prioritisation. Its overall reception in the Norwegian research and innovation community was positive. Most Norwegian stakeholders welcomed the ambitions of the plan and the increase of predictability both in terms of financial resources over a four-year period and of strategic focus on certain areas.

Since it was launched, different communities have pointed to various omissions in the LTP. As noted above, this was the case first of all for the higher education policy, which has since then been compensated for by the dedicated white paper. MER has also initiated a strategic process in response to criticism that no commitment has been made to updating buildings and infrastructure (MER, 2016b).

The softness and the broad range of the LTP present a challenge when it comes to implementation of the plan. Many specifically Norwegian topics are addressed, as well as others that are on priority lists in each country. Apart from the three MER budget lines mentioned, the numerous links to the "21" sector strategies and other documents appear to substitute for concrete action. From this perspective, the effect of the LTP on the predictability, prioritisation and co-ordination of public investments in R&D is soft and

often indirect. It sets the agenda for a common dialogue, but the plan still reflects a situation that assumes Norway is rich enough to afford and juggle many parallel priorities.

The revolving character of the LTP process, however, offers a major opportunity to add more concrete structural and programme-style policy activities to its agenda. Other ministries might use the LTP. Such a (soft and gradual) adjustment over the next LTP periods would allow more policy actors to enter this policy negotiating instrument, without giving up the sector and consensus principles, with better co-ordination and priority-setting mechanisms at a higher level.

Notes

1. The Norwegian government still spends relatively more on defence R&D than the other Nordic countries, Switzerland, Austria or the Netherlands (OECD, 2016a).
2. www.innovasjonnorge.no/en/start-page/our-organization/our-history.
3. See: www.stortinget.no/en/In-English/About-the-Storting.
4. The 2001 RCN evaluators went on to Austria to evaluate the Austrian intermediary level, concluding that "Nothing in the international experience that is visible to us, speaks for merging FFF and FWF," its Industrial Promotion Research Fund and Austrian Science Fund, Austria's applied and basic research funding organisations at the time (Arnold et al., 2004).
5. Document on "RCN activities/programmes" provided by MER and RCN, according to RCN's revised budget 2015.
6. Online version of the 2015 IN Annual Report, www.innovasjonnorge.no/aarsrapport/2015/index.html#keynumbers.
7. www.innovasjonnorge.no/aarsrapport/2015/index.html#strategi.
8. www.innovasjonnorge.no/en/start-page.
9. https://siva.no/om-oss/?lang=en#post-7087.
10. The interface between the agencies RCN, IN and Siva has been described as unproblematic; neither policy makers nor studies and the literature note major overlaps, problem zones or misunderstandings.
11. The 2012 evaluation states among other things that: 1) The proportion of people at Special Advisor or Director level at the RCN rose from 27% in 2004 to 37% in 2010. This is surprising given that the number of the council staff grew by more than 20%, from 330 to 411, in the same period. 2) Time allocation data suggest that RCN personnel spend 25% of their working hours on creating and sharing strategic intelligence, 15% on national "meeting places" and 10% on internationalisation, while devoting only 25% to programme management. 3) Half the RCN staff (228 people in 2012) is involved in internal co-ordination groups. A total of 60 people play a role in various ministry co-ordination forums.

12. The LTP also provides, less explicitly, for budget growth for RCN innovation programmes like BIA or FORNY.

13. The thematic and structural priorities of the LTP can be traced to the 1980s (MER, 2016a).

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