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Norway's participation in the EU framework programmes for research and innovation

An impact assessment of participation in FP7 and H2020

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Preface

The Ministry of Education and Research (MER) has commissioned Samfunnsøkonomisk analyse AS and Technopolis Group to conduct an impact evaluation of Norway's participation in the EU's framework programmes for research and innovation (FPs).

The report summarises our analysis of how Norwegian participation in the seventh and eighth framework programmes (FP7 and H2020) contributes to attaining the objectives of the government's strategy for research and innovation cooperation with the EU and a cost-benefit analysis of Norwegian participation in FP7 and H2020 to date and of participation in the ninth framework programme (Horizon Europe).

The analysis was carried out throughout 2019 by a team consisting of Maja Tofteng, Emil Cappelen Bjøru, Karin Ibenholt and Rolf Røtnes from Samfunnsøkonomisk analyse AS and Tomas Åström, Markus Lindström, Neil Brown, Carolina Spaini, Viola Peter, Amanda Bengtsson Jallow, Marie Uhrwing and Erik Arnold from Technopolis Group.

The team gratefully acknowledges support from a range of stakeholders who have helpfully assisted with the study. These include representatives of the Ministry of Education and Research, members of an Advisory Committee, 39 interviewees and 781 survey respondents, as well as Elisabeth Wiker and Kari-Anne Kristensen of the Research Council of Norway (RCN), who assisted with eCorda and RCN data.

Oslo, January 31st, 2020

Maja Tofteng
Project manager
Samfunnsøkonomisk analyse AS

Executive Summary

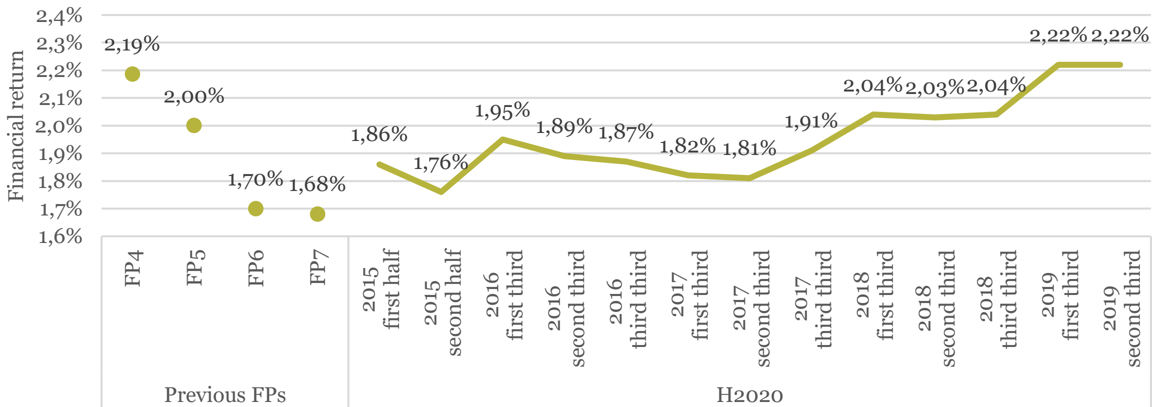
This report summarises the extent to which Norway's participation in EU's seventh framework programme (FP7) and eighth framework programme (Horizon 2020, H2020) contributes to the objectives of the government's strategy for research and innovation (R&I) cooperation with the EU. The report also includes a cost-benefit analysis of Norway's participation in FP7 and H2020 (up to the end of 2018) and of participation in the ninth framework programme (Horizon Europe). In the first two parts of the evaluation we investigate impacts of FP participation ex post ("*after the fact*"), whereas we in the third part assess costs and benefits ex ante (*"before the fact"*). The latter is of direct relevance as Norway is about to decide whether to participate in Horizon Europe (running 2021–2027).

Our assessment is based on a variety of data sources and methods, including registry analyses of the proposal and project databases of the European Commission (eCorda) and the Research Council of Norway (RCN), accounting statistics, innovation survey analyses, econometric analyses, web surveys, interviews, desk studies as well as analyses of data extracted from Samfunnsøkonomisk analyse's database on R&I instruments.

Increase in Norwegian participation in FP7 and H2020

There has been an increase in Norway's participation in the FPs during the assessment period, as indicated by an increase in Norway's financial return in NOK and in share of competitive funding to Norwegian participants. The Norwegian return from FP7 and H2020 amounts to 12.3 billion 2018-NOK with a year-on-year increase from 4 million 2018-NOK in 2007 (NOK 0,4 billion when including FP6) to NOK 2.2 billion in 2018 (based on signed FP contracts and average project duration of 3 years). Norway has been awarded 2.2 per cent of the competitive funds so far in H2020, compared to 1.7 per cent in FP7 see Figure 1.

Figure 1 Norway's accumulated return as a share of competitive funding



Source: RCN.

The FPs fund a variety of R&I-related activities in Norway. Companies and organisations from all parts of the country participate in the FPs, but participation is dominated by R&D providers (higher-education institutions, research institutes and hospital trusts/regional health authorities) and research- and innovation-intensive companies in the Oslo region and in the County of Trøndelag.

About two thirds of Norwegian FP7 and H2020 funding has benefited R&D providers. One quarter has gone to companies and the rest to other types of organisations. FP funding to companies has increased year on year and more rapidly than funding to R&D providers. FP funding to organisations in the public sector and other types of organisations has also increased but represents a small share of Norwegian FP funding.

Web surveys and interviews indicate high input additionality and we thus interpret results and impacts reported by project participants and other stakeholders to be a consequence of Norwegian participation in the FPs.

Contribution to the fulfilment of the Norwegian strategy for R&I cooperation with the EU

We have found that FP participation has **increased the quality of Norwegian R&I and Norwegian participants' competitiveness** and enhanced Norwegian participants possibility to succeed internationally (first objective of the government's strategy). Arguably the most important impact of FP participation is gaining access to international networks offering "benign friction" with foreign R&I partners and competitors, R&I import, access to foreign infrastructure and markets. Collaboration and competition allow for benchmarking that provides an impetus for a continued drive to increase one's own international R&I competitiveness.

FP participation has increased Norwegian R&I competitiveness as indicated by an increase in the share of Norwegian-led proposals that have achieved high excellence scores. However, similar developments are seen for other countries, meaning that Norway's relative position is largely unchanged during H2020. There nevertheless appears to be a slight Norwegian competitiveness improvement compared to other countries during H2020, as indicated by a slight increase in the share of proposals that are of sufficient quality to be funded as well as in the share of proposals that indeed are funded. This is positive given that a significant improvement relative to other countries would have been difficult, even unrealistic, to achieve. The accumulated financial return now substantially exceeds the government's 2 per cent objective which can be seen as a success.

We have also found that FP participation has contributed to **increased innovation capacity, value creation and sustainable economic development** (second objective). The web surveys and the interviews with company representatives indicate that participation in FP projects increases commercialisation, competitiveness and export. Half of the companies surveyed report the FP participation has led to a more scientific approach to in-house R&I. Four in ten companies report increased international competitiveness, and around one in five increased commercial benefits. The econometric analyses indicate that the immediate impact of FPs participation on company performance (up until 2018) is positive and similar to that of companies participating in RCN projects.

Participation in FP projects can have long-term impact on productivity by extending learning, international collaboration and channels for companies to "stay tuned and ready" when a commercial opportunity arises. The benefits of learning and collaboration are not limited to participating companies, but can spill over to other companies and other part of society through subsequent collaboration, labour mobility, spin-offs etc.

FP participation has contributed to **improved social welfare and more sustainable social development through research and innovation that enables Norway to deal with major societal challenges** (third objective). Of the four objectives this is the most all-encompassing and challenging to assess. This objective is also the one for which the evidence of achievements is the least convincing.

Norwegian FP participants have been active in sub-programmes addressing societal challenges and the web surveys also indicate that FP projects have indeed contributed to improved social welfare, more sustainable social development and coping with major societal challenges. However, it is reasonable to assume that any contributions to addressing such complex issues and challenges made by the individual project are minute. H2020's focus on societal challenges means that its overall project portfolio allows for addressing complex societal challenges on a large scale and at European level.

Last but not least, we have found that FP participation has helped to **develop Norway's R&I sector, both through further development of policies and instruments and through new patterns of cooperation across national borders, sectors and fields** (fourth objective). As mentioned above, the Norwegian R&I sector has benefited from expansion of FP participants' international networks, through accessing internationally leading R&I and infrastructure, and from international benchmarking which allows for learning and quality improvements. Norway's FP association has with time had a profound impact on the national policy dialogue, national R&I priorities, national R&I programmes and even the RCN's organisation and application assessment criteria. Interviews also suggests that Norway has been able to influence some FP priorities. Through the FPs, Norwegian policymakers have also gained access to arenas and fora that allow for policy coordination and international knowledge-sharing on sectoral issues (e.g. energy, transport, health). Getting access to European arenas for policy dialogue are considered by many interviewees to be particularly important as Norway is not an EU member.

Weighing costs and benefits of FP association

We have found that Norwegian FP association contributes to the objectives defined in the Norwegian strategy for R&I cooperation with the EU. In the cost and benefit analyses (CBA) we have assessed if similar benefits could have been realised (FP7 and H2020 to date) or can be expected to be realised (Horizon Europe) without FP association. We have done so by comparing costs and benefits of FP association with a baseline scenario of rather channelling the Norwegian direct cost of FP participation to RCN. By doing so, we can identify in what ways FP association differs from national instruments and make a qualified judgement on what would have happened or will happen if Norway decides not to associate itself with Horizon Europe.

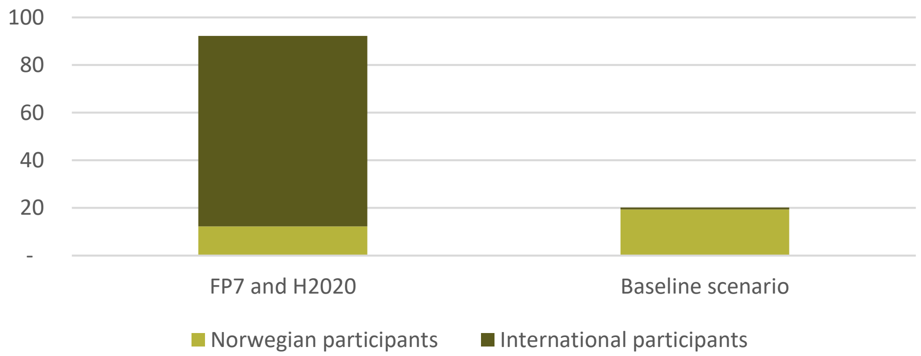
In the CBA we take both monetised and non-monetised costs and benefits into consideration. The monetised cost of association includes the FP participation fee, which simultaneous with the increase in funding to Norwegian participants, has increased from NOK 230 million 2018-NOK in 2007 (NOK 630 million when including FP6) to NOK 2.2 billion in 2018, amounting to 19.3 billion 2018-NOK over the entire assessment period. Cost of FP association also includes cost of taxation, mobilisation, coordination, writing proposals, reporting and co-funding. Monetised benefits include FP returns to Norwegian participants as well as returns of private sector investments in R&I.

According to a strict comparison of monetised costs and benefits, the net cost of FP association is marginally higher than the baseline scenario. Based on our assumptions, the net cost of FP association compared to baseline scenario is estimated to 6 billion 2018-NOK or an annual average of 0.5 billion 2018-NOK during the assessment period. The difference between the FPs and the baseline scenario mainly relates to financial return being lower in the FPs than in the baseline scenario.

FP association nevertheless brings significant benefits compared to the baseline scenario which cannot be monetised – most importantly and as mentioned, FP participation fosters international competition, collaboration, R&I capacity building and learning, and policy development and coordination to a greater extent than national instruments.

FP projects are generally bigger in terms of funding than nationally funded projects. Further, the total value of all FP projects that Norwegian organisations participate in extends far beyond Norwegian participant's funding share. Each FP project give Norwegian participants access to on average 18 international partners and the total value of R&I about seven times higher than the Norwegian funding share (see Figure 2). Although we cannot expect Norwegian participants, or other parts of the Norwegian community, to absorb and benefit from all the knowledge generated in all FP projects, it does indicate that the accessible pool of knowledge and R&I infrastructure is significantly larger in case of FP participation than in the baseline scenario. Through FP projects, Norwegian participants get access to more knowledge and R&I infrastructure than in national instruments, including knowledge and R&I infrastructure not available in Norway.

Figure 2 Value in billion 2018-NOK to Norwegian and international participants of projects with Norwegian involvement. FP participation and baseline scenario. Co-funding not included.



Source; Samfunnsøkonomisk analyse AS, Technopolis, eCorda

The benefits of international collaboration and knowledge sharing does not only apply to project participants, but also to policy makers, innovation agencies and other stakeholders participating in various FP activities. Further, knowledge can be spilled over to other parts of the Norwegian economy through policy dialogue, labour mobility, collaboration, spin-offs, education etc. Learning is important factor for innovation, productivity and other aspects in the development of society. For a small country like Norway the benefits of international collaboration and knowledge sharing can be significant. As we view the impacts on learning to be stronger in FP projects than in the baseline scenario, we expect the long-term impact on innovation, productivity and well-being to be higher.

In addition to R&I capacity building and learning, other non-monetised benefits of FP association compared to the baseline scenario includes getting access to R&I instruments not available in Norway, better access to European markets and contribution to development of and getting access to solutions to solving societal challenges.

When accounting for the significant non-monetised benefits, we judge that participation in FP7 and H2020 (to date) to has been very beneficial for Norway (i.e. exceeding the net cost of FP association compared to baseline scenario of NOK 0.5 billion per year).

Norway must now decide whether to participate in the next FP, Horizon Europe. The programme budget is still subject to negotiation but given the proposed budget of EUR 94 billion and the assumption that the UK does not participate in Horizon Europe, we estimate the Norwegian participation fee to a total of 22 billion 2018-NOK. Given these assumptions, the participation fee will increase also in the years to come reaching 3.2 billion 2018-NOK in 2027.

From what we know so far, Horizon Europe is regarded as an evolution and most instruments and themes included in H2020 will remain in Horizon Europe, and the programme offers many opportunities for prospective Norwegian participants. In the CBA, we have utilized a modest rate of return of 2.2 per cent (equivalent to the current accumulated return in H2020) in which FP association will continue to be slightly more costly than national instruments based on monetised costs and benefits (approximately NOK 0.6 billion a year in Horizon Europe). A financial return of 2.8 per cent of competitive funding will make participation in Horizon Europe equally cost-effective for Norway as the baseline scenario.

We expect the non-monetised benefits of participation in FP7 and H2020 deriving from international competition, collaboration, capacity building and learning to continue be significant. Therefore, we assess the risk of not participating in Horizon Europe as greater than the net cost of FP participation as we expect it to be problematic to compensate for the benefits of FP participation with national instruments. Without FP participation, the Norwegian R&I sector would to a lesser degree be exposed to international competition and it could be difficult to maintain the level of learning and international collaboration that we expect to see in Horizon Europe. Norwegian participants could participate in single FP projects on a third-country basis, but such participation can be difficult to organise in practice at a large scale.

Norwegian policymakers as well as the RCN could also strive to increase international collaboration and participation in RCN projects. However, such a strategy also could prove difficult (and costly) to pursue on a scale equivalent to the FPs. In addition, Norwegian policymakers, innovation agencies and stakeholders will not have access to foras and tools used for benchmarking, policy innovation and European policy co-ordination.

In our view, FP participation represents a sensible and valuable diversification of Norwegian R&I policy and it is our clear recommendation that Norway should associate itself with Horizon Europe. Given that learning and competence building, and R&I collaboration is cumulative in nature, not participating in Horizon Europe would have long-term implications for Norway's absolute and relative R&I competitiveness.

Although we judge the non-monetised benefits of FP participation to be significant and exceeding the net cost of FP association, it reasonable that the Norwegian FP policy includes an objective of return for Norway. The rationale being that higher return improves monetised benefits for Norway and because it is through active project participation that most non-monetised benefits arise.

That continued FP association is the preferred alternative in the cost benefit analyses must not be taken as an argument for channelling all national R&I funds to the FPs (or other international research programmes), or as a sign of deficiencies in the RCN or other national agencies. Our assessment is based on the FPs continuing to complement the R&I instrument portfolio and constitute a modest part of total R&D funding available to Norwegian organisations.

Sammendrag

Rapporten oppsummerer vår vurdering av om den norske deltakelsen i EUs sjuende rammeprogram (FP7) og EU's åttende rammeprogrammet (Horisont 2020) bidrar til å nå målene i regjeringens strategi for forsknings- og innovasjonssamarbeid med EU. Rapporten inkluderer også en nytte-kostnadsanalyse av den norske deltakelsen i FP7 og H2020 fram til i dag og for deltakelse i Horisont Europa. I de to første delene undersøker vi effekter målt i etterkant (ex post), mens vi i den siste delen diskuterer mulige framtidige effekter. Sistnevnte har direkte relevans ettersom norske myndigheter snart skal beslutte hvorvidt Norge skal delta i Horisont Europa (2021 til 2027). I rapporten sammenligner vi deltakelse i rammeprogrammene med nasjonale forsknings- og innovasjonsprogrammer, operasjonalisert som virkemidler forvaltet av Forskningsrådet (NFR). Sammenligningen gjør det mulig å kartlegge den mernytten deltagelsen i rammeprogrammene gir.

Våre vurderinger er basert på flere metoder og datakilder, inkludert registeranalyser av søknads- og prosjektdatabasene til Europakommisjonen (eCorda) og NFR, regnskapsdata, innovasjonsundersøkelsen til SSB, Samfunnsøkonomisk analyses samspillsdatabase, samt økonometrisk analyse, spørreundersøkelser, intervjuer og dokumentgjennomgang.

Deltakelse i FP7 og H2020

Den norske deltagelsen i rammeprogrammene har tiltatt i løpet av evalueringsperioden, indikert ved norsk retur målt i kroner og som andel av konkurranseutsatte midler i rammeprogrammet. Samlet utbetaling fra rammeprogrammene FP7 og H2020 var på 12,3 milliarder 2018-kroner ved utgangen av 2018, med en vekst fra 4 millioner kroner i 2007 (0,4 milliarder når man tar med FP6) til 2,2 milliarder kroner i 2018, målt basert på innvilgede prosjekter og gjennomsnittlig tre års prosjektperiode. Norsk retur som andel av konkurranseutsatte midler i rammeprogrammet tilsvarer 2,2 prosent så langt i H2020 (per november 2019). I FP7 var returraten 1,7 prosent.

Rammeprogrammene finansierer en rekke forsknings- og innovasjonsaktiviteter i Norge. Bedrifter og organisasjoner fra alle deler av landet har deltatt i de to rammeprogrammene, men deltakelsen er dominert av FoU-aktører og forsknings- og innovasjonsintensive bedrifter i Oslo-regionen og Trøndelag. Om lag to tredeler av de norske midlene fra rammeprogrammet har gått til FoU-aktører (høyere utdanningsinstitusjoner, instituttsektoren og helseforetak), mens en fjerdedel har gått til bedrifter og resten til andre organisasjoner. Finansiering til bedrifter har økt hvert år og raskere enn for FoU-aktører.

Spørreundersøkelse og intervju indikerer at støtten til EU prosjektene er utløsende, dvs. at forskningen ikke ville ha blitt gjennomført uten denne støtten (støtten er addisjonell). Resultater og virkninger rapportert av prosjektdeltakere og andre informanter vurderes derfor som en effekt av den norske deltagelsen i rammeprogrammet.

Måloppnåelse i henhold til den norske strategien

Vi finner at EU deltakelsen har **økt kvaliteten på norsk forskning og innovasjon (FoI) som videre har gjort det mulig for norske deltagere å vinne frem på internasjonale konkurransearenaer** (det første hovedmålet i regjeringens strategi). Ved å delta i EU prosjekter får norske deltagere tilgang til internasjonale nettverk, kunnskap, infrastruktur og markeder, samtidig som de utsettes for internasjonal konkurranse. Selv om kvaliteten i norsk forskning har tiltatt, har deltakere fra andre land opplevd lignende forbedringer. Norges relative posisjon er derfor om lag uendret, men deltagerdata indikerer en svak relativ forbedring mot slutten av evalueringsperioden. Selv om denne forbedringen er liten, bør det likevel ses på som en suksess, fordi enhver signifikant forbedring relativt til andre land er vanskelig, kanskje til og med urealistisk, å oppnå. Som nevnt er den norske returrate godt over regjeringens mål om 2 prosent og må tolkes som en suksess.

Evalueringen viser at FP-deltakelsen har **bidratt til økt innovasjonsevne, verdiskaping og bærekraftig økonomisk utvikling** (det andre hovedmålet i regjeringens strategi). Halvparten av bedriftsinformantene rapporterer om mer vitenskapelig tilnærming til egenutført FoI, mens fire av ti mener at deltagelsen i FP har styrket internasjonal konkurranseevne og om lag en av fem melder om bedriftsøkonomiske gevinster. Den økonometriske analysen indikerer at deltagelsen slår ut i mervekst i deltagende bedrifter som tilsvarer den for bedrifter som deltar i Forskningsrådets programmer (målt på bakgrunn av regnskapsdata frem mot 2018). Gjennom å styrke læring, internasjonalt samarbeid og markedskunnskap vil rammeprogrammet også legge til rette for at bedrifter kan realisere kommersielle muligheter i internasjonale markeder på sikt. Nytteeffektene tilkommer ikke bare deltagende bedrifter, men kan også komme andre bedrifter og deler av det norske samfunn til gode gjennom senere prosjektsamarbeid, arbeidskraftsmobilitet, spin-offs etc.

Evalueringen finner at deltakelsen i rammeprogrammene har **bidratt til å bedre velferd og en mer bærekraftig samfunnsutvikling** gjennom FoI som gjør oss i stand til å håndtere store samfunnsutfordringer (det tredje hovedmålet i regjeringens strategi). Dette det mest utfordrende av de fire hovedmålene i strategien. Det er vanskelig å identifisere indikatorer som kan gjør at vi kan vurdere graden av måloppnåelse. Norske FoI-aktører er aktive i programmer som handler om de store samfunnsutfordringer og spørreundersøkelsene indikerer at flere av de norske EU prosjektene har frembrakt kunnskap og løsninger som kan styrke velferd og en mer bærekraftig samfunnsutvikling. Samtidig er det nærliggende å forvente at ethvert bidrag til å adressere så komplekse spørsmål og utfordringer i et enkelt prosjekt vil være marginalt. Vektleggingen av store samfunnsutfordringer i H2020 innebærer imidlertid at den samlede prosjektporteføljen vil kunne bidra til å behandle komplekse samfunnsutfordringer i stor skala og på europeisk nivå.

Videre finner evalueringen at deltakelsen har **bidratt til utvikling av norsk forsknings- og innovasjonssektor, både gjennom videreutvikling av politikk og virkemidler, og gjennom nye samarbeidsmønstre på tvers av landegrenser, sektorer og fag** (det fjerde hovedmålet i regjeringens strategi). Den norske FoI-sektoren har hatt stor nytte av rammeprogrammet, med utvidelse av deltakernes internasjonale nettverk og adgang til internasjonalt ledende FoI-miljøer og FoI infrastruktur som sentrale nyttevirkninger. Deltakelsen har over tid hatt en stor påvirkning på den nasjonale FoI-politikken og på Forskningsrådets organisering og sogar søknadsprosedyrer. Intervjuer tyder også på at Norge har påvirket prioriteringer i rammeprogrammet. Deltagelsen i rammeprogrammet representerer videre en plattform for europeisk koordinering på andre politikkområder (eksempelvis energi, transport og helse), noe som flere informanter trekker frem som viktig all den tid Norge ikke er medlem i EU.

Sammenligning av mernytte og merkostnader ved deltakelse i rammeprogrammet

Norge nyter godt av deltagelsen i det europeiske rammeprogrammet. I nytte-kostnadsanalysen undersøker vi om nyttevirkningene er større enn kostnadene eller om nyttevirkningene kan oppnås på andre mer kostnadseffektive måter. I nyttekostnadsanalysen tar vi hensyn til både tallfestet og ikke-tallfestede nytte og kostnad. Kostnadssiden omfatter den direkte kostnader (den norske deltakelsesavgiften og stimuleringsmidler), men også indirekte kostnader som skattekostnader, kostnader til mobilisering og koordinering, søknadsskriving, rapportering og medfinansiering. Tallfestet nytte inkluderer den finansielle returen til norske deltakere samt avkastning av private investeringer i FoU. Nytte og kostnader sammenlignes med referansebanen der de direkte kostnadene knyttet til deltagelse heller kanaliseres til Forskningsrådet.

Den norske deltakelsesavgiften tilsvarte 19,3 milliarder kroner i perioden 2007-2018. Avgiften har variert fra år til år, men det har vært en oppadgående trend fra om lag 230 mill. kroner i 2007 (630 millioner kroner inkludert FP6) til 2,2 mrd. kr. i 2018. Det er flere grunner til at avgiften har økt. Viktigst er at H2020 er større enn FP7 var.

Analysen viser at når man kun tar utgangspunkt i nytte- og kostnadseffekter som kan tallfestes, så er merkostnaden sammenlignet med referansebanen i gjennomsnitt 0,5 milliarder kroner i årlig i perioden 2007–2018. Merkostnaden følger først og fremst av at returen i deler av perioden har vært lav sammenlignet med vår andel av forpliktelsene i rammeprogrammene. Det er også noe mer ressurskrevende å mobilisere til, søke til og delta i rammeprogrammene enn for nasjonale virkemidler. Til gjengjeld utløses mer forskning i Norge i referansebanen noe som også øker kostnadene til medfinansiering.

Evalueringsteamet finner at deltagelsen har gitt mernytte sammenlignet med referansebanen som ikke kan tallfestes, men som vurderes som betydelig. Mernytten knytter seg særlig til lærings- og nettverkseffektene som følger av å delta i internasjonale forskningsprogram. EU prosjekter er generelt større enn nasjonalt finansierte prosjekter, både når det gjelder finansiering og antall deltakere. Videre strekker den totale størrelsen på EU-prosjekter seg langt utover de norske deltakernes andel av prosjektene. Samlet størrelse på finansieringen til EU-prosjekter med norsk involvering er omtrent syv ganger høyere enn den norske andelen, noe som indikerer at kunnskapstilfanget er betydelig. Gjennom deltagelse i EU-prosjekter får norske forsknings- og innovasjonsmiljøer tilgang til mer kunnskap og forskningsinfrastruktur enn ved deltagelse i nasjonale virkemidler, samtidig som de får tilgang til kunnskap og forskningsinfrastruktur som ikke er tilgjengelig i Norge. Det å delta på internasjonale konkurransearenaer kan også stimulere til læring. For et lite land som Norge kan læringseffektene være betydelige.

Lærings- og nettverkseffekter er ikke begrenset til FoI-aktørene, og deltagelsen gir som nevnt også norske beslutningstakere tilgang på arenaer og verktøy for norsk politikkutvikling og europeisk politikkoordinering. For et land som ikke er medlem i EU kan verdien av deltagelse på slike fora være betydelig. Videre er læringseffektene akkumulative ved at kunnskapen kan komme til anvendelse i senere FoI-aktiviteter, og også overføres til andre deler av det norske samfunnet gjennom nasjonal politikkutvikling, samarbeidsprosjekter, arbeidskrafts-mobilitet, nyetableringer etc. Teamet vurderer lærings- og nettverkseffektene som større i rammeprogrammene enn i nasjonale virkemidler og følgelig også den langsiktige effekten på innovasjon, konkurranseevne og verdiskaping.

Andre ikke-tallfestede nyttevirkninger ved deltagelse i rammeprogrammene sammenlignet med referansebanen inkluderer tilgang til FoU-instrumenter som ikke er tilgjengelige i Norge, bedre tilgang til europeiske markeder og mulighet for å bidra til utvikling og oppskalering av løsninger på store samfunnsutfordringer. Når vi tar hensyn til de betydelige ikke-tallfestede nyttevirkninger vurderer vi deltakelsen i FP7 og H2020 (til dags dato) som samfunnsøkonomisk lønnsomt for Norge (dvs. at denne nytten er større enn 0,5 milliarder kroner i året).

Norske myndigheter skal nå bestemme om Norge skal delta i neste rammeprogrammet, Horisont Europa. Programbudsjettet er fremdeles gjenstand for forhandlinger, men gitt det foreslåtte budsjettet på 94 milliarder euro og antakelsen av at Storbritannia ikke deltar i rammeprogrammet, estimerer vi den norske deltakeravgiften til 22 milliarder 2018-kroner. Gitt disse forutsetningene, vil deltakeravgiften øke også i årene som kommer og nå 3,2 milliarder 2018-kroner i 2027. Fra det vi vet så langt, blir Horisont Europa sett på som en forlengelse av H2020, og de fleste virkemidler og temaer som inngår i H2020 vil også være representert i det nye rammeprogrammet. På bakgrunn av våre forutsetninger estimeres merkostnaden sammenlignet med referansebanen til 0,6 milliarder kroner årlig i gjennomsnitt når vi kun ser på tallfestede nytte- og kostnadsvirkninger. I nytte-kostnadsanalysen har vi lagt gjeldende norsk retur på 2,2 prosent til grunn, men estimert at en retur på 2,8 prosent vil gjøre deltakelsen i det neste rammeprogrammet like kostnadseffektivt som referansebanen.

Det neste rammeprogrammet ventes å være en videreføring av H2020 og dekke mange av de samme virkemidler og temaer som i H2020. Vi forventer at lærings- og nettverkseffekter vil fortsette å være betydelige og overstige merkostnaden ved deltagelse. Motsatt, vurderer vi risikoen ved ikke å delta som større enn merkostnaden ved å delta. Vi anser det som krevende å skulle opprettholde samme grad av læring og internasjonalt samarbeid i prosjekter finansiert med nasjonale midler. Fordi både læring og deltagelse i rammeprogrammet er akkumulativ kan det å ikke delta i det neste rammeprogrammet ha stor betydning for Norges relative FoI-konkurranseevne. Samtidig kan det norske myndighetsapparatet og FoI-aktører også miste tilgangen til fora og verktøy for politikkutvikling og europeisk politikk-koordinering.

Etter vår vurdering er Norge tjent med å delta i Horisont Europa. Selv om vi vurderer ikke-tallfestet nytte som betydelig og høyere enn merkostnaden ved deltagelse, er det rimelig at den norske FP-strategien inkluderer et mål for norsk deltagelse. Begrunnelsen er at ved økt deltagelse øker de tallfestede-nyttevirkningene for Norge og fordi det er gjennom aktiv prosjektdeltakelse at mesteparten at ikke-tallfestede nyttevirkninger oppstår.

At fortsatt deltagelse i rammeprogrammet er det foretrukne alternativet i vår nytte-kostnadsanalyse, betyr ikke at vi mener at Norge er tjent med å kanalisere alle nasjonale FoU-midler til EUs rammeprogram. Våre vurderinger er basert på at deltagelsen supplerer norske virkemidler og at deltageravgiften fortsatt utgjør en relativt begrenset andel av samlede offentlige bevilgninger til forskning og innovasjon. Det å delta i rammeprogrammet vurderes som en rasjonell diversifisering av norske FoI-virkemidler.

Content

1 Introduction

Norway became associated with the Framework Programmes (FPs) through the European Economic Area (EEA) agreement, which entered into force on 1 January 1994. Norway has thus participated in the FPs as an associated member since 1994 (starting with FP4). Prior to that, Norway participated on a bilateral basis in the first FPs.

In 2014, the Norwegian government presented its strategy for research and innovation (R&I) cooperation with the EU, including the Framework Programme. The strategy has four qualitative objectives (Norwegian Ministry of Education and Research, 2014) for this cooperation:

- Participation shall increase the quality of Norwegian research and innovation and help Norwegian research and innovation succeed internationally
- Participation shall contribute to increased innovation capacity, value creation and sustainable economic development
- Participation shall contribute to improved social welfare and more sustainable social development through research and innovation that enables us to deal with major societal challenges
- Participation shall help us to develop our own research and innovation sector, both through further development of policies and instruments and through new patterns of cooperation across national borders, sectors and fields

The strategy also includes the ambition that Norwegian organisations should acquire 2 per cent of the competitive funds in H2020, although it is pointed out that economic factors should not be the main motive for participation.

1.1 Assignment consisting of three parts

The Norwegian Ministry of Education and Research (MER) commissioned Samfunnsøkonomisk analyse AS and Technopolis Group to conduct a three-part impact evaluation of Norway's participation in the FPs:

1. An assessment of how Norwegian participation in the seventh and eighth framework programmes (FP7 and Horizon 2020 (H2020)) has contributed to attaining the objectives of the government's strategy for research and innovation cooperation with the EU (Norwegian Ministry of Education and Research, 2014)
2. A cost-benefit analysis of the impacts of Norwegian participation in FP7 and H2020 to date
3. A cost-benefit analysis of the future potential of Norwegian participation in the ninth framework programme (Horizon Europe)

In part 1 and part 2 we investigate impacts ex post ("*after the fact*"), whereas in part 3 impacts are assessed ex ante (*"before the fact"*). The assessment of hypothetical impacts rests on current knowledge of Horizon Europe and experience (parts 1 and 2).
The impact evaluation is intended as input to the ongoing discussion on Norway's participation in Horizon Europe.

1.2 Methodology

1.2.1 RCN as the benchmark and baseline scenario

There is a general belief that investment in R&D is a key factor driving innovation and economic growth and Norway has several instruments supporting research and innovation. Throughout the evaluation we compare the FPs with national instruments. By doing so, we can make a qualified judgement on the impacts of FP association and what would have happened or will happen if Norway decides to participate in future FPs – or not. In addition, we can reflect on the role of the FPs in the national R&I policy mix. This comparison implicitly assumes that the impacts of FP and national instruments are the identical and that there is no interdependency between FP and national instruments. We know that neither of these implicit assumptions is entirely correct, but we believe that this is nevertheless the most valid comparison possible, and we later discuss both differences in impacts and interdependencies.

We have operationalised the benchmark and baseline scenario as the instruments of the Research Council of Norway (RCN). Both the FPs and RCN are treated as single instruments, which is obviously an over-simplification. Both portfolios are complex and change with time, and they are not identical. Any effort to make general statements about similarities and differences between FP and RCN instruments will thus inevitably fail to cover the complexity of the portfolios. We attempt nonetheless to identify and through the report to elaborate on the main similarities and differences. When assessing whether Norway benefit from the FP association we are particularly interested in identifying the differences as the differences will define what additional benefits the FP association bring to the portfolio of R&I instruments available for Norwegian participants and thus the Norwegian society.

Both the FPs and national R&I portfolios include instruments for excellent research, to address societal challenges and business-oriented instruments to foster innovation and commercialisation. It should however be noted that the Research Council of Norway (RCN) covers a variety of research and research-based innovation instruments but that the portfolio of nationally funded R&I instruments also includes SkatteFUNN[1] and instruments supplied by other agencies than RCN, including most notably Innovation Norway (IN) and Enova. IN's portfolio is heterogeneous and covers various funding instruments as well as advisory and network services to foster innovation, internationalisation, business and cluster development. Enova funds amongst other pilot and demonstration projects aimed at reducing climate gas emissions. H2020 and Horizon Europe place a stronger emphasis on innovation and commercialisation and on addressing societal challenges than FP7 did – including tackling climate change. Therefore, the instruments of later FPs increasingly overlap IN and Enova instruments. Implications of using RCN as the benchmark and baseline is discussed throughout the report and in our final remark.

[1] The SkatteFUNN Tax Deduction Scheme is a rights-based tax deduction scheme designed to stimulate research and development (R&D) activities in Norwegian companies.

In principle, the FPs aim to foster R&I that may prove relevant at a European (or an international) level. The FPs are rooted in the EU policy areas of competitiveness and jobs and are considered an important tool for enhancing European competitiveness, productivity and well-being. The criteria for the framework programmes (originally the 'Riesenhuber criteria') start with the idea of subsidiarity, in that the EU should not do things that can be done at national level. By implication, the FP is therefore not aimed at building national capacity, although national and European objectives may coincide. National instruments also aim to foster productivity and well-being but based on national capacity needs and goals. Over time, many EU Member and Associated States have aligned many of their national R&I objectives with EU objectives.

In the FPs (as well as in RCN's instruments), the best projects are generally awarded funding without any consideration of sector or geography[2] and the much larger pool of proposers in the FPs means tougher competition than in national instruments (although competition for national funding still can be perceived as high). FP projects are generally bigger in terms of both funding and number of participants than nationally funded projects.

These substantial differences have implications for what member countries can expect from FP participation. Our hypothesis is that the FP is first and foremost a policy instrument increase international collaboration and to expose national R&I sectors to international competition, which with time may increase research quality, innovation capacity, productivity and export. Through the FPs, Norwegian participants get access to knowledge, networks and R&I infrastructure not available in Norway.

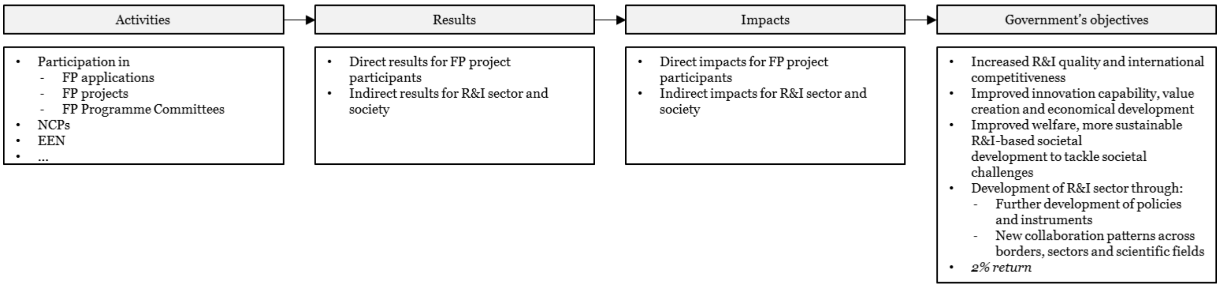
The second hypothesis is that international application-based instruments are more costly than national ones. Application-based instruments are (in theory) more costly to administer than rights-based instruments, but the advantage of application-based instruments is that national policymakers and innovation agencies decide what kind of R&I activities to support. Application-based instruments are thus considered important for implementation of long-term policy regarding strategic capacity-building in society. Programme administration cost (i.e. for instrument design, project evaluation and reporting) apply to both national and international application-based instrument, but for international R&I programmes there is an additional need for policy coordination at the international level. For participants countries there are also cost of coordination and mobilisation, as well as the risk of mismatch between international policy objectives and the national ability to respond to these objectives with the potential consequence of low national rate of return. We seek to test if FP association is more costly than national instruments and if FP association bring benefits that outweighs additional cost.

[2] Except for actions under Spreading Excellence and Widening Participation actions which are limited to certain countries.

1.2.2 Part 1 of the evaluation

In the first part we investigate whether there is evidence to support the notion that Norwegian participation in FP7 and H2020 has contributed to fulfilling the objectives of the government's strategy for R&I cooperation with the EU. Our assessment follows the structure of a basic impact logic (see Figure 1.1), where the ultimate impacts are equivalent to the objectives of the strategy.

Figure 1.1 Impact logic



Source: Technopolis.

Moving from left to right in the figure, participation in FP projects[3] may be assumed to lead to immediate results for project participants. Under otherwise benign conditions, these results may contribute within a few years to impacts for participants, the Norwegian R&I sector and society as a whole. Similarly, the results and impacts of participating in FP Programme Committees and gradually developing national support measures will most likely also take some time to become observable. However, benefits of policy develop is development are assumed to be independent of participation in R&I projects. With time, results and impacts hopefully will contribute to gradual fulfilment of the government's objectives.

We are careful to use "contribute to" rather than "lead to" when it comes to impacts since there are many other factors that may also contribute to – or indeed hinder – this sequence of events. The time scales involved in moving from FP projects to impacts vary greatly depending on technology, sector, regulations etc., from a handful of years to decades (e.g. when it comes to commercial impacts for companies).

The impact logic of the figure is deceptively simple, but in practice the sequence of events is likely to be quite complex and at times opaque. In this report we gradually develop a detailed impact logic based on the empirical evidence that we have gathered in the course of this evaluation and – where appropriate – complement this evidence with findings from previous evaluations and studies.

[3] By "FP projects" we refer to FP projects registered in the eCorda database. Instruments such as the InnovFin SME Guarantee Facility (managed by the European Investment Bank, EIB), which targets eligible local banks, leasing companies and guarantee institutions are not included in eCorda despite being co-funded by H2020.

As far as possible, the impacts of FP projects are benchmarked against the impacts of comparable RCN projects. By doing so, we aim to identify similarities and differences between FP and RCN instruments which will serve as basis for assessing what would happen in the absence of FP participation (part 2 and 3).

1.2.3 Parts 2 and 3 of the evaluation

In parts 2 and 3 we conduct cost-benefit assessments (CBAs) of the Norwegian FP participation. The main purpose of the assessments is to determine whether FP participation is economically profitable for Norway. The analysis follows the cost-benefit methodology set out in the Norwegian Government Agency for Financial Management's (DFØ) CBA guidelines (2018) and the Ministry of Finance's circular R-109/14 on principles and requirements for the preparation of a socio-economic analysis (Ministry of Finance, 2014).

CBA is usually applied to investments and regulatory changes or programmes but is also suitable for analysing costs and benefits of various social phenomena.

In general, it is desirable to place a monetary value on as many of the direct cost and benefit elements as possible so that they can all be compared using the same units. Valuation of the costs and benefits of participation is based on actual figures and estimates where these are available, from part 1 of the evaluation (chapters 3-5), publicly available data and previous studies. FP participation also may have benefits that cannot be valued in monetary terms (non-monetary effects). Such effects have been assessed using a qualitative discussion of advantages and disadvantages.

The CBAs were performed by channelling all FP participation fees to national instruments (operationalised as RCN instruments) as the baseline scenario. Using national instruments as benchmark and baseline scenario allows for a discussion of what might be expected if Norway had decided or will decide in the future not to participate in the FPs.

This document reports on a CBA of FP7 and H2020 to date (2018) (part 2) and one of Horizon Europe (part 3).

1.3 Empirical data and methods

We have utilised a number of qualitative and quantitative data sources and analysis methods to solve the tasks at hand. The data sources and analysis methods were selected specifically to the conduct the three evaluation tasks and in particular to be able to secure evidence to support (or not) contributions to the objectives of the government's strategy.

- **Document studies**: Policy documents, previous studies and evaluations etc. The document studies have yielded a thorough understanding of the political context, historical developments and previous FP-related studies and developments, which has resulted in chapter 2 of this report. The most important documents are summarised in the reference list (right before the appendices).
- **Registry analyses**: Quantitative analyses of eCorda data on FP proposals and projects (data extracted 13 March 2019) and RCN data on proposals and projects (data extracted March

2019). The registry analyses have revealed trends in Norwegian FP proposal quality, FP collaboration nationally and internationally, and researcher mobility over time and relative to other countries. The analyses have also provided mailing lists for web surveys and a list of potential interviewees (see below). The details of the participation analyses are presented in Appendix A

- **Interviews**: Semi-structured interviews with 39 representatives of government ministries and agencies, management of frequent FP participants and individual FP project participants. Interviews have provided in-depth understanding of impacts of FP project participation at individual, organisational and systems level, as well as of developments in R&I policies and instruments due to Norway's FP affiliation. Whereas interviews provide in-depth understanding, web surveys (see below) provide a broad empirical foundation; these two data acquisition methods therefore complement each other well and to a degree interviews may also serve as aid in interpreting survey results. The interviewees are listed in Appendix B
- **Web surveys**: Surveys of FP and RCN project participants. Four distinct but similar surveys were conducted:
    - Companies participating in FP projects ("FP - Companies"): 55 responses (18 per cent response rate)
    - R&D providers[4] participating in FP projects ("FP - R&D providers"): 146 responses (18 per cent response rate)
    - Companies participating in RCN projects ("RCN - Companies"): 120 responses (14 per cent response rate)
    - R&D providers participating in RCN projects ("RCN - R&D providers"): 460 responses (18 per cent response rate)

Though rather low, the response rates are consistent with FP-related surveys in many countries (including in previous Norwegian studies). It is notoriously difficult to achieve high success rates for broad surveys such as these since there is no "ownership" or implicit "obligation" to respond (in contrast to, for example, national programme evaluations). Given the large gross populations (the largest possible with the available data sources and the selection criteria used) and the relatively large number of responses per survey, results should be representative enough for the purposes of this evaluation. The surveys have provided a broad empirical foundation on motives, results and impacts resulting from participation in FP projects and in RCN projects, as well as perceived advantages and disadvantages of FP participation.

Appendix C provides details of the way the surveys were conducted and about the respondents, and as an example lists the survey questions for FP - Companies

[4] The term R&D provider is used as a common notation for universities, university colleges, research institutes and hospital trusts/regional health authorities (HF/RHFs).

- **Social network analyses and text mining**: Analyses of FP collaboration networks based on eCorda data on FP projects and text mining of published periodic reports available from the EU Open Data Portal. The analyses have characterised Norwegian organisations' FP participation patterns nationally and internationally, as well as the most common project topics. The details of the analyses are presented in Appendix D
- **Econometric analyses**: Econometric analyses of FP company performance compared to the performance of companies participating in national R&I instruments. The details of the analyses are presented in Appendix E
- **Analyses of Community Innovation Survey (CIS) data:** Comparison of CIS data for FP companies and data for participants national instruments. The details of the analyses are presented in Appendix E
- **Cost-benefit analyses**: Assessment of direct costs and benefits of Norwegian FP participation based on established CBA methodology
- **Descriptive analysis of participants in R&I instruments**: Investigation of participant characteristics and comparison of participants in FP and national R&I instruments, based on Samfunnsøkonomisk analyse's database for R&I instruments and national accounting statistics. The details of the analyses are presented in Appendix E.

The evaluation team was supported by an Advisory Committee (AC) consisting of representatives of government ministries and agencies as well as of key stakeholder groups. The evaluation team presented its plans to the AC and received valuable feedback on two occasions. Appendix B lists AC members.

1.4 Structure of the report

The report follows the structure of the three parts of the evaluation. Chapter 2 recapitulates the history of the FPs, previous evaluations of Norway's FP participation and briefly presents Norwegian FP policy.

In chapters 3–5 we assess whether FP participation contributes to the objectives set out in the government's strategy (corresponding to part 1 of the evaluation), and in chapters 6 and 7 we assess cost and benefit of FP participation for Norway (corresponding to parts 2 and 3 of the evaluation). In chapter 8 we make our concluding remarks.

2 Background

This chapter recapitulates the history of the FPs and previous evaluations of Norway's FP participation and then briefly summarises the Norwegian FP policy.

2.1 History of the FPs

The legal basis for FPs is the Council resolutions of 14 January 1974 about the coordination of national policies, the definition of science and technology projects of interest to the EC and the need for the Community to have its own science and technology policy.

FP1, launched in 1984, was an extension of existing initiatives in computing and energy. FP2 (1987–1991) concentrated on ICT, energy and materials. FP3 (1990–1994) broadly followed the same pattern, focusing on fewer action lines and besides collaborative research projects introduced also aspects of human capital and mobility. FP1 had a clear industry focus and was very much "technology push" orientated, reflecting the Commission's desire to bridge the technology gap (Arnold, et al., 2011). The early efforts in ICT and industrial technology development exemplify this trend. Subsequent FPs strived to achieve economic impact. The FP was also to play a role in modernising public research organisation structures, limit duplication of research activities in the Community and limit intra-Community competition (European Parliamentary Research Service, 2017). The "Riesenhuber criteria"[5] served as guidelines as to which activities to be supported by the Community (see textbox).

Textbox: "Riesenhuber criteria"

Community action could be justified when:

- The scale of the research was beyond a single Member State'sresources or capacities;
- The benefits of the results would outweigh the cost of coordination; the research was on a large scale that would be beneficial throughout the Community;
- The activities developed could support the establishment of the single market and help create a unified European research area (ERA)
- All the activities were to contribute to the definition and implementation of Community policies

Source: European Parliamentary Research Service (2017)

The Maastricht Treaty of 1993 empowered the Commission to coordinate national R&D policies. Moreover, a major shift in the Commission's approach to R&D policy was introduced in that period presenting a much more holistic view on innovation (European Commission, 1995). Instead of support to single

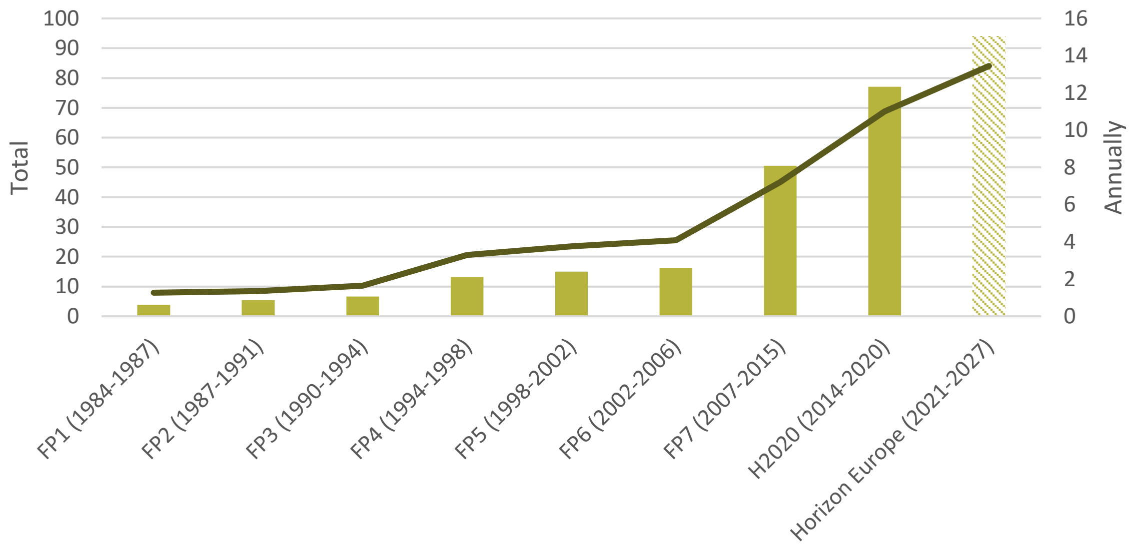
[5] These criteria are known as the 'Riesenhuber criteria' after the then German research minister

industry sectors, attention was shifted to diffusion and the use of new technologies. The EC white paper on Growth, Competitiveness and Employment (1993) and the following communications underlined the importance of education and training, increased labour market flexibility, financing of new companies, regulations and technology transfer. Following these lines, FP4 (1994–1998) built on previous initiatives but extended the scope of the Community R&D programme to basic research, applied research, technology development and demonstration. While FP4 included few socioeconomic aspects, FP5 (1998–2002) marked a clear shift from technologically oriented research to R&I tackling defined societal objectives.

Across FP3–FP6 there was "considerable thematic continuity with major themes either flat or growing in budget terms" (Arnold, et al., 2011). The biggest field in terms of funding was ICT-related research with a rather consistent volume but decreasing share of total funds across FPs. Life sciences, biotechnology, food and health benefited from steady growth in the volume and share of the total FP budget.

The FP budget is negotiated alongside the negotiation of other policy area. The overall budget of the FP has grown with time, particularly from FP7 and onwards (see Figure 2.1) reflecting the growth in number of EU members states and overall EU budget, but also the growing importance of European cooperation in research and innovation.

Figure 2.1 The EU Framework Programmes budget. Total (in column) and annual (dots). Nominal prices at the time of agreement. In billion euro.



Source: European Commission

Note: Total budget in current prices at the time of adoption of the programmes. Annual average is based on the years of commitments. Budget for Horizon Europe is set to EUR 94.1 billion but is subject to change.

2.2 FPs in focus in this report

2.2.1 FP7

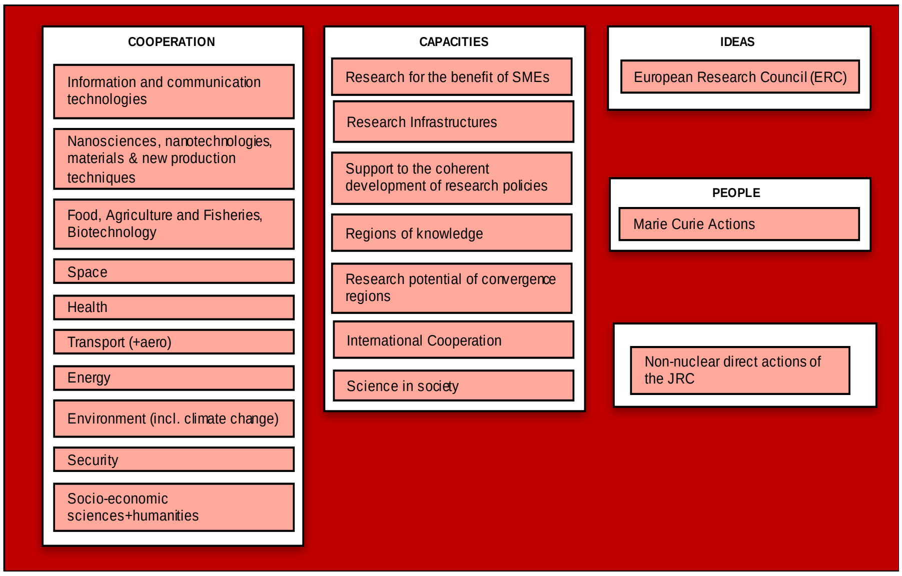
FP7 (2007–2013) contained a layer of new initiatives, including the creation of the European Research Council (ERC) to support excellent research, and a focus on research infrastructure. This period was marked by the launch of Joint Technology Initiatives (JTIs) around key technologies as a framework for public-private partnerships (PPPs) at a European level. Growing numbers of Public-to-Public partnerships (P2Ps) were also set up under Article 185 (previously 169) of the Treaty and Joint Programming Initiatives to coordinate Member States' thematic research started to operate from 2010. The 'international' (i.e. non-EU) dimension was mainstreamed into the specific programmes of FP7, and increased attention was given to SMEs.

FP7 had five specific sub-programmes:

1. Cooperation – supporting collaborative research in nine thematic priorities;
2. Ideas – introducing the ERC;
3. People – supporting training and career development of researchers;
4. Capacities – supporting key aspects of European research and innovation capacities; and
5. Non-nuclear actions of the JRC.

The sub-programmes are summarised in Figure 2.2. In the second half of FP7, there were much more targeted attempts to merge R&I policy agendas leading to a conclusion that this effort also requires concerted complementary policies, such as demand side policy.

Figure 2.2 Programmes in FP7.



Source: Technopolis

2.2.2 Horizon 2020

H2020 (2014–2020) marks a change in European policy-making due to its comprehensive and integrating approach to R&I, reflecting the developments in the ERA 2020 and the Europe 2020 strategies. The acknowledgement of a need for balance between “supply push” and “demand pull” in innovation policy, and the backing of projects that could cut across the phases of research, testing, procurement and deployment of innovations, is a core concept. Figure 2.3 shows the overall structure of H2020, with its three “pillars” of Excellent Science, Industrial Leadership and Societal Challenges, corresponding to its academic, industrial and political constituencies.

Despite the new structure, most previous themes remain present in H2020. Growth of the ERC and the addition of the Future Emerging Technologies (FET) programme meant that science-orientated activities increased from about 25 per cent to 31 per cent of the budget between FP7 and H2020. Industrial leadership accounts for 21 per cent of the H2020 budget, though many industry-relevant themes have been continued within the new Societal Challenges pillar, which has the largest slice of the budget (39 per cent).

A major objective of H2020 is to support bridging the innovation gap in Europe by making better use of its innovation instruments. The H2020 policy toolbox covers almost the whole spectrum of public policy instruments in the field of R&I. H2020 employs both supply- and demand-side instruments in its support to innovation. Demand-side actions are intended to complement the technology push of the R&I initiatives. They include pre-standardisation or pre-commercial procurement of innovative solutions (i.e. the co-funding of Pre-commercial procurement (PCP) and Public procurement of innovative solutions (PPI) actions), standardisation and other user-centred instruments to help accelerate the deployment and diffusion of innovative products and services into the market.

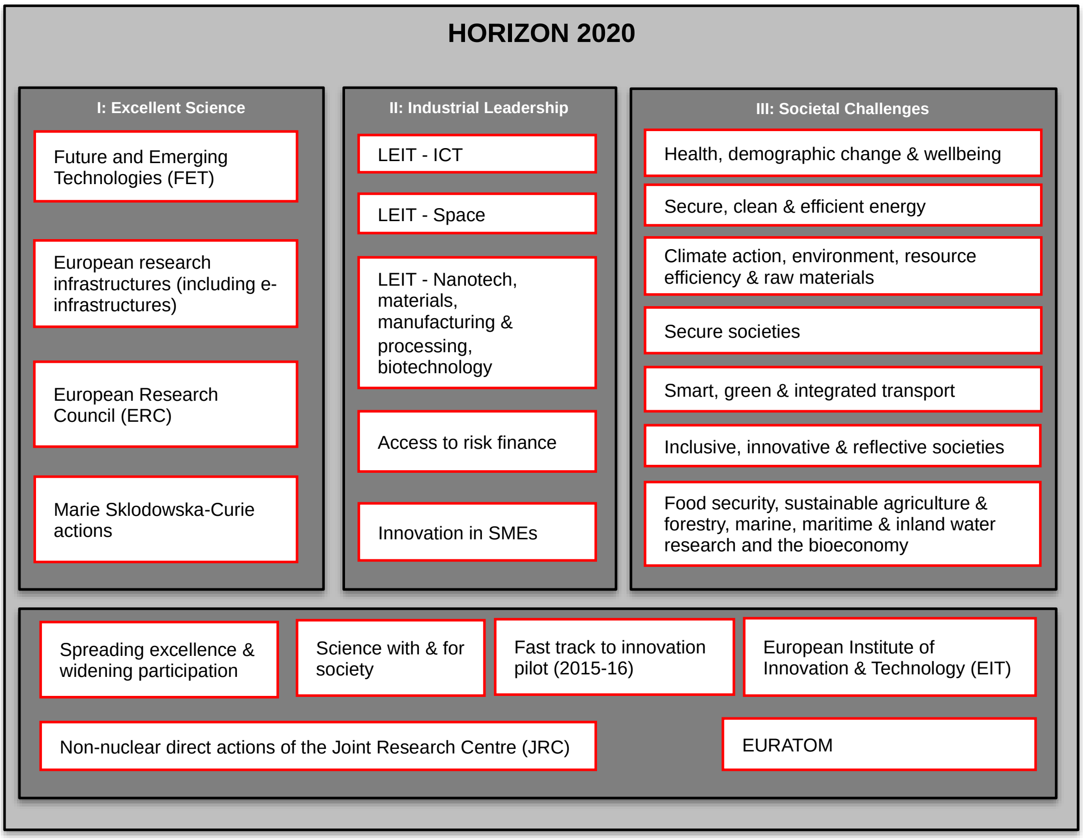
In addition to the major funding instruments, Research and Innovation Actions (RIA) and Innovation Actions (IA), and the SME instrument (a new bottom-up innovation instrument), H2020 provided new financial instruments such as the InnovFIN SME Guarantee Facility (managed by EIB), which targets eligible local banks, leasing companies and guarantee institutions.[6] H2020 also covers a range of “linkage instruments” such as forward-looking activities and foresight (including embedded foresight in, for example, joint programming or innovation partnerships), cross-sectoral networks and brokerage activities, innovation observatories and policy learning networks. These “linkage” instruments support cross-cutting networks to respond to societal challenges, e.g. encouraging collaboration between different disciplines and sectors and supporting links between established and emerging networks.

The organisational structure of H2020 around the challenge areas is geared towards facilitating and fostering these “interlinkages”, i.e. multi-disciplinary and multi-sectoral collaboration. Addressing

[6] IN has entered into an agreement with EIB which then can cover a portion of the losses incurred by the financial intermediaries on loans, leases and guarantees in selected IN measures.

societal challenges, while simultaneously enhancing industrial competitiveness and supporting excellent basic research, is at the core of H2020. The H2020 programme is structured around three main pillars and holds dedicated budget lines also for the programmes "Spreading excellence and widening participation" and "Science with and for society", the European Institute of Innovation and Technology (EIT), the pilot project "Fast track to innovation" and the non-nuclear direct actions of the Joint Research Centre (JRC), see Figure 2.3.

Figure 2.3 Pillars and programmes in H2020.



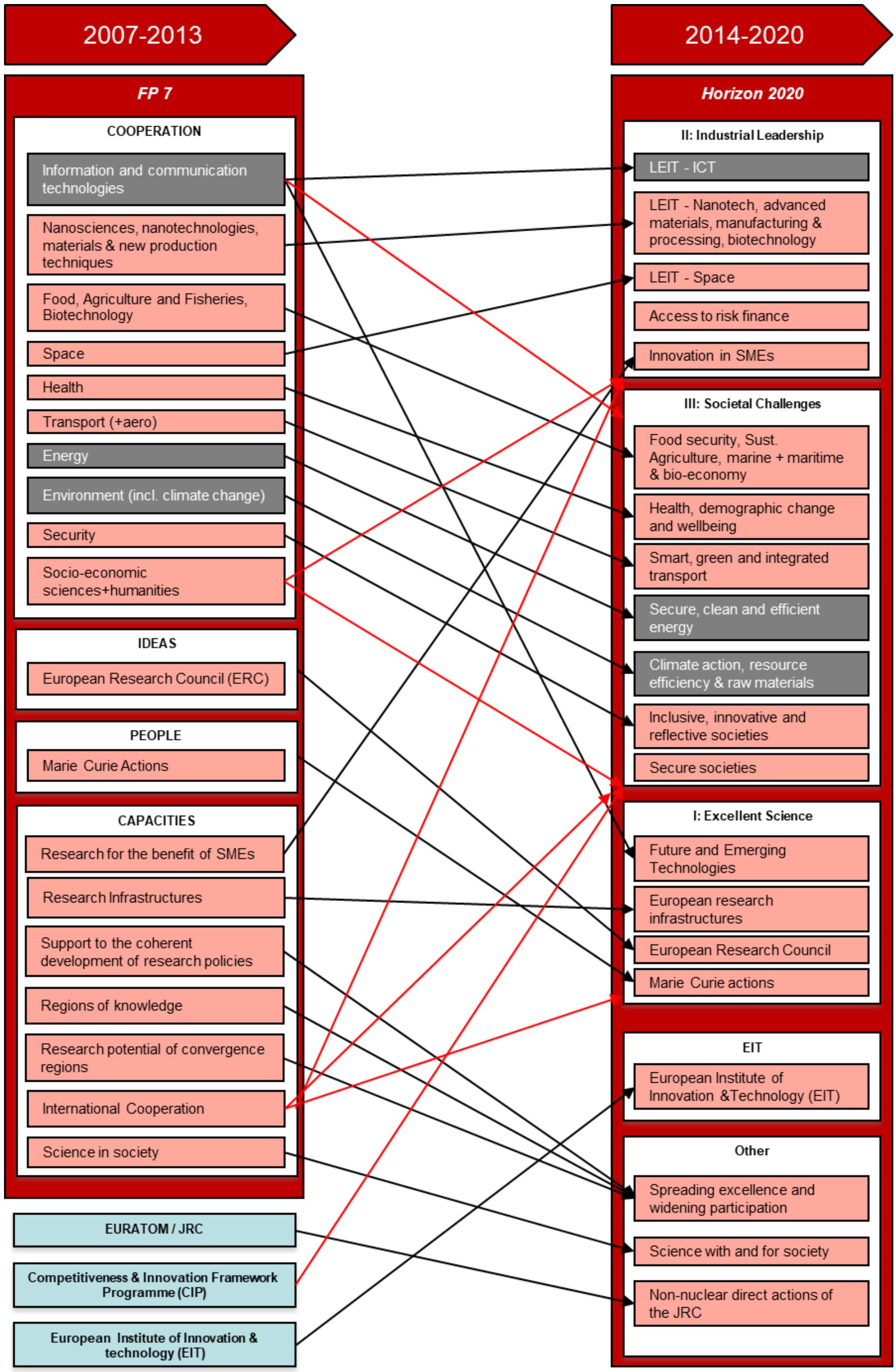
Source: Technopolis

H2020 increasingly aims to foster links between R&I, public and private sector actors and among European, national and regional R&I systems. There is an increasing number of network and partnering initiatives at European level. The major change that occurred with H2020 is the increased emphasis on the creation of coherence and synergy among these initiatives, as well as between the initiatives and H2020.

Another development was the strengthening of the initiatives' alignment with Europe's higher-level policies, in particular Europe 2020. The Strategic Research and Innovation Agendas (SRIAs) established by ETPs, JPIs and EIPs are now considered key elements of the external advice and societal engagement needed for the implementation of the FP. H2020 also (co)funds the R&I activities that implement these SRIAs, upon condition of a clear commitment by the participants in PPPs and JPIs. This encourages alignment of the H2020 work programme with needs in the stakeholder communities but also tends to align some private and public sector national funding towards the Europe 2020 objectives.

While H2020 has a more pronounced emphasis on innovation than FP7 did, and a completely new structure, most previous themes remain present in H2020, see Figure 2.4,where red lines indicate the coverage of the FP7 topic across all programmes in the H2020 pillar.

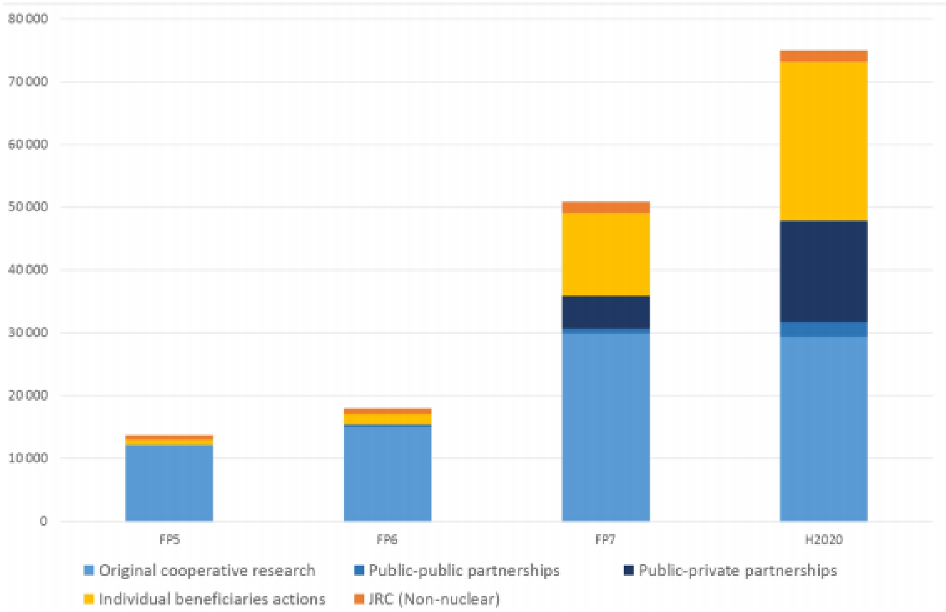
Figure 2.4 Concordance between FP7 and H2020.



Source: Technopolis.

From FP1 to FP5, the instruments used to implement the FP remained limited, but with the FP6, the FP7 and the Horizon 2020, new instruments and structures were progressively introduced i.e. SME instruments, public-public partnerships (P2P), public-private partnerships (PPP) and risk finance instruments. The creation of these different instruments has meant that the share of funding attributed to original cooperative research projects has declined, whereas the share of funding to individual beneficiaries (i.e. ERC, MSCA and business innovation) has increased, see Figure 2.5.

Figure 2.5 Evolution of the support provided by the framework programme for various types of beneficiary (million EUR, nuclear energy not considered)



Source: European Parliamentary Research Service (2017)

2.2.3 Horizon Europe

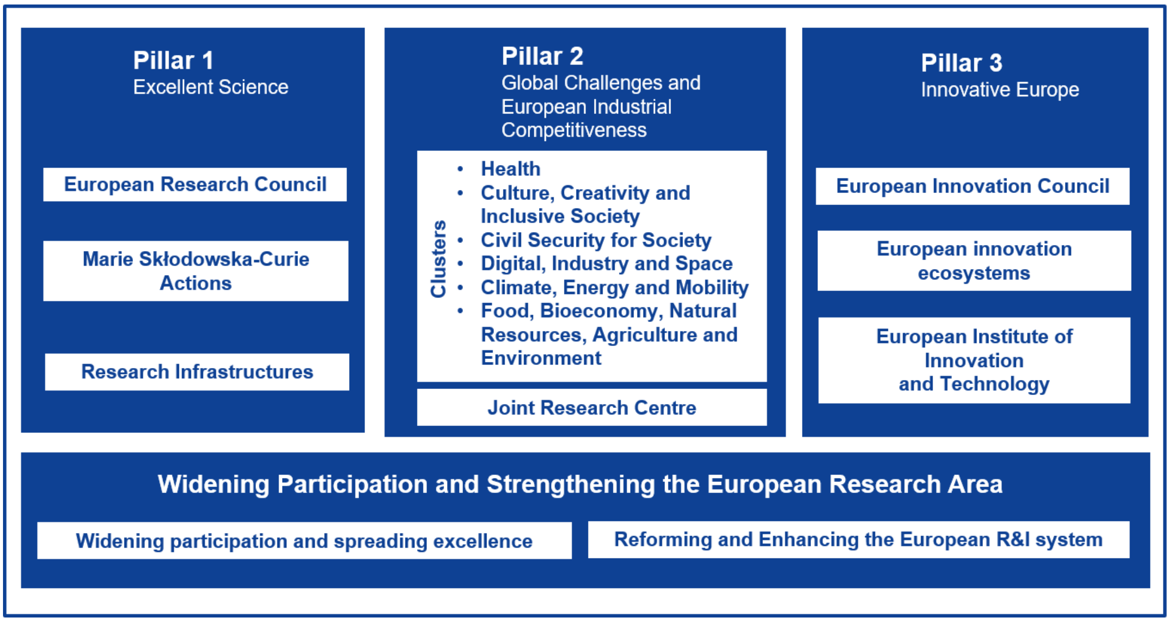
The ninth framework programme for research and innovation, Horizon Europe will last from 2021 to 2027. The European Parliament and the Council reached a partial general political agreement on Horizon Europe in April 2019, on the basis of which the Commission has started to prepare for the programme's implementation, including through the strategic planning process. The partial political agreement on Horizon Europe in April 2019 sets the indicative budget to €94 billion (as was proposed by the European Commission in June 201 8) but, as of December 2019, the final budget as well as instrument design and participation criteria are still subject to change following political negations.

The European Commission describes Horizon Europe as an "evolution, not revolution". Horizon Europe seems very much to be rooted in the policy priorities emerging in the latter phases of H2020, i.e. the concepts of Open Innovation, Open Science and Open to the World and the three-pillar structure. Further, Horizon Europe is expected to rest on the global Sustainable Development Goals (SDGs) that are a key underlying framework to EU policy priorities.

While Pillar 1 "Excellent Science" will focus on reinforcing EU scientific leadership, Pillar 2 "Global Challenges and European Industrial Competitiveness" will focus on tackling global challenges, in line with the SDGs, while strengthening the global competitive positioning of European industry. Pillar 3 "Innovative Europe" focuses on stimulating, nurturing and deploying disruptive and market-creating innovations, and on enhancing European ecosystems conducive to innovation, including through the European Innovation Council (EIC).

One of the main novelties of pillar 2 of Horizon Europe is the introduction of missions which are high-ambition, high-profile initiatives, based on stakeholder involvement, aiming to find concrete solutions to challenges facing European citizens and society.

Figure 2.6 Pillars and programmes in Horizon Europe



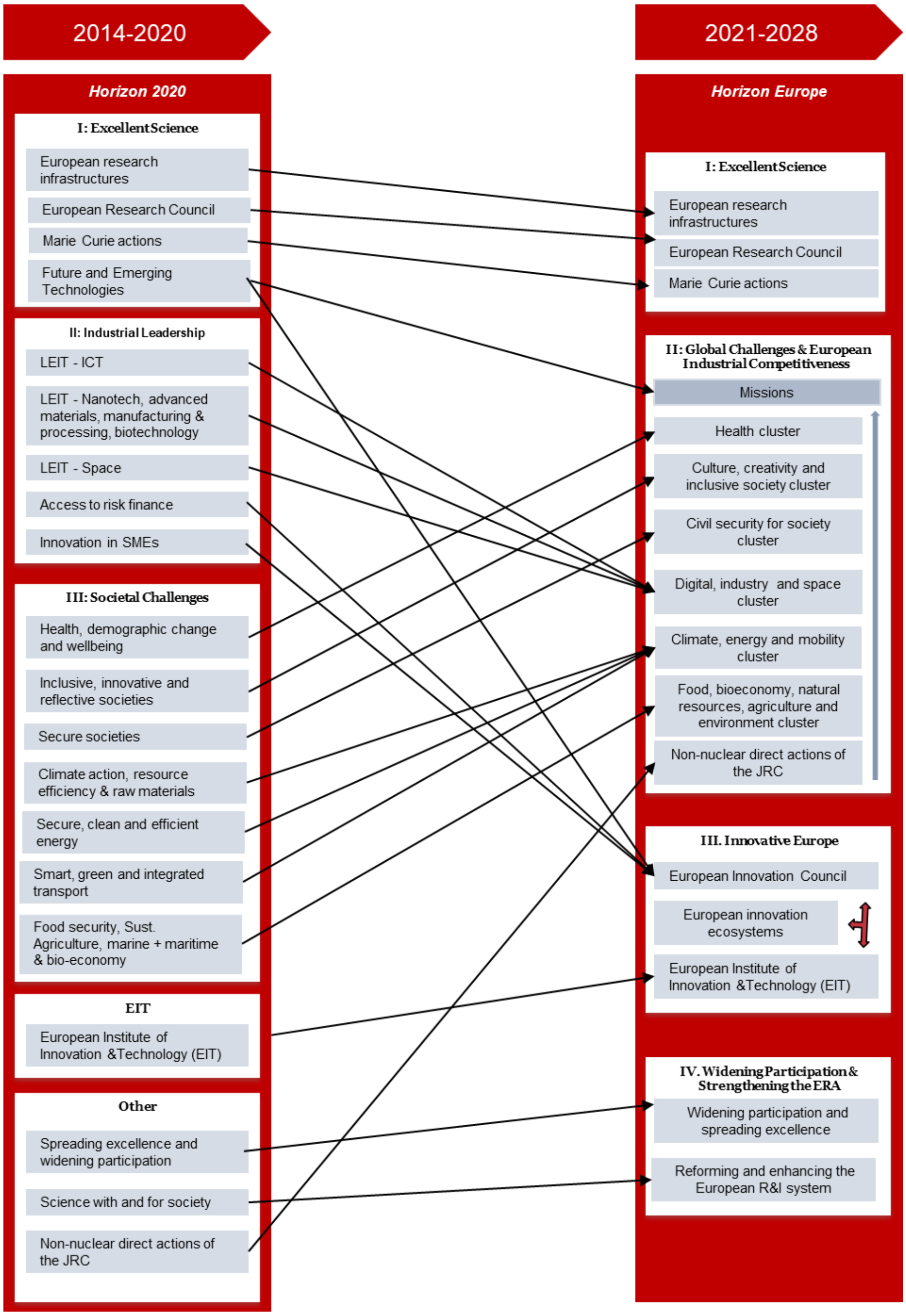
Source: European Commission

A novelty in pillar 3 is the introduction of the European Innovation Council (EIC), aimed at supporting top-class innovators as well as start-ups with radically different ideas through the successors of the SME Instrument: the Pathfinder and the Accelerator programmes. This responds to the need for Europe to foster more disruptive and breakthrough technologies and to support the scaling-up of start-ups. The Pathfinder will provide grants from the early-stage, high-risk innovation and aims at multi-disciplinary consortia, i.e. collaborative research involving universities, research organisations and the industry sector (SMEs, including start-ups), and the Accelerator aims to bridge the "valley of death" and support entrepreneurs in launching breakthrough innovation by encouraging co-investment between public and private sector investors and attracting scalable firms.

Further EC steps will be taken to simplify the implementation of the Programme, starting with model grant agreements and covering all processes, documentation, helpdesks, support services, and IT systems, alleviating further the administrative burden for participants and accelerating the granting process (European Commission, 2018).

Being described as an evolution, Horizon Europe is expected to continue the problem-driven research and innovation emphasis of H2020. Despite the new FP, like its predecessor, having three pillars, they are not directly comparable but again most instruments and themes remain, see Figure 2.7.

Figure 2.7 Concordance between H2020 and Horizon Europe.



Source: Technopolis.

2.3 Previous evaluations of Norwegian FP participation

Participation in the FPs involve a substantial reorientation of Norway's international research relationships. Before World War II, Norway's main cultural and scientific links were with Germany. That relationship ended abruptly on 9 April 1940. During and after the war, links were built with the UK and the USA, which were Norway's dominant international scientific partners in the post-War period – despite the continuous cooperation, both informal and formal, with the other Nordic countries. Participating in the FPs therefore represented a reorientation and a reconnection with continental Europe that required building up new networks.

2.3.1 FP2–4

Norway initially participated in certain of the Specific Programmes in the FPs on a self-funding basis under a framework agreement on science & technology cooperation between Norway and the EU. From 1994, with the signature of the EEA Agreement, Norway became a full participant in the FPs. NIFU's report "A Sky full of Stars" reviewed Norwegian experience with Specific Programmes of the FPs up to 1996–1997, i.e. the period of the framework agreement and the first couple of years of FP4, which started in 1994.

In FP2–3, the largest group of Norwegian participants was the research institutes, followed by the universities, whereas industry was barely represented. In FP2, Norway was involved in about 2 per cent of FP projects, but by the start of 1996 this had increased to some 6 per cent. Industry started to be more involved by the start of FP4, with almost one third of Norwegian project participations in 1996–1997 being from companies. About 23 per cent of participations were by universities, but the leading group remained the institutes (38 per cent). For the whole period covered by the report, Norway was most strongly represented in themes that reflected national priorities and strengths, notably marine and maritime, transport, energy and parts of electronics.[7] The UK was Norway's biggest partner in the FPs, followed by Germany, France, Italy, the Netherlands and Sweden. To a considerable extent this list simply reflects the fact that large countries have more potential partners than small ones. However, the ranking and presence of the UK, the Netherlands and Sweden suggest that links to these countries were stronger than would be suggested simply by their size.

NIFU's survey of participants in 1996 showed that the three most important reasons researchers gave for participating in FP4 were access to funding, networks and knowledge in other countries. Success in getting into the FP networks required experience. All participants had previously conducted research using national funding, but FP projects were usually more interdisciplinary than their national work. Almost all (86 per cent) Norwegian coordinators had managed international research collaborations before. Success was cumulative: one FP project tended to lead to another. Norwegian project leaders in

[7] The programmes involved were MAST, TSER, ACTS, JOULE and TRANSPORT.

FP3 felt well positioned to participate in FP4, based on the experience and networks they had accumulated.

One result of this was that 65 per cent of Norwegian participants said they had been contacted by others and invited to join a consortium. Still, 45 per cent said they had heard of the consortium through EU-*Forskningsinfo* or RCN. Research institutes valued the “quality label” that FP participation gave them. They put more time into FP proposals than the universities, but they struggled to meet the co-funding requirements of the FP at the time, since they had very little core funding compared with institutes in most other European countries.

2.3.2 FP5

FP5 distinguished itself, among other things, by a greater focus on societal problems and thus a greater role for social science than its predecessors. However, the overlaps between Norwegian and FP thematic priorities remained limited. Norway accounted for 2 per cent of all project participations and was present in 7 per cent of all projects. The NIFU, STEP and Technopolis report (2004) indicated that the financial return – in the sense of the proportion of Norway’s financial contribution to the FP that returns to Norway in the form of FP project funding – was about 90 per cent, but pointed out that the costs of administration (10 per cent) and the commitment to the Joint Research Centre (JRC) (5 per cent) together meant that only 85 per cent of the FP budget was contestable, so a 90 per cent return was more than would be needed to “bring back” the addressable part of Norway’s subscription to the FPs. (NIFU, STEP and Techopolis, 2004).

As before, the institutes were the biggest beneficiaries of FP5, though their share of participations fell from 43 per cent in the first three years of FP3 to 37 per cent in FP5. While the number of SMEs participating rose in response to the SME increased focus in FP5, large Norwegian companies reduced their participation compared with FP4. Compared with its notional financial contribution to each programme, Norway was in FP5 over-represented in ENVIRO and ENERGY and under-represented in IST and GROWTH.

2.3.3 FP6 and FP7

The most recent evaluation covers FP6 and the first two years of FP7 (2007–2008) see Godø, et. al.. (2009). In FP6, Norway had 1.8 per cent of all participations and was involved in 8.4 per cent of the projects. That compared with 6.6 per cent of the projects in FP5, but FP6 was organised into fewer, bigger projects than its predecessors. Norway coordinated 149 (18 per cent) of the 834 projects in which it was involved.

Another effect of the larger projects was an apparent increase in the size of project networks. Thus, Norwegian participants had links to 5,933 project partners in FP5, but 23,557 in FP6. Norway had the largest number of project links with the UK (13 per cent), Germany (12 per cent), France (11 per cent), Italy (8.5 per cent) and the Netherlands (7 per cent). The tendency for some projects to be extensions of previous FP work continued, with 16 per cent of the projects with Norwegian involvement being such extensions.

The Norwegian success rate was 25 per cent – well above the overall rate of 18 per cent. However, much of this difference was probably the result of the large number of participations by SMEs. Norwegian participation was above the level needed for a *juste retour* in the FOOD, SUSTainable DEVelopment, CITIZEN and SME programmes. Norway was also prominent in the ERA-NETs and the programme of Support for the Development of Coherent Policies.

2.4 Development of Norwegian FP policy

Norway's financial contribution to the FPs is calculated based on its gross domestic product (GDP) and paid for in cash.[8] The fact that the cost is explicit and growing has contributed to a clear policy focus on making the most of the FP association, and a series of research white papers and national strategies have therefore focused on the importance of increasing Norwegian participation to gain as much benefit as possible.

The 2005 research white paper St.meld. 20 *Vilje til forskning* (2004-2005) (Commitment to research) highlighted that internationalisation of Norwegian research is a main objective of the government's research policy, and specifically emphasised the importance of active participation in the FPs. The white paper led to the development of a Strategy for Norway's research collaboration with the EU, which set the objective for the 2007–2010 timeframe that Norwegian organisations should bring back a share of funding from the competitive parts of the FP corresponding to Norway's contribution to the overall FP budget.

The 2009 research white paper St. meld. 30 (2008-2009) *Klima for forskning* (Climate for research) stated that participation in the FPs is a crucial part of the internationalisation of Norwegian research. The white paper reiterated the return objective for the 2007–2010 timeframe from the 2008 strategy but went on to note that it would be difficult to achieve.

The 2013 research white paper St. meld. 7 (2014-2015) *Lange linjer – kunnskap gir muligheter* (Long-term perspectives – knowledge provides opportunity) confirmed that participation in the FPs is the government's most important instrument for promoting internationalisation of Norwegian research. The white paper clarified that cooperation with Europe is essential, regardless of the form of association that Norway would choose for H2020.

In 2014, Norway decided to associate itself with H2020, and shortly thereafter the government presented its Strategy for R&I cooperation with the EU, which set four qualitative objectives (Norwegian Ministry of Education and Research, 2014):

[8] See Chapter 6 for a more thorough assessment of costs of FP participation

- Participation shall increase the quality of Norwegian research and innovation and help Norwegian research and innovation succeed internationally
- Participation shall contribute to increased innovation capacity, value creation and sustainable economic development
- Participation shall contribute to improved social welfare and more sustainable social development through research and innovation that enable us to deal with major societal challenges
- Participation shall help to develop our own research and innovation sector, both through further development of policies and instruments and through new patterns of cooperation across national borders, sectors and fields

In addition, the government announced the ambition that Norwegian organisations should bring back two per cent of the competitive funds in H2020, while noting that economic factors are not the main motive for participation. The strategy concluded that universities and university colleges, research institutes, hospital trusts and the private sector have significant potential for greater participation.

The 2014 white paper St. Meld. 7 (2014-2015) *Langtidsplan for forskning og høyere utdanning 2015–2024* (Long-term plan for research and higher education) emphasised the need to strengthen research and education to meet challenges and seize opportunities in the Norwegian knowledge society in the coming decade. The importance of continued internationalisation was stressed, and the white paper noted that for the two per cent goal to be reached, the scope of Norwegian activities must increase radically. The white paper concluded that there is an inherent potential to increase the scope of Norwegian FP participation in all sectors. In cooperation with the RCN, the government was therefore to develop a set of instruments to respond to the needs of various sectors, taking the Strategy for R&I cooperation with the EU as point of departure. The white paper emphasised that different sectors have different needs. Research institutes were described as needing support to meet the gap between costs covered by European Commission funding and actual costs. Since the institutes play an important role in mobilising industry, support to institutes also was seen as a means to increase company participation. The higher education (HE) sector and the hospital trusts were described as needing information and support for positioning activities, writing proposals, and establishing and conducting projects. Industry's greatest need was said to be funding to mobilise companies to take part, and to assist them in establishing projects In the white paper, the Government announced that it would raise appropriations to programmes that stimulate Norwegian participation in the Horizon 2020 by NOK 400 million.

The 2017 white paper St. Meld. 25 (2016-2017) *Humaniora i Norge* (Humanities in Norway) points out that humanities is an underutilised resource in tackling societal challenges, and declares that the government will work to increase the presence of humanities in Horizon Europe.

The 2017 white paper St. Meld. 27 (2016-2017) *Industrien – grønnere, smartere og mer nyskapende* (A greener, smarter and more innovative industry) explains that Norway's competitiveness depends on its ability to use and exploit R&D results and technology developed in other countries, and states that FP participation is a means of facilitating this. The white paper argues that there is scope for increasing industry's H2020 participation in order to foster innovation capacity, value creation and sustainable economic development, including for SMEs. It also argues for effective cooperation between the RCN and

IN, in particular when it comes to SMEs. The strategy reiterates the two per cent overall objective for Norwegian participation.

The 2018 version of the white paper *Langtidsplan for forskning og høyere utdanning 2019–2028* (St. meld. nr. 4, 2018-2019) continues the previous long-term plan's emphasis on making the most of the FPs and preparing for the upcoming Horizon Europe. However, the new plan is less explicit about the importance of H2020 participation, presumably since it has come to be taken for granted (as suggested by interviewees).

2.5 Norwegian FP facilitation measures

The main agencies responsible for facilitating FP participation are the RCN and IN. The Norwegian part of the pan-European network of National Contact Points (NCP) is led by the RCN, apart from the SME instrument and Access to risk finance that are the responsibilities of IN, and space-related matters that are handled by the Norwegian Space Centre (NSC). Together these agencies provide elaborate information and advisory services, mainly through NCPs covering all H2020 sub-programmes. IN also co-funds EU advisors within clusters funded through the Norwegian Innovation Clusters programme (NIC)[9] and hosts the Enterprise Europe Network (EEN) in Norway, which assists SMEs with partnership search, reviews proposal drafts, advices on business-related matters and provides support to innovation. Together, the NCPs and IN's regional EU advisors located throughout Norway provide comprehensive information on FP opportunities and advice regarding FP participation, both in the form of seminars and courses and in individual interaction. Moreover, the RCN's competence-building initiative for H2020 proposers, the Path to EU Excellence, provides a comprehensive set of relevant courses to researchers, EU advisors and administrators. The Path to EU Excellence, provides a comprehensive course offering to researchers, enterprises, EU advisors and administrators.

RCN has a range of FP support measures. These are dominated by project establishment support (*PES* under FP7 and *PES2020* under H2020) introduced in 2004, which among other things supports development of FP applications and FP support services, and co-funding to research institutes in granted FP projects (*STIM-EU*) introduced in 2012. Several of the RCN's R&D programmes also provide additional funding to Norwegian participants in selected H2020 subprogrammes in order to get more impact from the H2020 project (Åström, et al., 2017)

Through the ECs Seal of Excellence scheme, IN provides funding to Norwegian SMEs whose proposals to phase 1 of H2020's SME instrument scored above the quality threshold but did not receive EC funding due to budgetary constraints. The measure is aimed at triggering R&I activities considered to be of high quality and increasing the likelihood of success in phase 2.

[9] NIC is co-funded from IN, RCN and SIVA.

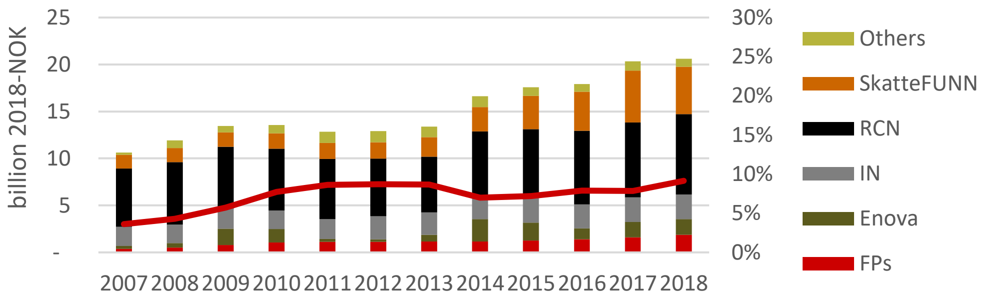
Last but not least, part of the basic funding of universities, university colleges, hospital trusts and research institutes depend upon international income (amongst other funding criteria). However, while this dependency is substantial for universities, university colleges and hospital trusts, it is quite weak for institute (Åström, et al., 2017).

2.6 Norwegian R&I portfolio

The Norwegian portfolio of instruments to stimulate research, innovation and industrial growth has developed over time and consists of both economic (e.g. loans, guarantees, grants) and non-economic instruments (e.g. public procurement standards). The RCN and IN are the largest agencies (measured in terms of administrative cost and total funding given as grants), whereas SkatteFUNN is the single largest instrument (measured by the total cost of foregone corporation tax plus grants to companies) [10].

Figure 2.8 illustrate the scale and growth in funding from the main application-based grants available to Norwegian beneficiaries with the aim of fostering research, innovation, and business development. Funding from these instruments totalled about NOK 21 billion in 2018. FP funding to Norwegian participants totalled to about NOK 1.8 billion[11] in 2018.

Figure 2.8 Funding given as competitive grants for research, innovation and business development (left axis, in billion 2018-NOK) and FP funding as a share of total funding to Norwegian participants (right axis, in %). 2007-2018.



Source: Samfunnsøkonomisk analyse AS, RCN and SSB

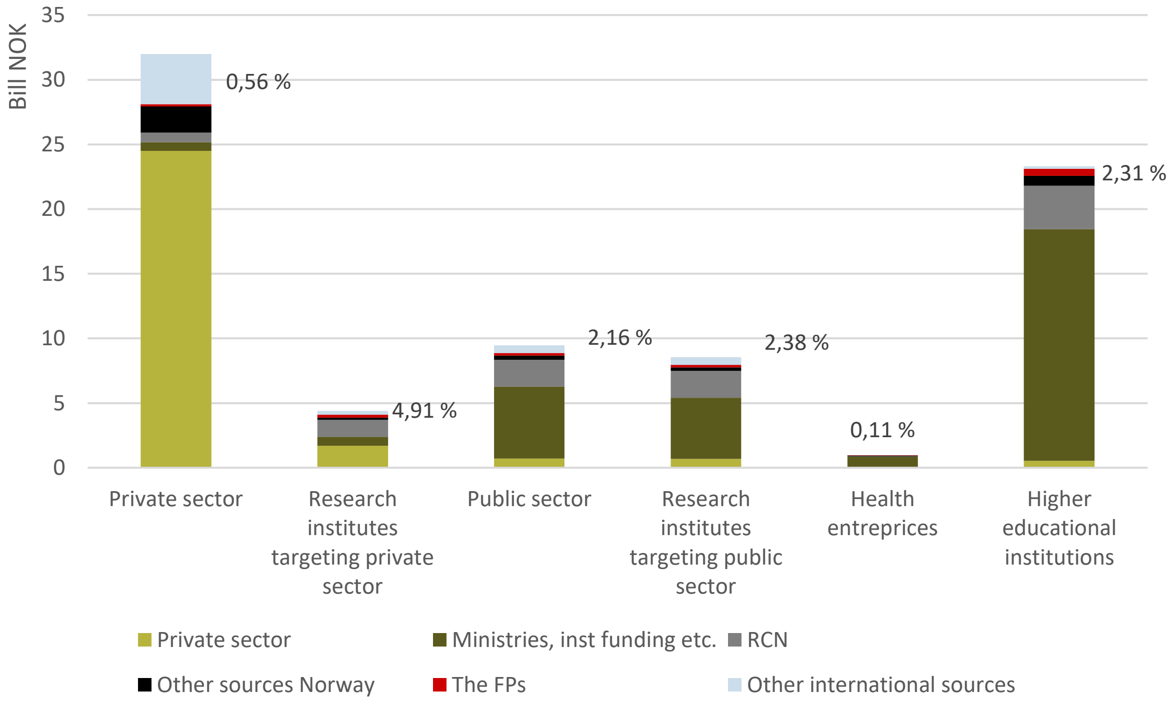
Note: The FPs cover FP6, FP7 and H2020. Annual return from FP6 is estimated based on total FP6 return allocated according to payment pattern of FP7. FP funding is estimated based on total funding from FP grants awarded, average annual exchange rate in the year of project being awarded and average project duration period of 3 years. Includes grants and tax reductions only, not loans, guarantees and equity, profiling or advisory services or grants for enhancing energy efficiency. RCN funding does not include institutional funding to research institutes, PES and STIM-EU and Enova funding does not cover funding from instruments that SØA has categorised as instruments to enhance energy efficiency. "Others" include Norwegian Seafood Research Fund (FHF), SIVA, county authorities, Norwegian Space centre, Arts Council of Norway and DOGA.

[10] The RCN has an administrative role with regards to SkatteFUNN, but SkatteFUNN is a rights-based scheme that differs from other instruments in the RCN portfolio. Thus, it is useful to regard SkatteFUNN not as a part of the RCN, but as a distinct instrument.
[11] FP funding is estimated based on total funding from FP grants awarded and contract signed, exchange rate as in the year of project being awarded and average project duration of 3 years.

For comparison, funding from the FPs was equivalent to about one third of SkatteFUNN (NOK 5,1 billion) and three times the size of BIA[12] (NOK 582 million) that same year. The share of FP funding relative to total funding from application-based grants has increased gradually from 4 per cent in 2007 to 9 per cent of all competitive R&I grants in 2018 (Figure 2.8) indicating an increased importance of the FPs as a source of R&I funding relative to other national R&I instruments.

Still, it should be borne in mind that EU funding represents a small share of total R&I funding in Norway. Figure 2.8 does only covers grants from the main agencies and tax redemption, but not funding given as loans, guarantees and equity, profiling or advisory services nor institutional R&D funding and private sector R&D funding. FP funding only represented 1.65 per cent of total R&D funding in 2017 see Figure 2.9. Total R&D funding was estimated to NOK 69 billion in 2017[13] (R&D statistics bank, 2019).

Figure 2.9 Total R&D funding in Norway. EU funding as a share of total R&D funding (in per cent).2017.



Source: R&D statistic bank (2019). OECD R&D sector categorization.

[12] RCN programme for User-driven Research based Innovation, amount as reported in the RCN annual report 2018
[13] Last available data cross OECD sectors.

3 Activities

In chapters 3–5 we present our findings on the extent to which Norway's FP participation has contributed to fulfilment of the objectives of the government's Strategy for R&I cooperation with the EU. We structure our findings according to the impact logic, where chapter 3 presents activities, chapter 4 results and chapter 5 impacts, thus gradually reconstructing a full impact logic for Norway's FP participation from the observations at hand.

In practice, a country's FP participation has many aspects. In this evaluation, we focus on two broad types of activities, one being participation in FP projects, to which this chapter is devoted, the other being participation of ministry and agency representatives in a large number of FP-related committees, which we address in Section 4.3.3.

This chapter focuses on competitive instruments only, i.e. on R&I projects won in competition, which constitute the vast majority of the FPs' instruments – as well as of RCN's instruments, which we will use as a benchmark. While direct comparison between FP and RCN funding rules would be incredibly difficult, both the FPs and RCN usually co-fund R&I projects, meaning that project participants have to contribute some of the project costs from their own funds. In line with state-aid rules, basic (fundamental) research may be fully funded by public sources (such as the FPs and RCN), whereas the permissible share of public funding decreases the closer to market a project gets. In practice, this means that organisations that mainly conduct basic research – most often higher-education institutions (HEIs) – may get up to 100 per cent public funding, whereas at the other end of the spectrum private companies sometimes receive less (or even no) public funding in projects together with HEIs and institutes (because the HEIs and institutes receive the public funding). Within the framework of state-aid rules, co-funding requirements in collaborative projects are determined at project, not participant, level, so the funding level can vary substantially among participants. However, in practice all participants in FP projects usually receive some level of public funding – but with substantial differences between participant types, instrument types and FPs.[14]

This chapter sets out to provide an overview of Norway's overall participation in FP7 and H2020 applications and projects. The first section of the chapter provides some basic statistics about Norway's FP7 and H2020 participation based on the registry analyses, and then describes some characteristics of the specific FP projects in which the web survey respondents have participated.

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[14] Funding levels in FP projects is an immensely complex issue so it is difficult to generalise. The financial regulations changed from FP7 to H2020 and funding levels vary between stakeholder categories, instruments, sub-programmes, activity types etc. Moreover, there is rarely consensus between the Commission, countries, stakeholder categories and individual participants on what the resulting funding levels are, in large part because it depends on differences in accounting practices.

The data sets used for the registry analyses were extracted in March 2019, which means that while data on proposals to H2020 are available for the period up to March 2019, funding data are available only until the end of 2018 (reflecting the fact that that most contracts for projects awarded in the first three months of 2019 had not been signed by March). Where we link eCorda data with Norwegian accounting statistics and other R&I instruments, 2018 is the most recent year for which accounting data are available.

3.1 Norway's FP project participation

The analyses below are based on eCorda databases of proposals and projects that cover the entirety of FP7 and the first five years of H2020. We have used the following terminology to report on our analyses:

- A proposal is often submitted by a consortium. Each organisation's involvement in that **proposal** is termed an **application**. Similarly, the involvement of each individual organisation within a **project** is termed a **participation**
- When analysing the coordination of proposals and projects, we look separately at **multi-partner (MP)** cases, in order to exclude those cases where no consortium is involved (no partners)
- The stakeholder categories in eCorda are: **HES** (Higher or Secondary Education Organisation), **PRC** (Private for Profit Organisation – excl. education), **REC** (Research Organisation), **PUB** (Public Body – excl. research and education) and **OTH** (Other)

The eCorda stakeholder categories do not completely coincide with the ones commonly used in Norway, but since we want to compare Norway's FP participation with that of other countries, we have no choice but to use the eCorda categories, but in chapter 3.3. in which FP participants are compared with participants in national instruments we rely on RCNs sector categorization. In general, the concordance between eCorda and Norwegian classifications is quite good, and the odd inconsistencies at participant level do not materially disturb overall analyses by stakeholder category. However, it should be noted that the uniquely Norwegian HF/RHF (hospital trusts/regional health authorities) category does not exist in eCorda; the HF/RHFs are spread over the HES, PUB, RES and PRC categories.

Given the different sizes of the comparator countries, we also present normalised results, which have been weighted based on national research capacity. Specifically, we weight country participation data by the number of researchers, using UIS figures on the total number of R&D personnel (FTE) in each country.

Further details of the participation analyses and a more extensive presentation of statistics are given in Appendix A.

3.1.1 Proposals

Norwegian applicants were involved in over 7,000 **proposals** during FP7 (4.5 per cent of the total). This number has already been surpassed in H2020, with Norwegian involvement in over 8,500 proposals in the first four years (4.2 per cent of the total), see Table 3.1. The first years of H2020 have seen an increase in Norway's involvement, with the weighted number of proposals in which Norwegian participants are involved and the share of all proposals with Norwegian participation increasing year on year.

Table 3.1 Norwegian involvement in FP7 and H2020 proposals and applications in absolute numbers, relative share compared to the total and relative to FTE (full-time equivalent) researchers

Proposals			Applications	
FP7 proposals	7,078		FP7 applications	9,658
H2020 proposals	8,531		H2020 applications	11,815
Share of all FP7 proposals	4.5%		Share of all applications FP7	1.5%
Share of all H2020 proposals	4.2%		Share of all applications H2020	1.6%
FP7 proposals per 1,000 FTE	195		FP7 applications per 1,000 FTE	266
H2020 proposals per 1,000 FTE	202		H2020 applications per 1,000 FTE	280

Source: Technopolis analysis of eCorda data.

The trends are the same for Norwegian **applications in proposals**: an increase in applications (9,658 applications to FP7 (1.5 per cent of the total) and 11,815 applications to H2020 (1.6 per cent of the total) and an increase year on year in H2020. Table 3.2 also shows that both the numbers of Norwegian proposals and applications have increased when normalised by the number of FTE researchers in the country.

Half of Norwegian applications to FP7 were accounted for by just four sub-programmes: ICT, SME, PEOPLE and KBBE.[15] However, these were also large areas of activity generally. When we compare the distribution of Norwegian applications with the average, we find above-average concentrations in SME, KBBE, ENV and ENERGY programmes, and below average concentrations in PEOPLE and HEALTH. Similarly, nearly half of Norwegian applications to H2020 were accounted for by the MSCA, ICT, ENERGY and HEALTH sub-programmes. However, compared to the average, Norway was relatively active in FOOD, INNOSUPSME and ENERGY, and relatively inactive in FET, ADVMANU and NMP.

There was a Norwegian coordinator for 1,190 FP7 multi-partner proposals (1.7 per cent of coordinators), while Norway has already coordinated 1,221 H2020 multi-partner proposals (1.9 per cent of coordinators). When weighted for the size of the R&D population, the number of multi-partner proposals

[15] Abbreviations are explained in the Acronyms list right before the appendices.

coordinated by a Norwegian organisation has decreased, but the overall share of multi-partner proposal coordinators has increased significantly.

Table 3.2 Norwegian coordination of multi-partner FP7 and H2020 proposals.

FP7			H2020	
MP proposal coordinators	1,190		MP proposal coordinators	1,221
Coordinators per 1,000 FTE	33		Coordinators per 1,000 FTE	29
The proportion of all MP proposal coordinators that are from Norwegian organisations.	1.7 %		The proportion of all MP proposal coordinators that are from Norwegian organisations.	1.9 %
Share of all MP proposals in which Norwegian organisations are involved that are coordinated by Norwegians.	14 %		Share of all MP proposals in which Norwegian organisations are involved that are coordinated by Norwegians.	20 %

Source: Technopolis analysis of eCorda data.

3.1.2 Projects awarded

Turning to **projects** (grants awarded), Norway participated in 1,485 projects during FP7 (5.9 per cent of the total). The figure (and proportion) so far in H2020 is slightly lower at 1,277 project participations (5.3 per cent of the total), see Table 3.3. These trends mirror the general trends; in short, competition is more intense in H2020 than in FP7, so success rates (share of proposals that receive grants) have decreased overall. There is no clear trend in the number or proportion of projects for which Norway accounts so far in H2020.

Table 3.3 Norwegian involvement in FP7 and H2020 projects.

Projects			Participations	
FP7 projects	1,485		FP7 participations	2,185
H2020 projects	1,277		H2020 participations	2,003
Share of all FP7 projects	5.9 %		Share of all participations FP7	1.6 %
Share of all H2020 projects	5.3 %		Share of all participations H2020	1.7 %
FP7 projects per 1,000 FTE	41		FP7 participations per 1,000 FTE	60
H2020 projects per 1,000 FTE	30		H2020 participations per 1,000 FTE	47

Source: Technopolis analysis of eCorda data.

The number of individual Norwegian **participations in projects** in FP7 was 2,185 (1.6 per cent of the total), and this has already almost been surpassed in H2020, with 2,003 Norwegian participations and a slight increase in the share of all participations accounted for by Norway (1.7 per cent of the total). The first years of H2020 have also seen an increase in Norway's involvement, with the weighted number of participations and the share of all participations for which Norway accounts increasing in most years.

Over half of Norwegian participations in FP7 were in just five sub-programmes: ICT, SME, PEOPLE, ENV and KBBE. When we compare Norway's distribution of participations with the average, we find above average concentrations in SME, ENV and ENERGY, and below average concentrations in ICT, PEOPLE and HEALTH. Similarly, nearly half of Norwegian participations in H2020 were accounted for by the MSCA, ICT, ENERGY and FOOD sub-programmes. However, compared to the average, Norway was relatively active in ENERGY, FOOD, ENV and INFRA programmes, and relatively inactive in MSCA, HEALTH and FET.

There was a Norwegian coordinator for 238 multi-partner FP7 projects (2.0 per cent of all coordinators), while Norway has already coordinated 187 multi-partner projects in H2020 (1.9 per cent of all), see Table 3.4. The share of Norwegian multi-partner coordinators has dropped slightly in H2020, but the share of all projects with a Norwegian participant that is led by a Norwegian coordinator has increased somewhat.

Table 3.4 Norwegian coordination of multi-partner FP7 and H2020 projects.

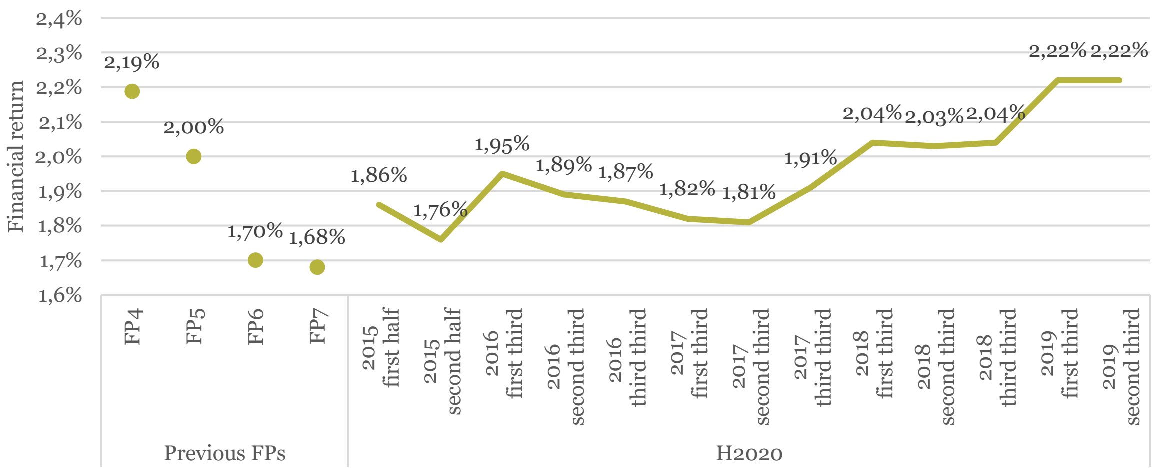
FP7			H2020	
MP project coordinators	238		MP project coordinators	187
Coordinators per 1,000 FTE	6.5		Coordinators per 1,000 FTE	4.4
Share of all MP project coordinators	2.0 %		Share of all MP project coordinators	1.9 %
Share of MP project as coordinator	17 %		Share of MP project as coordinator	18 %

Source: Technopolis analysis of eCorda data.
Note: Return as shown here are based granted projects and allocated to the year in which the contract between the project manager and EC was signed.

3.2 Financial return

Figure 3.1 shows Norway's financial return as a share of total competitive funding since FP4. For H2020 the data show the accumulated return, illustrating a very positive trend since mid-2017 (and of course compared to FP6 and FP7).[16] The Norwegian FP7 return totalled to NOK 7,0 billion in 2018-NOK. By March 2019, FP funding to Norwegian participants totalled to EUR 906 million or approximately NOK 9 billion based on so far awarded projects and the current exchange rate[17]. Return is well above the objective of 2 per cent.

Figure 3.1 Norway's accumulated return as a share of competitive funding.



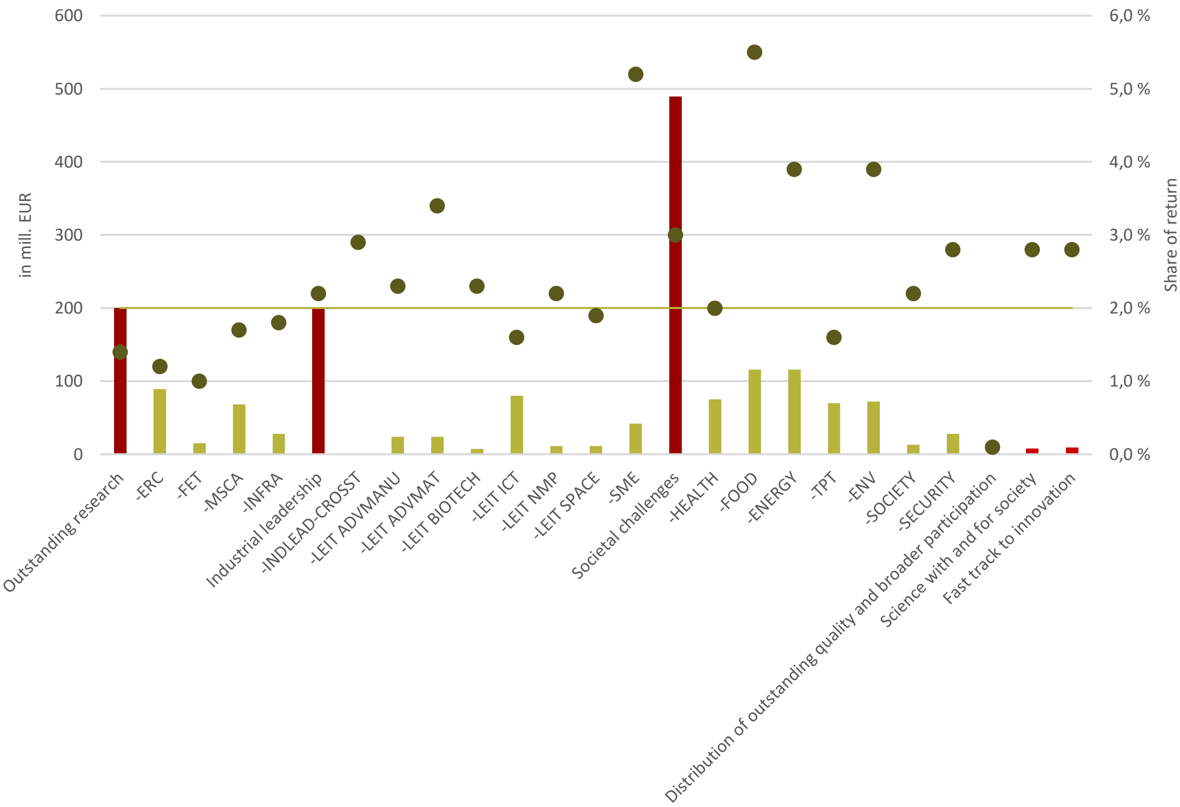
Source: RCN.

Norwegian return (in per cent) is as of March 2019 on par with Finland (2.17 per cent), but behind the other comparator countries[18]; the Netherlands (7.99 per cent), Sweden (3.49 per cent), Austria (2.87 per cent) and Denmark (2.52 per cent). Relative to research full-time equivalents (FTE) Norwegian return (in EUR) is higher than for the other Nordic countries and Austria, but behind the Netherlands (The Research Council of Norway, 2019).

As reflected in projects awarded, the Norwegian return differs cross programme sections and sub programmes see Figure 3.2 which covers Norwegian participation in H2020 (2014-2018). Norwegian participants are well represented in the programme section "societal challenges" with 55 per cent of Norwegian return and a share of return well above the objective of 2 per cent. Norwegian share of return is lower for "outstanding research" (1.4 per cent). Norwegian return is particularly high within the sub programmes SME, FOOD, ENERGY and ENV.

[16] The share is calculated as the amount of funding granted to Norwegian participants divided by that awarded to all participants. The fact that almost all projects have multi-year budgets has been ignored.
[17] In the cost benefit analysis, we estimate the actual return to Norwegian participants by the end of the 2018 to NOK 5.3 billion. This figure is significantly lower as it is based on signed contracts and an annual average project and payment period of three years.
[18] Austria (AT), Denmark (DK), Finland (FI), the Netherlands (NL) and Sweden (SE).

Figure 3.2 Norway's accumulated return in EUR (left axis, columns) and as a share of competitive funding (right axis, dots). Per programme section and subprogramme (only covering the three pillars). Per March 2019.



Source: RCN.

The financial return as share of competitive funding at a given point in time is calculated based on Norway's share of FP funding thus far awarded and serves as an indication of Norwegian success relative to other countries. An increase in the Norwegian rate of return can indicate increased R&I capacity, proposal quality and/or increased motivation for participating, but can also reflect a decline in these respects in other countries. If all countries change in these respects at the same pace, the Norwegian return will not change. Other indicators of R&I quality and capacity are investigated in chapter 5.

Further, an increase in the financial return means that more FP funds are channelled to the Norwegian R&I community (and economy) and a larger portion of the Norwegian membership participation fee is "recovered". Costs and benefits of FP association are investigated in chapter 6 and 7.

3.3 FP project participants

In this section we present the characteristics of the FP7 and H2020 projects participants by linking Samfunnsøkonomisk analyses' database for R&I instruments and national accounting statistics. Data on FP participation originate from eCorda data, but we rely on the research sector categorisation of RCN in order to compare the FP project participants with the RCN project participants. RCN's research sector categorisation. FP funding is based on funding for projects with signed contracts and allocated to the year in which the project was awarded, whereas RCN funding is allocated according to the project period. Further, RCN data is only available up until 2017. See appendix E for further details also covering Enova, IN and SkatteFUNN participants.

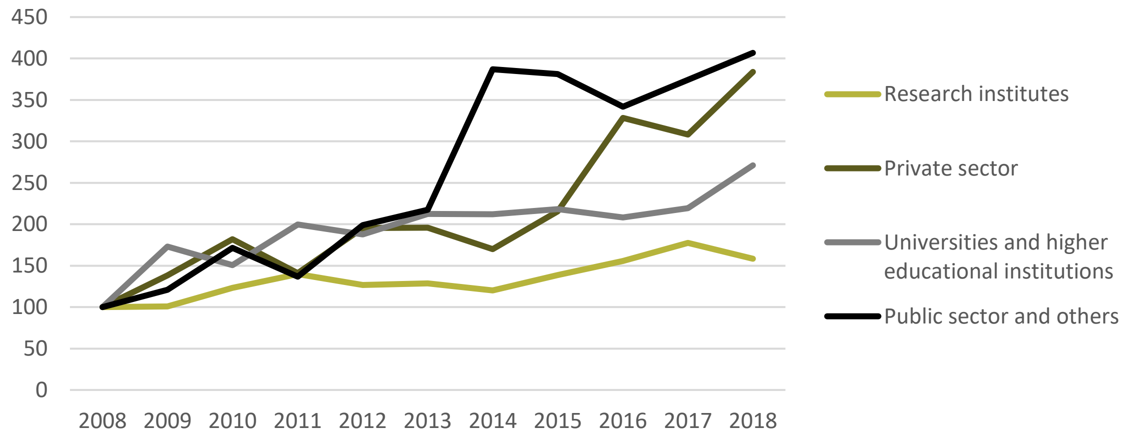
3.3.1 Research sector distribution

About two thirds of the Norwegian FP funding has benefited universities, university colleges and research institutes, whereas one quarter has gone to companies. Other public sector participants and other organisations have benefitted from the remaining. When only looking at R&D providers, FP participation is dominated by four large players - UiO, NTNU and UIB and SINTEF.

The FP funding to the private sector has grown year by year, see Figure 3.3. We interpret this as an indication of the current FP being more relevant for sector participants than the previous FP, but it can very also be an impact of the increased efforts to mobilise companies to participate.

There has also been a strong growth in funding to "public sector and others" and the hospital trusts/regional health authorities, although their participation remains at a modest level. Funding to the hospital trusts/regional health authorities also varies greatly from year to year and is therefore not included in the figure. Growth has been modest for research institutes and higher educational institutions. Consequently, these sectors' relative share of Norwegian H2020 funding is lower than it was in FP7 (Figure 3.4).

Figure 3.3 Growth in FP funding to Norwegian participants. By R&D sector. Funding is indexed at 2008=100.

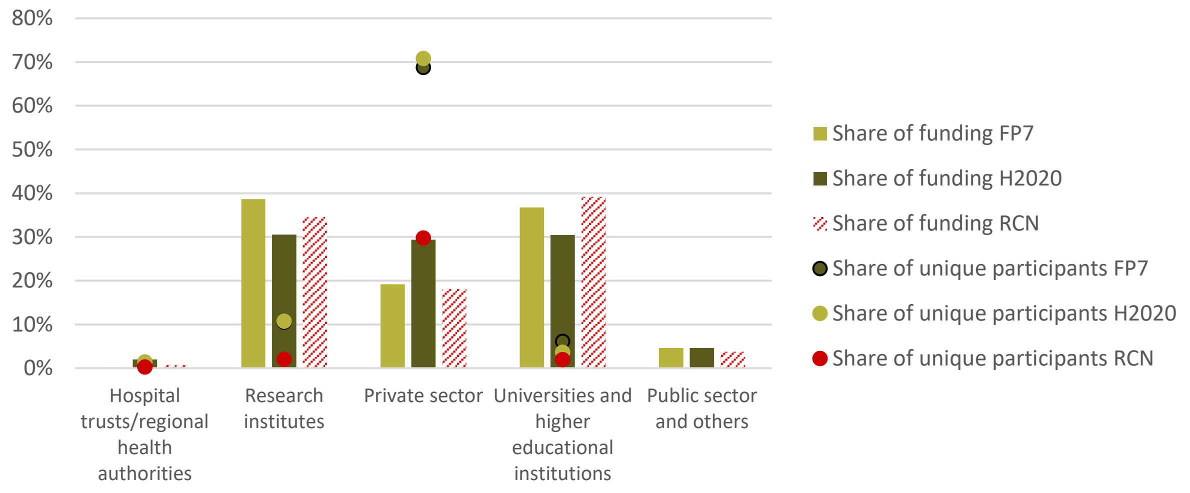


Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.

The sectoral distribution of FP funding follows a similar pattern to that of RCN funding at large, but the private sector has benefited to a larger extent from the FPs and particularly in H2020.[19]

The share of unique participants[20] is generally much higher within the private sector than for the research sector, but higher for the FP than for the RCN. This indicates that the RCN funding is more concentrated.

Figure 3.4 Sectoral distribution of R&I funding to Norwegian participants. FPs and RCN. Share of funding (columns) and share of unique participants (dots). 2007-2018.



Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN funding does not include basic funding to research institutes, STIM-EU nor PES funding. 2017 as the most recent year for RCN.

3.3.2 Geographical distribution

Organisations from all parts of the country participate in the FPs, but participation is dominated by organisations in the Oslo region (Oslo and Viken) and Trøndelag, which together receive about 75 per cent of all Norwegian FP funding and account for about 60 per cent of the Norwegian FP participants, see Figure 3.5.

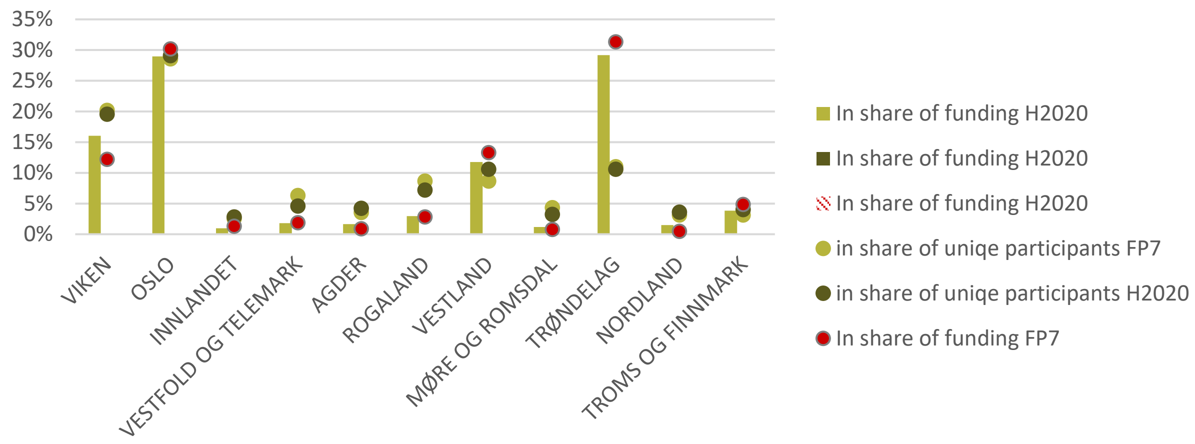
Trøndelag receives around 30 per cent of Norwegian FP funding, but only hosts around 10 per cent of Norwegian participants, which reflects the frequent and significant participation of two R&D providers SINTEF and NTNU. Participation from Oslo and Viken is much more diversified. The geographical distribution of FP funding remains relatively stable across the two FPs. Share of funding to participants located in Viken has gone up in H2020 (from 12 per cent in FP7 to 17 per cent in H2020), whereas Oslo

[19] Norwegian R&I system in which instruments such as SkatteFUNN, Enova and Innovation Norway (IN) predominately target companies (See appendix E)
[20] *Unique participants* refer to each participant only being counted once independent upon the number of participations

and Vestland decline relatively. The increase in FP funding for Viken is largely, but not only, caused by a NOK 230 million project awarded in 2016.

Counties with little FP participation (share of funding) like Agder, Nordland and Møre & Romsdal have seen relative increases in H2020 funding compared to FP7. Comparing FP funding with funding from RCN reveals similar geographical distribution although FP funding is more concentrated to Trøndelag.

Figure 3.5 Geographical distribution of FP participation. FPs and RCN. Share of funding (columns) and share of unique participants (dots). 2007-2018.

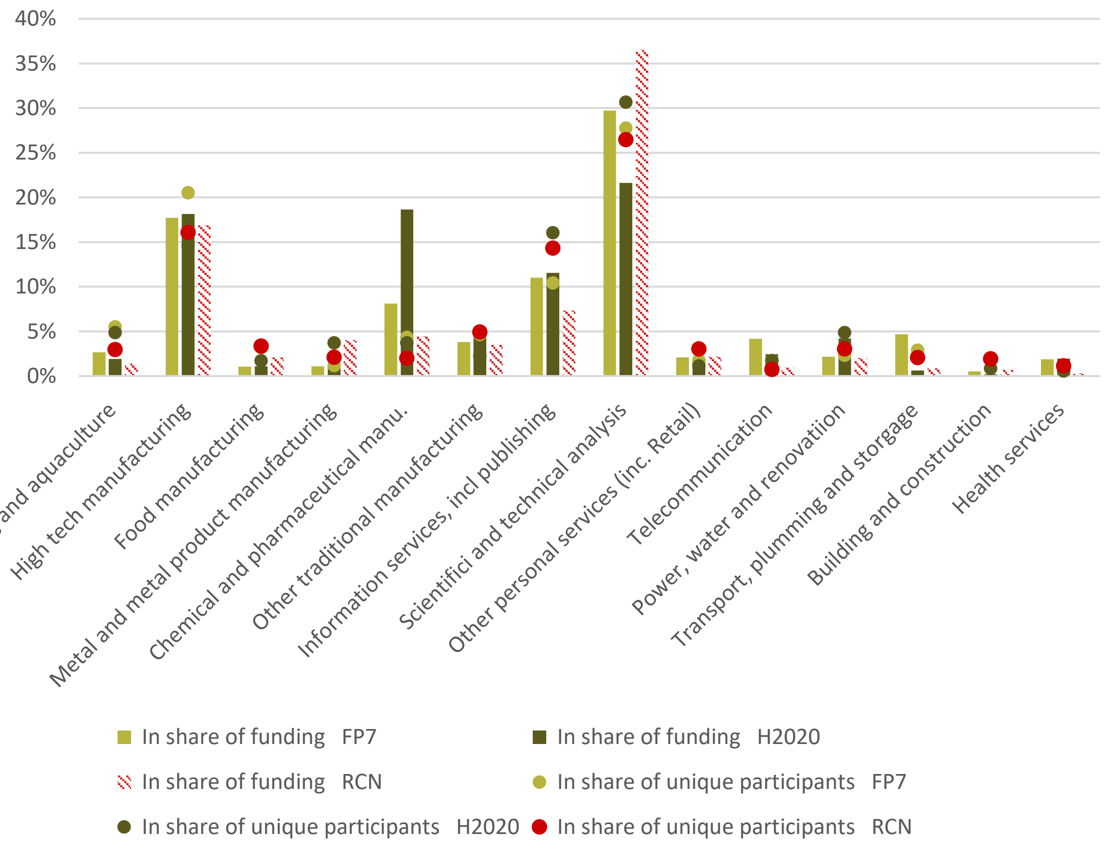


Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN funding does not include basic funding to research institutes, STIM-EU nor PES funding. 2017 as the most recent year for RCN.

3.3.3 Private sector participation

In total 654 companies have participated in FP7 and so far into H2020. Companies in all parts of the economy are active in the FPs, but three sectors stand out, namely advanced manufacturing, ICT and professional, scientific and technical activities, see Figure 3.6. These are also among the industries with the highest share of firms performing R&D (Statistics Norway, 2019) and highest share of RCN funding see Figure 3.6.

Figure 3.6 Share of FP funding to companies by industry (columns) and share of unique participants (dots). 2007-2018.



Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN funding does not include basic funding to research institutes, STIM-EU nor PES funding. 2017 as the most recent year for RCN. Samfunnsøkonomisk analyses AS' industry categorisation (based on NACE, see appendix E for further details). Oil refinery, Tourism, Power, water and renovation, Building and construction and Other personal services (incl. Retail) are excluded due to low shares of FP funding.

FP company participation is dominated by companies from the Oslo region. Funding distribution resembles that of RCN and is for example much more concentrated than IN and SkatteFUNN funding (see appendix E).

Close to 40 per cent of FP companies are small companies (with less than 10 employees), around 40 per cent are companies with 10-250 employees and 20 per cent have more than 250 employees. In Norway, fewer than 1 per cent of all companies have more than 250 employees. Compared to their share in the economy, the share of large companies with FP participation is thus relatively high.

Large companies typically participate in more and or larger projects and their involvement has increased in recent years. In FP7 around 8 per cent of all participating companies were large and these companies accounted for 14 per cent of private sector funding. In H2020, large companies accounted for 11 per cent of private-sector participation and 30 per cent of funding.

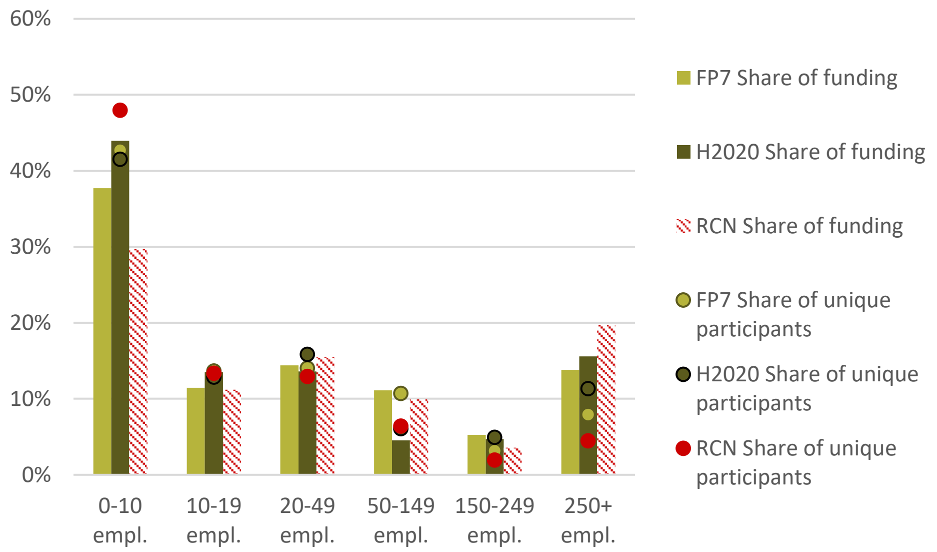
DNV is by far the most frequent private-sector participant with 38 projects granted in the period 2007-2018 (including projects coordinated by others than DNV). Equinor, Marlo, Nor-Tek[21] and Telenor are examples of other companies with participation in several FP projects. Borregaard is the company that has been awarded most FP funding. However, private-sector participation is clearly dominated by companies that have only participated once (75 per cent of all companies in FP7 and H2020); only one per cent of FP companies have participated in 10 or more projects and 20 per cent have participated in two or three projects.

Funding to small companies is also higher in H2020 than it was been FP7, and higher than for RCN. We interpret this as an indication of the H2020 being more relevant for small companies than FP7 was.

Comparison of beneficiaries' characteristics (size, age and industry) indicate that the there is no sharp division of labour between the FPs and RCN along these dimensions. The RCN does to a lesser degree fund R&I activity in small companies, small firms are however well represented amongst IN and Skatte-FUNN users (see appendix E). Findings suggests that FP participation is determined by company and R&I project specific factors such as the company's motivation and eligibility to participate in the FPs which we will assess more thoroughly in the next chapters.

[21] Nor-tek went into bankrupcy in 2017

Figure 3.7 Private-sector participants by number of employees. FPs and RCN. Share of funding to private sector (columns) and share of unique private sector participants (dots). 2007-2018.



Source: Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN funding does not include basic funding to research institutes, STIM-EU nor PES funding. 2017 as the most recent year for RCN.

3.4 Participants' motivation to participate

We now go on to consider the nature of the Norwegian FP projects. The results presented here come from web surveys of participants in FP and RCN projects, respectively. We compare the responses of FP project participants with responses of participants in projects funded by RCN to try to single out the characteristics that are specific to FP projects.

The survey information presented in this and the following chapters only applies to RCN programmes that correspond to the three main pillars of H2020 according to a mapping by RCN. We have therefore only included projects within the three main pillars of H2020 and the FP7 sub-programmes correspond-ing to these. The reason being that RCN's mapping only included the three main pillars and we wanted as comparable as possible project portfolios.

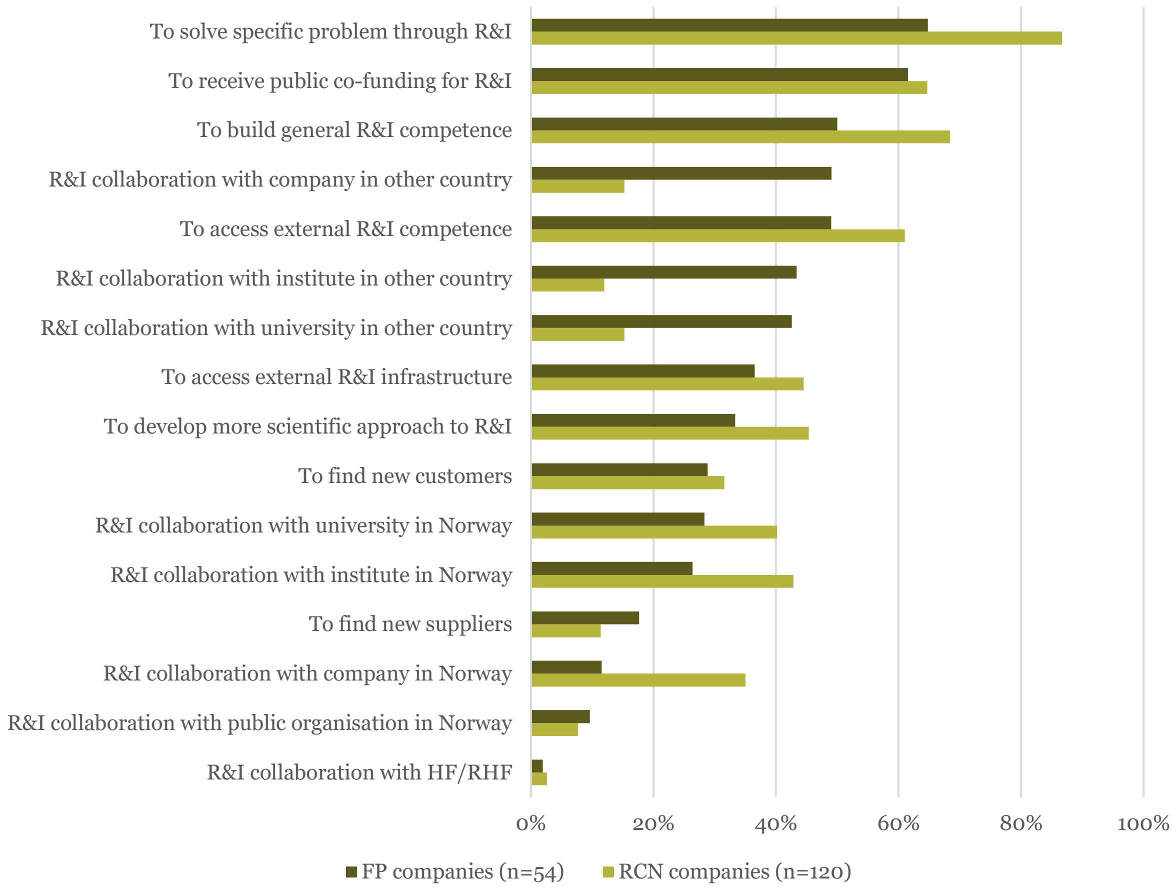
Participants in all the FP and RCN projects in question have received public co-funding, but the level of funding (share of actual costs reimbursed) has varied. Since most researchers have participated in both FP and RCN projects, we formulated the questions in the surveys in relation to a specific project, named FP or RCN project. Each individual has only received one survey invitation. Further details of the surveys are provided in Appendix C.

We first consider companies' motives for participating in R&I proposals, and thus in R&I projects, see Figure 3.8. In this figure, motives are sorted by the responses of companies that have participated in an FP project ("FP companies") and the percentages shown are the share of respondents that clearly agreed that the motive was important for the company's participation.[22] In this and later figures showing survey results, alternatives have been abbreviated to enhance readability; the full formulations that respondents considered are available in Appendix C.

To solve a specific R&I problem, to receive public co-funding and to build general R&I competence within the company are the three most common motives for FP companies. The same three motives are the most common also for companies that have participated in an RCN project ("RCN companies"), albeit to a greater extent and in different priority order. To access external R&I competence and infrastructure, as well as to develop a more scientific approach to in-house R&I, are other common and frequent motives for both respondent groups, again more commonly so among RCN companies. When it comes to R&I collaboration with other organisations, FP projects are much more commonly used by companies to develop international networks and RCN projects to develop national ones.

[22] Respondents were asked to rate motive statements on a five-tiered Likert-type scale: Not at all/To a small extent/To some extent/To a large extent/To a very large extent. The results shown are the sum of the shares of respondents that chose the two "top" alternatives: To a large extent and To a very large extent.

Figure 3.8 Companies' motives for participation.

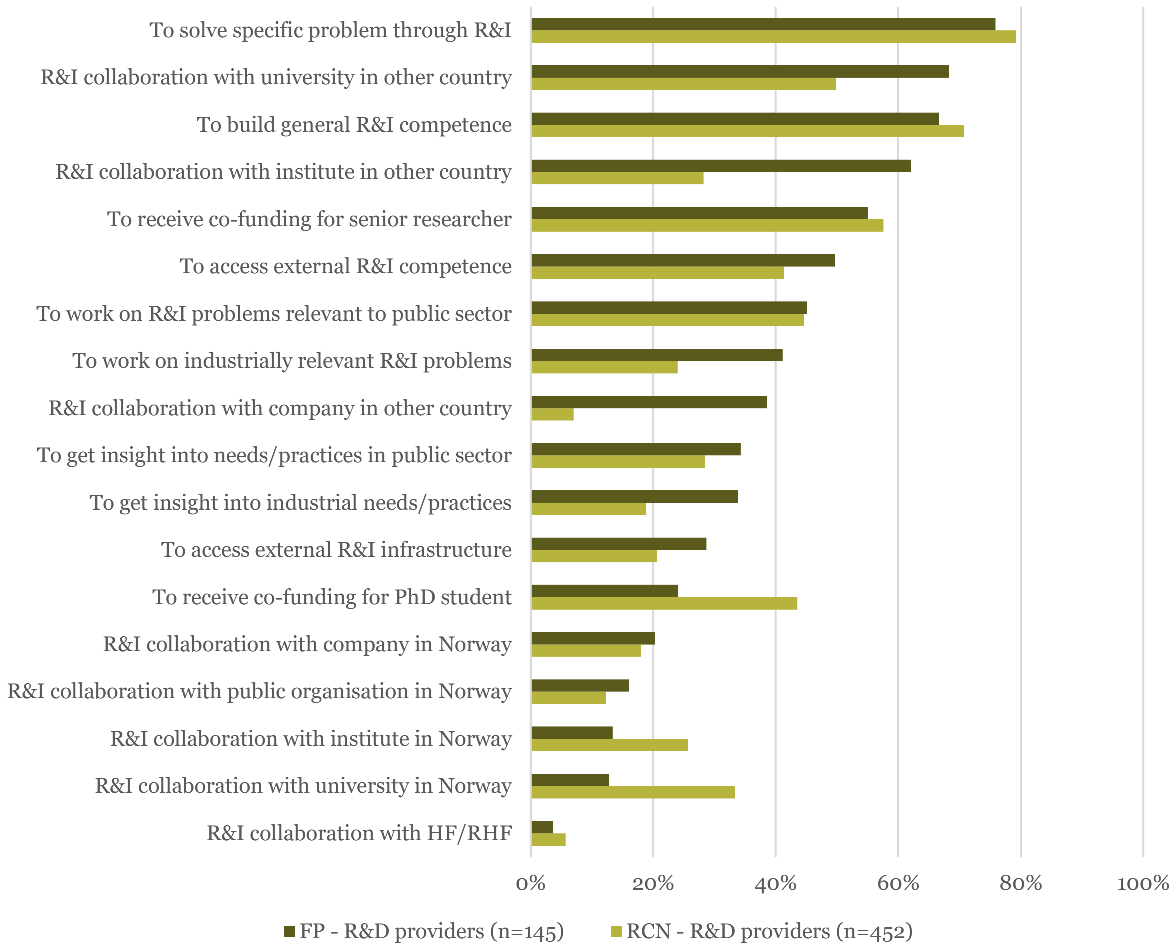


Source: Technopolis web surveys.

Just as for companies, solving a specific problem and building general R&I competence within the organisation are among the top three motives for R&D providers (i.e. universities, university colleges, research institutes and hospital trusts/regional health authorities (HF/RHFs)) participating in FP projects, but the second most important motive is R&I collaboration with a foreign university, see Figure 3.9. Presumably the reason why receiving public co-funding is not as highly rated as by companies is that for R&D providers there were two public co-funding alternatives (for senior researchers and for PhD students); however, the third most important motive among RCN project participants is to receive funding for a senior researcher.

To get to work on R&I problems of relevance to the public sector and to get insight into its needs and practices are rather highly rated motives for participants in FP and RCN projects alike, whereas to get to work on R&I problems of relevance to industry and to get insight into industrial needs and practices are considerably higher rated by FP project participants. Again, R&I collaboration with Norwegian partners of all kinds is rated the lowest by FP project participants, while collaboration with foreign partners is rated high. However, it is noteworthy that R&I collaboration with Norwegian companies and public organisations is a slightly more common motive among FP project participants, whereas RCN projects tend to be used for networking with other R&D providers in Norway. Moreover, to receive funding for a PhD student is an almost twice as important motive among RCN project participants.

Figure 3.9 R&D providers' motives for participation.

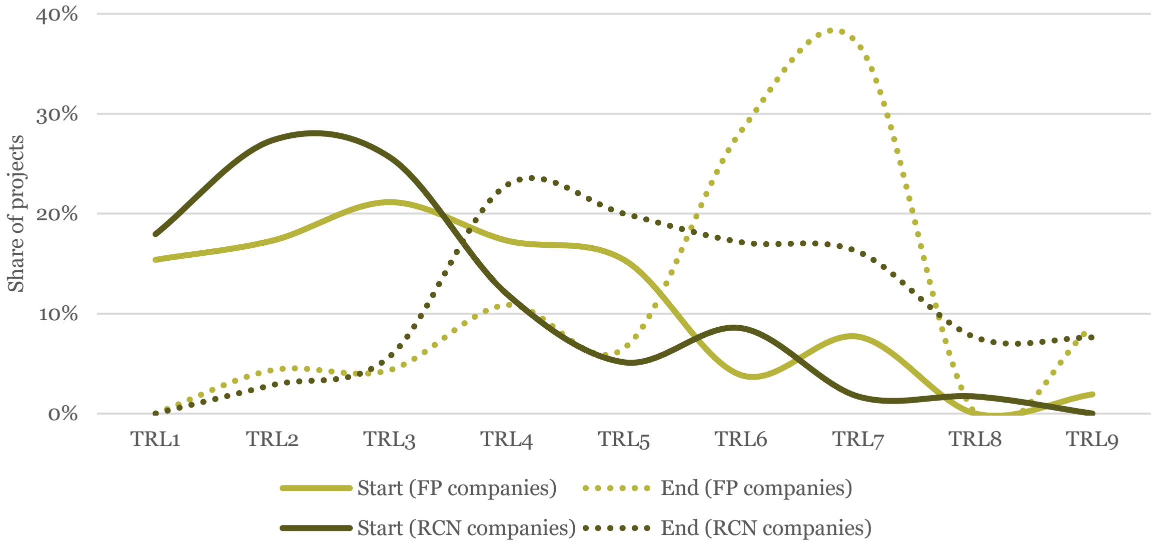


Source: Technopolis web surveys.

That industrial relevance is more pronounced in FP than in RCN projects is further indicated by Figure 3.10, which shows the Technology Readiness Level (TRL) at the start and the end of the project as estimated by company respondents. Source: Technopolis web surveys.

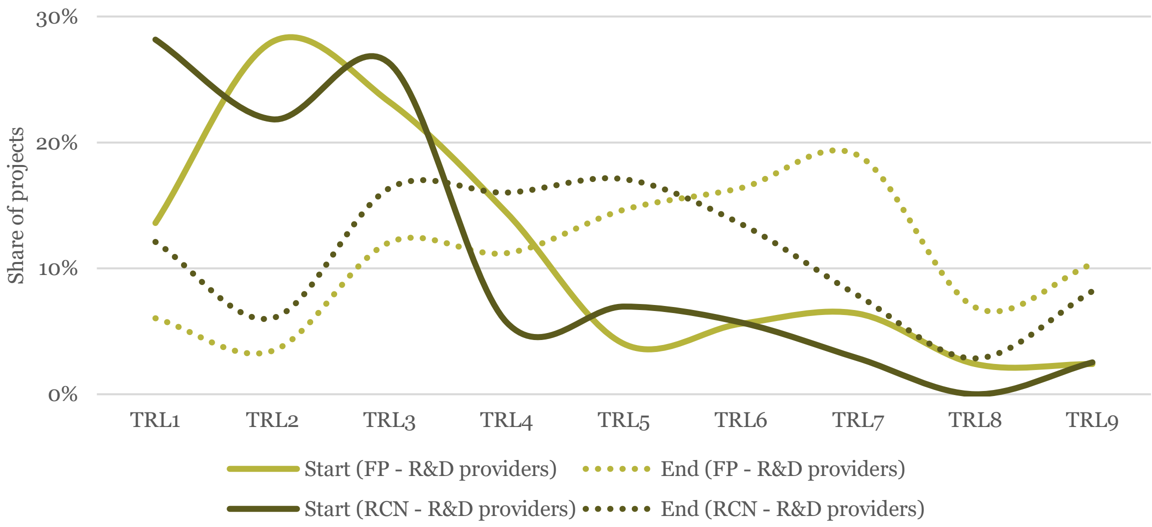
Figure 3.11 with the R&D providers' responses, confirms this difference, although it should be noted that the differences between FP and RCN projects is not large (on average 0.5 for companies and 0.7 for R&D providers).

Figure 3.10 TRL at start and end of project according to companies (n=54 for FP projects, n=117 for RCN projects).



Source: Technopolis web surveys.

Figure 3.11 TRL at start and end of project according to R&D providers (n=144 for FP projects, n=316 for RCN projects).



Source: Technopolis web surveys.

Table 3.5 shows that according to companies, the average TRL progression in FP and RCN projects are the same, as are - roughly - the average project durations. In contrast, the R&D providers' assessments are rather lower despite their projects on average being longer, particularly RCN projects. Overall, these assessments appear reasonable in light of the rule of thumb that it takes at least 1.5 years to progress from one TRL to the next within reasonably complex industry sectors.

Table 3.5 TRL progression between start and end of project according to survey respondents.

	Mean	Median	Project duration (years)
FP - companies	2,5	2,5	4
RCN - companies	2,5	2	4,3
FP - R&D providers	2,1	2	4,3
RCN - R&D providers	1,7	1	5

Source: Technopolis web surveys.

3.5 High input additionality amongst project participants

Additionality is the property of an activity being additional, i.e. to have an impact besides a redistribution of funds.

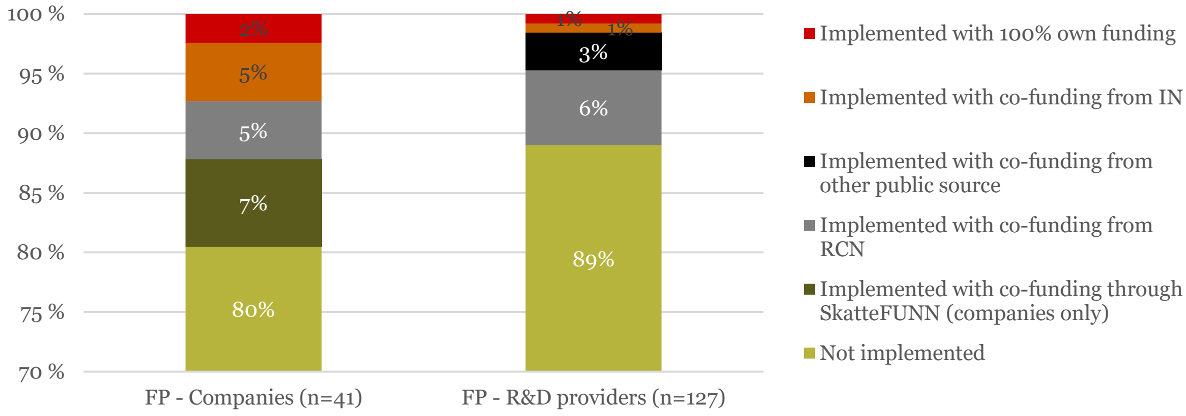
One possible way to identify input additionality is to ask beneficiaries. The challenge with this approach is that respondents may answer tactically and thus not entirely truthfully. Respondents who want an instrument to be maintained have incentives to respond positively regardless of the facts. Despite these challenges, it is of interest to get a picture of respondents' own assessments of the instruments.

In the web survey, both companies and R&D providers were asked what would have happened to the project if it had not been supported through FP7/H2020. Projects that would have been conducted in the same way without FP support may be considered to have no additionality. Projects that would have been reduced in some way (scaled down, conducted with fewer partners or postponed) may be considered to have intermediate additionality. Projects that would not have been conducted at all without FP funding may be considered to have high additionality.

Survey results indicate that the FPs bring high input additionality. Figure 3.12 shows that eight in ten companies and nine in ten R&D providers believe that the project probably would not have been implemented at all if it had not been funded through the FPs.[23] RCN is obviously the most likely recourse for R&D providers, but companies point to SkatteFUNN, RCN and IN as alternative sources of funding. Very few projects would apparently have been implemented without any public co-funding. A clear majority of the very few respondents who answered that the project would have been implemented anyway agree that foreign partners (from the unsuccessful FP proposal) would have been dropped and that the project would have been implemented later. These results are supported by interviews.

[23] Please note that the "Not implemented" part of the columns have been truncated to enhance resolution of the other alternatives.

Figure 3.12 What would have happened if the project had not been co-funded through the FP?



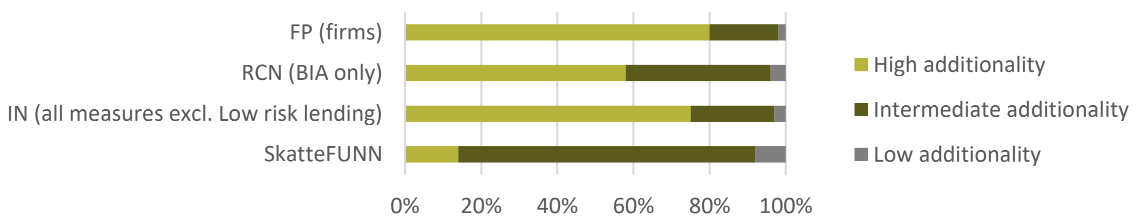
Source: Technopolis web surveys.

Questions of similar nature have been asked in previous FP evaluations and studies of national instruments. Any direct comparison should be made with caution, as the specific formulation of a survey question can influence results. With this caveat in mind, we note that the result in this survey echoes the findings in the previous Norwegian FP evaluation in which 62.5 per cent of the participants fully agreed and 17.8 partly agreed to the statement that "Our organisation would not have participated in this project or a similar project without the EU contribution". Only 5.5 per cent fully disagreed (Godø, Langfeldt, & Kaloudis et al., 2009).

Figure 3.13 indicates that FP projects have higher additionality for companies than projects with funding from RCN (BIA instrument only), IN and SkatteFUNN. SkatteFUNN projects are likely to be strategically important, but are also small, so it is more likely that a SkatteFUNN project is conducted regardless of tax deduction. FP projects are application-based, just as RCN and IN projects, but FP projects are (generally) larger and or involve more participants. It is thus reasonable that absence of FP funding would alter either scale, timing or collaboration.

Web surveys and interviews indicates high input additionality and we thus interpret results and impacts reported by projects participants and other informants to be a consequence of Norwegian participation in the FPs.

Figure 3.13 Additionality in various R&I schemes. Only companies.



Source: Technopolis web surveys, Samfunnsøkonomisk analyse AS (2018), Bergem et. Al (2017), Innovation Norway (2018)

4 Results

In the previous chapter we provided an overview of Norway's participation in FP7 and H2020 and investigated the motives for participating in projects and the TRL characteristics of these projects. The next step is to assess what results these activities have produced in order to start reconstructing the impact logic for Norway's FP participation.

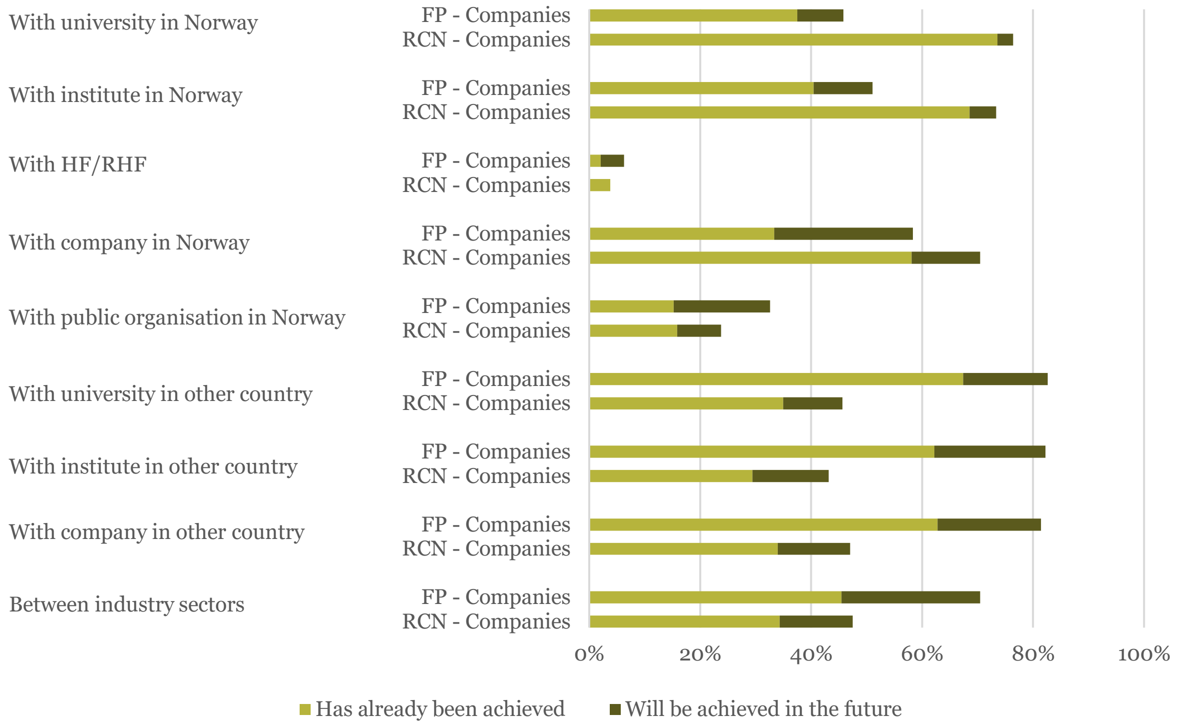
Since R&I projects by definition produce knowledge this is taken for granted (and thus not a subject of any web survey question). In addition to web survey data, this chapter presents information from interviews with FP project participants, management of key FP participants and R&I policymakers, as well as selected results from the registry and network analyses.

4.1 Results for companies

Figure 4.1 summarises project results in terms of R&I collaboration according to company respondents.[24] The trends shown are essentially in line with the original motives for participation (cf. previous chapter), i.e. RCN projects have mostly resulted in collaboration with Norwegian organisations and FP projects mostly with foreign ones. One exception is collaboration with Norwegian public organisations where the outcome so far appears to be the same for both FP and RCN projects, but with higher expectations for the future among FP project participants. Another exception is that around a third of participants in RCN projects state that there has been collaboration with foreign organisations, which shows that RCN projects also provide opportunities for international collaboration (possibly as a bit of an afterthought given that international collaboration was considerably lower-rated as motive). Participants in FP and RCN projects agree that collaboration between industry sectors has been achieved to a significant extent.

[24] Respondents were asked about the achievement of possible results on the following scale: Has already been achieved/Will be achieved in the future/Will not be achieved/Not applicable. The results shown are the first two alternatives; percentage calculations include the Not applicable alternative.

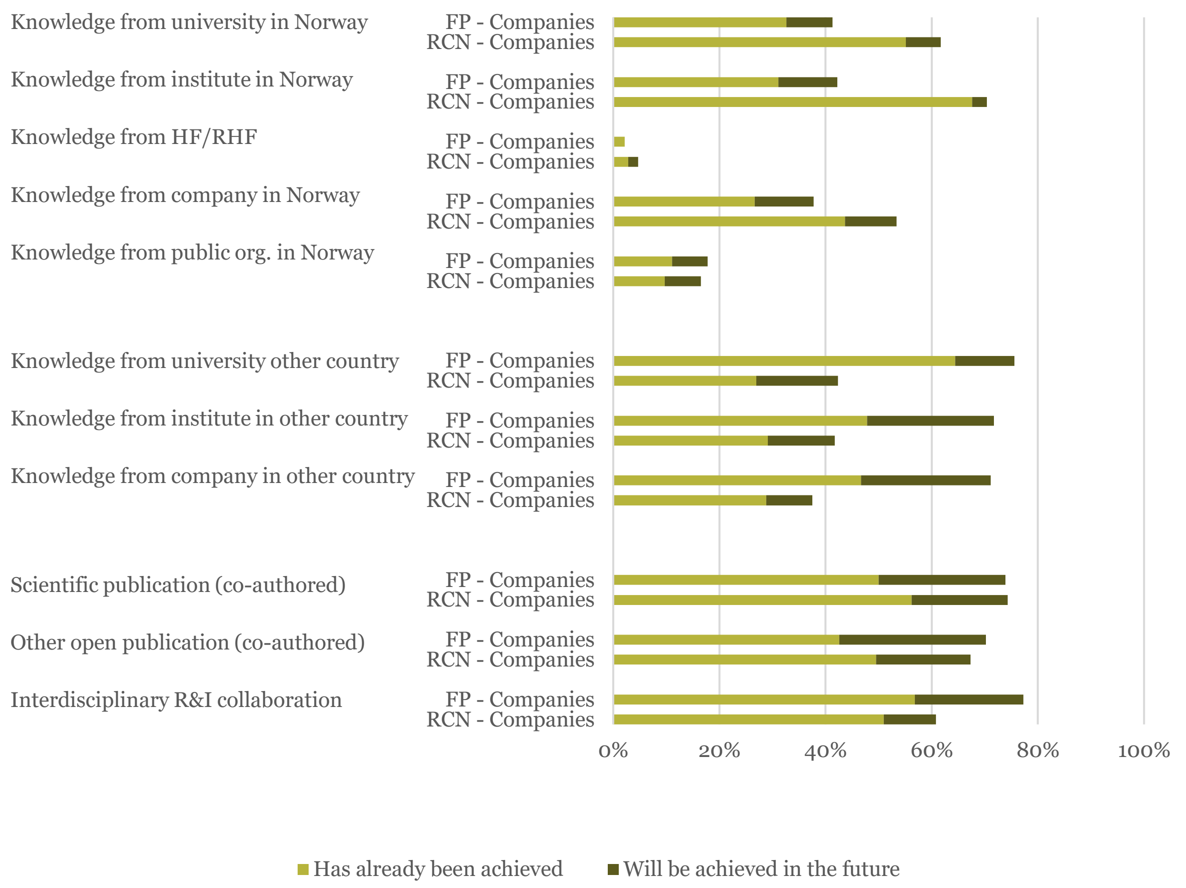
Figure 4.1 Results in terms of R&I collaboration according to companies (n=48 for FP participants, n=108 for RCN participants).



Source: Technopolis web surveys.

Figure 4.2 shows additional results according to companies. As expected, given the results in Figure 4.1, knowledge transfer from the different types of organisations to the companies follows the same pattern, although the expectations for future knowledge transfer from foreign institutes and companies are greater for FP than for RCN projects. Slightly less than a third of company participants in RCN projects state that there has been knowledge transfer from foreign organisations, which is consistent with the results in the previous figure. Results in terms of publications (co-authored by company personnel) and interdisciplinary R&I collaboration are rather common – the former slightly more common in RCN than FP projects and the latter the opposite (though differences are small).

Figure 4.2 Other results according to companies (n=48 for FP participants, n=108 for RCN participants).



Source: Technopolis web surveys.

The interviews with company representatives confirm that knowledge transfer from universities in other countries is an important result of FP projects, as is interdisciplinary collaboration. Several company representatives find the multi-partner, interdisciplinary approach in H2020 very relevant. In the words of one of the company representatives that described this as the main result of participating in FP projects:

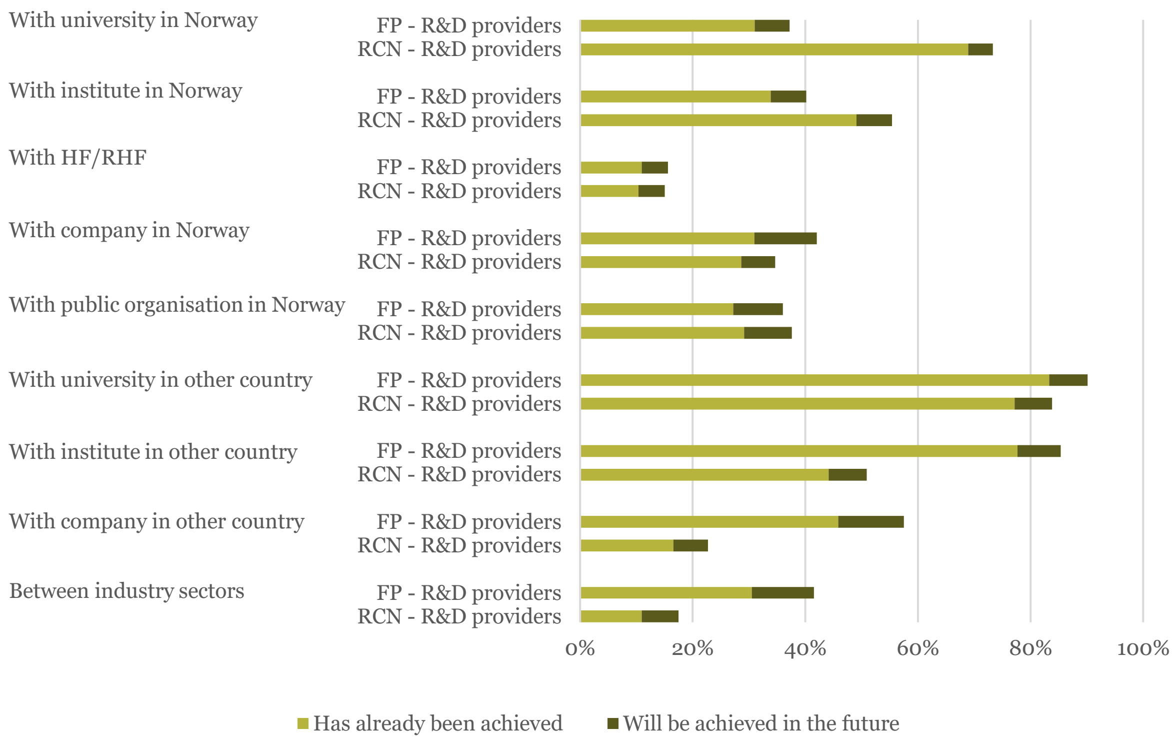
> *We get access to interdisciplinary networks in Europe without paying extra for it.*

Moreover, some of the company representatives who have participated in both FP and RCN projects stress the importance of the difference in funding rules. In many of RCN's funding instruments (*søknadstyper*) companies do not receive any (or little) public funding, whereas they generally receive substantial public funding in all types of FP projects. Some company representatives also stress the difference in scale between FP and RCN projects. The scale of FP project networks can sometimes be very attractive and make large undertakings possible that are not achievable nationally. At the same time, the smaller size of RCN projects with fewer participants is sometimes considered "much easier and in line with the agile processes of the company", according to other company representatives.

4.2 Results for R&D providers

Figure 4.3 shows that the collaboration patterns for R&D providers are somewhat different to those of companies. While the trends are similar for collaboration with other Norwegian R&D providers, RCN projects appear to lead to notably less collaboration with Norwegian companies than they do for companies. R&D providers seem to collaborate considerably more with hospital trusts/regional health authorities (HF/RHFs) and (other) public organisations in Norway. There are no material differences between FP and RCN projects in these respects. The R&D providers experience more collaboration with R&D providers in other countries, but less with foreign companies and they experience less collaboration between sectors than companies. Except when it comes to collaboration with universities in other countries, R&D providers experience considerably more international collaboration in FP projects than in RCN projects.

Figure 4.3 Results in terms of R&I collaboration according to R&D providers (n=132 for FP participants, n=393 for RCN participants).

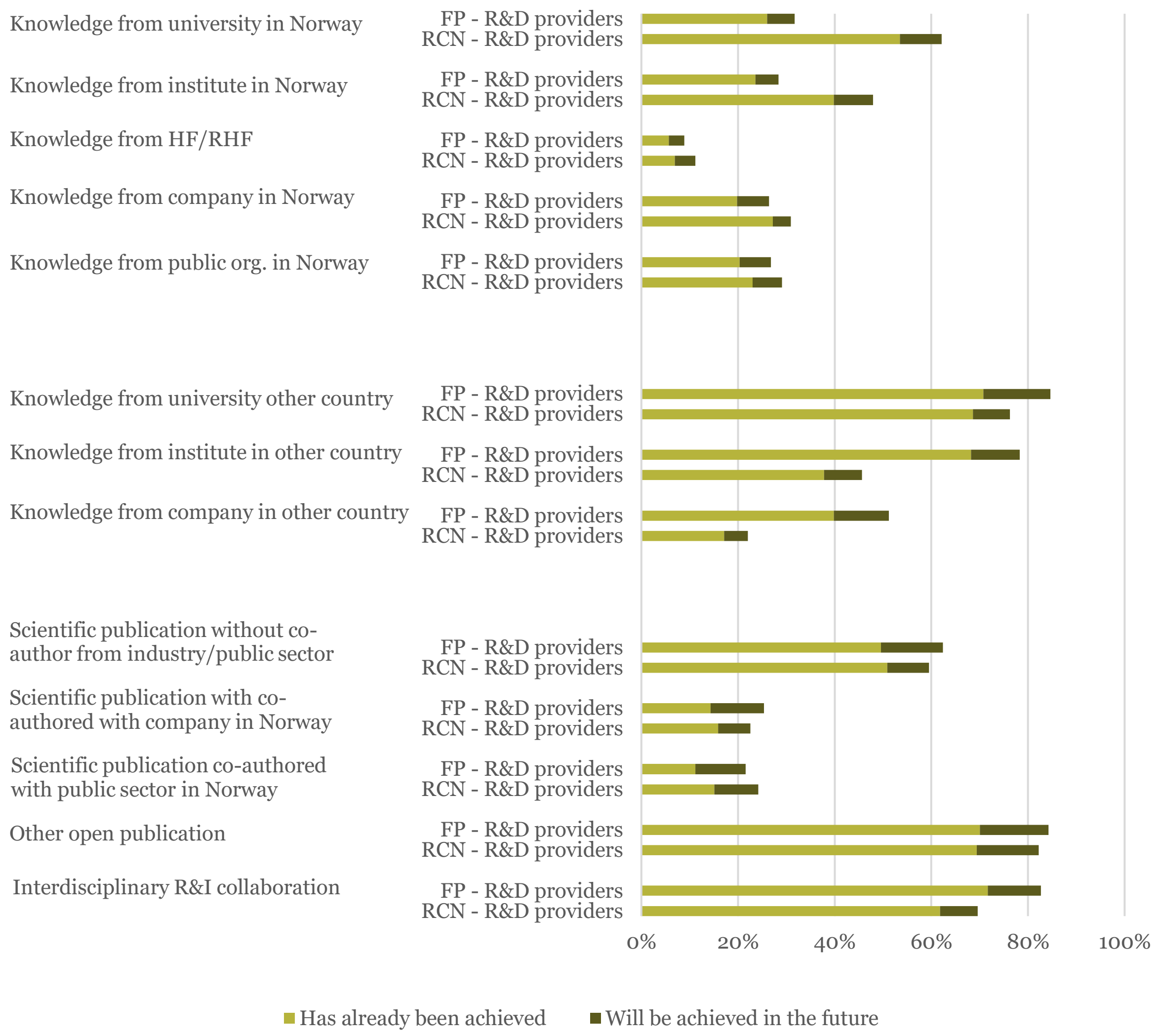


Source: Technopolis web surveys.

Figure 4.4 shows that R&D providers, just like companies, generally experience more knowledge transfer from other Norwegian organisations in RCN projects than in FP projects, although differences are insignificant when it comes to HF/RHFs, companies and public organisations. Moreover, the knowledge transfer to R&D providers resulting from FP projects is less pronounced than for companies for all organisation types except public organisations. Just as for companies, knowledge transfer from foreign organisations is more noticeable in FP projects, but with some interesting differences. Knowledge transfer from foreign R&D providers is greater for R&D providers than for companies and the opposite holds true for foreign companies. Moreover, there appears to be no significant difference between RCN and FP projects when it comes to knowledge transfer from foreign universities. Again, it seems as if collaboration with foreign universities is very good also in RCN projects. Publications are essentially equally common in FP and RCN projects, in both cases around half of scientific publications are co-authored with companies and public organisations in equal proportions. Just as for companies, it seems as if interdisciplinary R&I collaboration is a bit more common in FP projects.

The interviews with R&D providers indicate that there may not be such a big difference in the type of partners in FP and RCN projects, but there is a considerable difference in the number of partners. Expanding and maintaining international networks is an important result for R&D providers participating in FP projects. These large international networks give access to leading knowledge and competence and provide opportunity for international benchmarking. "Building excellence through international competition", as a representative of an R&D provider puts it, summarises a general notion among many of our interviewees. The number of participants in RCN projects is generally smaller, thus providing fewer opportunities for knowledge transfer and benchmarking, particularly internationally. A few interviewees and survey respondents representing R&D providers also mention access to foreign research infrastructure as an important result of FP projects.

Figure 4.4 Other results according to R&D providers (n=132 for FP participants, n=393 for RCN participants)



Source: Technopolis web surveys.

4.3 Results for R&I sector and society

Having in the previous sections considered results for project participants, we go on to consider results that go beyond what participants experience and that may be considered results for the Norwegian R&I sector and for society (keeping the objectives of government strategy in mind).

4.3.1 Collaboration networks

We start by looking at the national collaboration networks, i.e. in projects with more than one Norwegian participant, in order to understand what FP projects do to intra-Norwegian collaboration. We then go on to investigate the international networks of Norwegian participants (regardless of the number of Norwegian participants in the projects).

4.3.1.1 Intra-Norwegian collaboration

The registry analyses reveal that the overall degree of intra-Norwegian collaboration in FP projects has increased from FP7 to H2020, see Table 4.1. The increase is the largest for multi-partner (MP) projects, particularly for Norwegian-led ones where the average number of Norwegian participants also is by far the highest. The reason for the smaller relative increase for all projects is that there is a notably higher proportion of single-partner projects in H2020.

Table 4.1 Average number of Norwegian participants per project in FP7 and H2020 with at least one Norwegian participant.

FP7			H2020	
All projects	1.47		All projects	1.57
MP projects	1.51		MP projects	1.70
MP projects led by Norway	2.19		MP projects led by Norway	2.50

Source: Technopolis analysis of eCorda data.

The network analyses illustrate that the national network of Norwegian FP participants is characterised by a core-periphery structure (see Appendix D for details). In such a structure, a few influential participants (hubs or gatekeepers) located at the centre of the network establish strong collaboration ties among themselves and weaker ties with the periphery, where the density of ties between participants is lower. An organisation's location in a network is important because it determines the speed and accuracy of flow of knowledge. Unless they have a tie between themselves, knowledge exchange between peripheral participants must go through another (mutual) participant (often a hub).

The total number of collaboration pairs, i.e. ties between participants, is so far smaller in the overall H2020 network (all countries) than in FP7 (recall that H2020 is still on-going so the network is still growing). Despite this, there are more collaboration pairs that involve a Norwegian organisation in H2020 than in FP7. This increasing number means that Norwegian FP7 participants do so again in H2020 and do so more often. Thus, most of the core Norwegian participants are more successful in the sense that they are involved in more projects. While most core participants have increased their presence, a number of new Norwegian organisations have joined in H2020.

Figure 4.5 presents the intra-Norwegian collaboration networks in H2020, i.e. for projects with at least two Norwegian participants; the figure to the left for projects with at least one HEI and the one to the right with at least one institute. The colour intensity of the nodes indicates participants' importance as hubs in the network (in the sense of the number of links they have to other nodes); the darker, the more important. The size of the node and the width of the interconnecting lines indicate number of ties. Among HEIs, NTNU is clearly the most important hub for other Norwegian participants, followed by the universities of Oslo (UiO) and Bergen (UiB). Among institutes, the SINTEF Group dominates massively with Nofima as a very distant second. In FP7, UiO was the most important hub among HEIs, followed by NTNU and UiB, meaning that the order of importance has changed in H2020. Among institutes, the SINTEF Group was the main hub also in FP7, but the second most important one was Teknologisk Institutt (TI), which has been all but absent in H2020 (following a change in ownership). Since FP7, NTNU's importance as hub has increased and so far in H2020 it has proved almost as important as SINTEF.

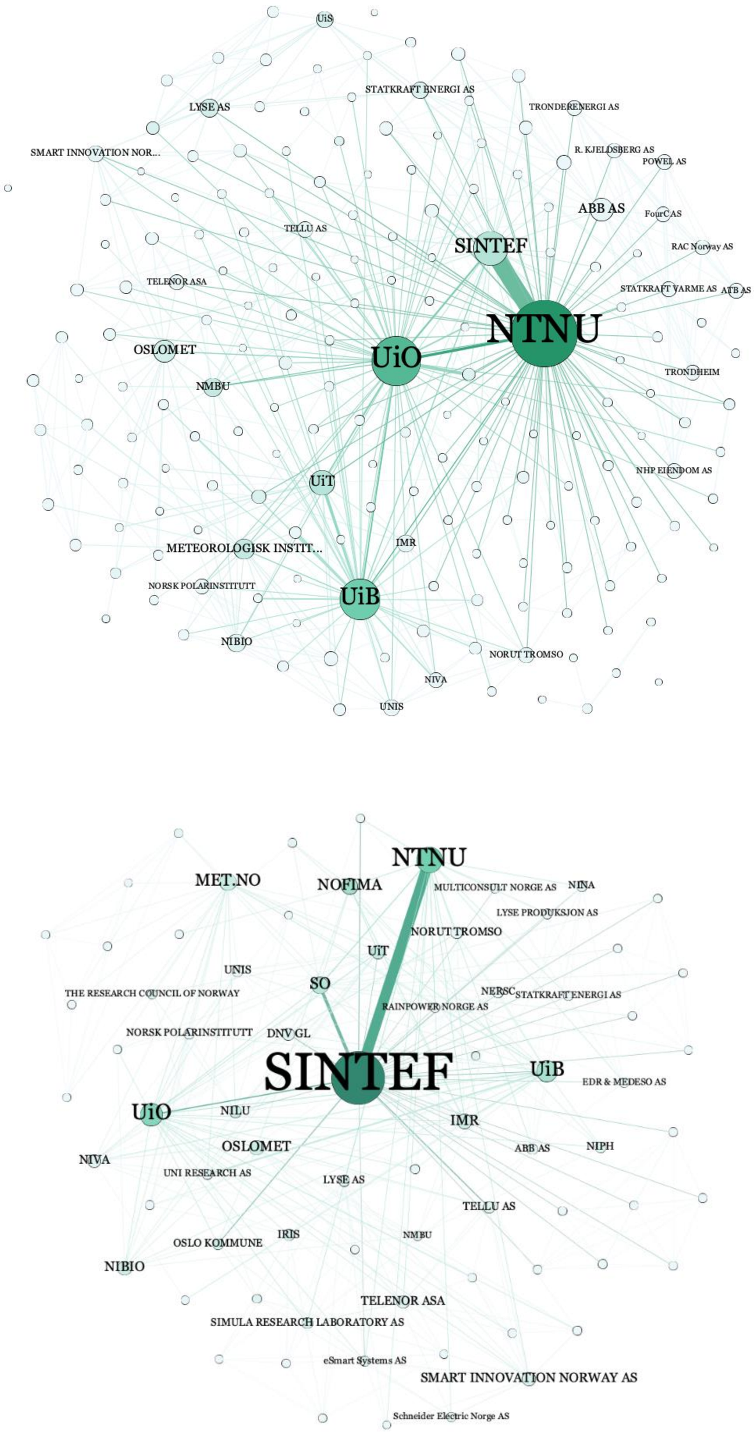
The network analyses also show that by far the most common intersectoral and intra-Norwegian collaboration in both FPs is between the institute and private sectors; this dominance has decreased somewhat in H2020, while all other intersectoral combinations have increased, with collaboration between the HE and institute sectors seeing the largest increase (see Appendix D).[25]

4.3.1.2 Extra-Norwegian collaboration

Looking then at extra-Norwegian collaboration, the most central countries in Norway's FP7 network were the UK, followed by Germany, Spain, France, Italy and the Netherlands (see Appendix D). These countries were the most central in order to ensure collaboration with participants in other countries. In H2020, there has been a change in collaboration countries and hubs. While Norwegian participants have increased collaboration with the UK, Germany and the Netherlands, the two former countries are the key hubs for Norwegian H2020 participation. German organisations dominate Norway's international network in all main sub-programmes of H2020 except Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy (FOOD) and Smart, green and integrated transport (TPT). In FOOD, French, Spanish, British and Italian organisations dominate, while French organisations dominate in TPT. In MSCA, UK and German organisations are equally common as partners. The strong scientific links with Germany that dominated before World War II thus seem to have been reinstated more than half a century later.

[25] Stakeholder categories refer to eCorda stakeholder categories.

Figure 4.5 National H2020 collaboration networks in projects with at least one HEI (left) and at least one institute (right).



Source: Technopolis analysis of eCorda data.

A corresponding analysis of projects coordinated by Norwegian organisations shows that in FP7, British organisations were the most common and French organisations the most important for accessing other countries (see Appendix D). In H2020, there has been a shift away from the UK to a wider range of countries. The dominant country is now Germany, but Italian and Spanish organisation also have been included in Norwegian-led projects; the key hubs in H2020 for Norwegian coordinators to access partners in other countries are Germany and Italy.

Although SINTEF has a vast international H2020 network the institute mostly collaborates with organisations similar to itself, including Finnish VTT, French CEA, German Fraunhofer, Dutch TNO and Spanish Tecnalia (see Appendix D). NTNU has fewer foreign partners in H2020 than SINTEF; the key ones being French CNRS, Italian CNR and Spanish CSIC, which are institutes with strong ties to universities and that focus less on applied research than the SINTEF's preferred partners. The international H2020 networks of UiO and UiB in many respects differ from those of SINTEF and NTNU, mainly because academic partners dominate both. UiO's network is denser than that of UiB (and NTNU) in the sense that it has many more links and more partners. Among the preferred ones are CNRS and CNR, but also intergovernmental EMBL and a number of HEIs, including the universities of Helsinki, Edinburgh, UCL, DTU and KTH. UiB's main partners are CNRS, CSIC, and CNR, and the most important universities are DTU, University of Helsinki, ETH Zurich and Lund University. Given these four organisations' importance as hubs for other Norwegian organisations, their networks are important assets for the national R&I system.

Looking at the collaboration networks in the H2020 thematic areas of greatest importance to Norway, we find that:

- In LEIT, the national network is centred around SINTEF, which maintains very strong collaboration links internationally
- In FOOD, the national network is quite loosely connected with a slightly more pronounced sub-network around Nofima, which is the only notable Norwegian participant in the international network
- In TPT, the national network is also loose, with few strongly connected organisations, but with SINTEF as the obvious core; the institute is rather well placed internationally
- In ENV, the national network consists of three sub-networks that are hardly connected to each other. The sub-network around UiB is the most important, and the university is at the centre of the network, although not in a dominant position
- In ENERGY, the national network is centred around SINTEF and NTNU, and SINTEF is very centrally placed also in the international network
- In HEALTH, the national network is quite small with a limited number of participants in two sub-networks, one centred around NIPH and UiO, the other around UiB. NIPH is well connected in the international network

These observations on national and international networks highlight that a very small number of gatekeepers are critically important for Norway's FP participation, both through being the hub of national networks and through holding the key to international networks. The observations by thematic area also suggest that the national networks seem to be very strong in some areas, e.g. in LEIT and ENERGY, and that they may be fragmented in others, e.g. in FOOD, TPT, ENV and HEALTH. (Note that it is possible that national networks that appear fragmented when looking through the FP project lens after all are well connected through all-Norwegian projects funded by for example RCN and IN, but this has not been the subject of this evaluation to investigate.)The overall participation of non-EU Member States (MS), has decreased in H2020 compared to FP7 (European Commission, 2017a). Network analyses nevertheless show that Norway, an Associated Country (AC), is quite active in integrating other third countries in its FP networks, and much more so than Switzerland (another AC) and Finland (a similar-size MS) (see Appendix D). In fact, Norwegian collaboration with third countries has increased substantially in H2020. Norway's most common third-country partners in FP7 came from Switzerland, Iceland and Russia, followed by Turkey, China, Israel, Canada and South Korea. For H2020, the most common partners among non-members come from Switzerland, China, the US, South Africa and Israel.

4.3.2 Researcher mobility

The registry analyses demonstrate that the MSCA sub-programme (MCA in FP7), which promotes researcher mobility, is underutilised by Norway, but that there is already an upward trend in participation in H2020 compared to FP7 (see Appendix A).

Looking first at long-term secondments (fellowships; usually around two years), the analyses show that the number of Norwegian researchers hosted abroad was very low in FP7, both in absolute terms and when normalised for R&D population, and has (so far) not improved in H2020. When it comes to the reverse mobility – Norwegian organisations hosting foreign researchers – Norway does slightly better but is still a less common destination country than most comparators, and there is a downwards trend in H2020.

In contrast, the number of Norwegian researchers hosted abroad for short-term exchanges (one month to one year) was very high in FP7 (when normalised for R&D population), as was the number of foreign researchers hosted for short-term exchanges by Norwegian organisations. Both numbers have inexplicably dropped dramatically in H2020, both in absolute terms and when normalised for R&D population.

4.3.3 Policy development

There is a broad consensus among interviewees that participation in the FPs is important for the Norwegian R&I sector and for industry. Access to large, high-quality R&I undertakings, as well as access to the European market, are considered key benefits of participating. A ministry representative said:

> *We are a small country. We would miss out enormously if we did not participate.*

Norwegian participation in the FPs has involved contribution to the development and articulation of the FPs and related policy, both by the Norwegian authorities and through the contributions of the wider research policy community within FP7 and H2020 (as for FP5 and FP6). As an Associated Country Norway has the right to be a speaking but non-voting member of programme committees and the like. As a small country, Norway would never expect to have a major influence on the design and content of the FPs. However, despite its formal position as an Associated Country, interviews with Norwegian policymakers and participants, as well as previous evaluations, highlight that in practice Norway is very involved in the various committees and groups that influence the FP and related policies of the EU. A strong (if qualitative) impression from Norway's role in these fora is of a Norway striving to be "the best kid in the class" in terms of participation. A more objective indicator is Norway's high participation in ERA-Net and ERA-NET Plus in FP7 and ERA-NET Cofund in H2020, since these are formal R&I policy learning fora. It is, however, difficult for a small country to maintain such an effort, given the limited number people who can be committed to it and the resources of RCN, for example, have sometimes been stretched by the effort. It is difficult to produce clear evidence that this investment has been worthwhile, but it appears to be viewed positively both in Oslo and in Brussels.

Interviewees explain that there is an on-going dialogue between ministries, agencies, R&D providers and company representatives on FP participation. The prevailing consensus on the overall importance of FP participation facilitates this dialogue. The government strategy has set clear roles for ministries, agencies and R&D providers. There is a general notion that Norway has been particularly successful in the topic areas of oceans, energy, climate and food, while there is still unrealised potential within health. There is also an on-going discussion on the financial conditions for Norwegian research institutes participating in the FPs. These discussions led to Ministry of Education and Research in April 2019 announcing that RCN's STIM-EU measure (which co-funds institutes' FP participation) would provide a higher funding percentage to around 20 institutes during a trial period in 2019 and 2020.[26]

Significant policy coordination has taken place in relation to the FPs, particularly during H2020. FP participation is now considered an integral part of Norwegian R&I policy and is therefore ever more seldom specifically advocated in policy documents. The H2020 pillars are clearly reflected in national policy documents and priorities (as for example noted in RCN's proposal to Ministry of Education and Research on support measures in Horizon Europe (The Research Council of Norway, 2019) and the influence of the FPs has brought an increased focus on challenge-driven R&I in Norway. The EU position on open data is also reflected in national priorities including RCN and IN strategies. Although H2020 has left a significant mark on Norwegian priorities, ministry and agency representatives also believe that they have been able to influence European priorities concerning for example oceans and climate-related R&I. Ministries and agencies have increased their activities on the European arena in recent years, while at the same time encouraging other Norwegian actors to increase theirs. In its proposal, RCN emphasises that Norwegian Ministry of Education and Research, Ministry of Trade, Industry and Fisheries and RCN and IN have invested a lot of resources to influence both design and priorities of Horizon Europe.

Ministry and agency representatives point out that FP participation has led to Norwegian R&I having become more deliberately international. Several interviewees point out that there is "a high correlation between international success and quality in research". Many actions have been taken to further increase Norwegian FP participation. Ministries and agencies encourage R&I actors to participate more,

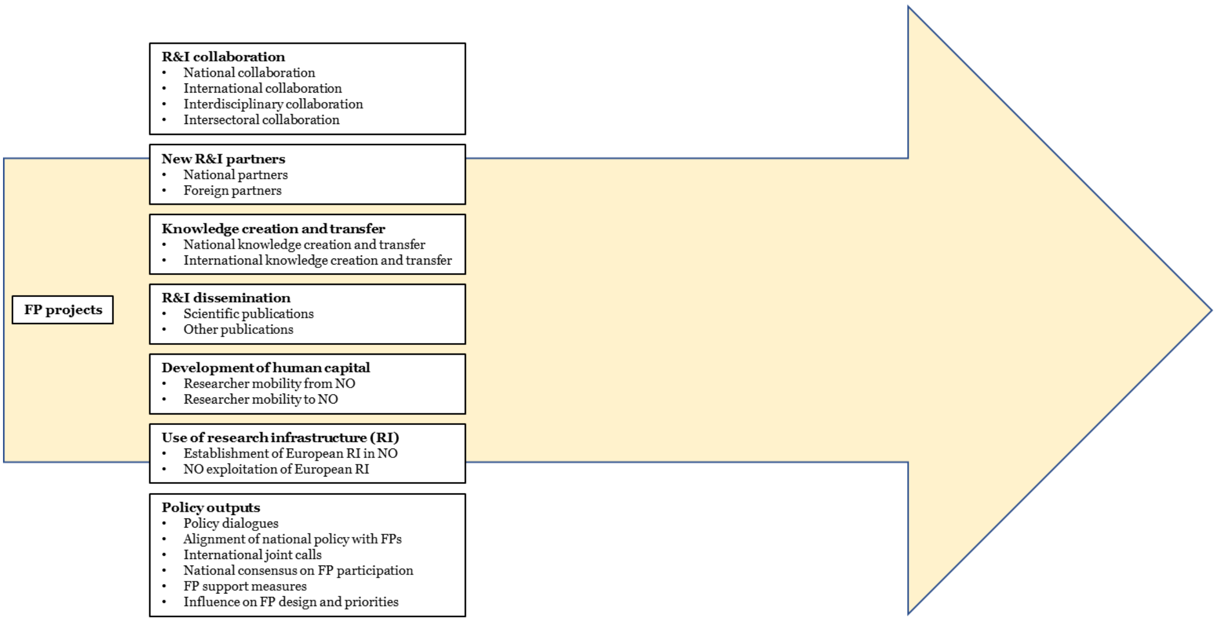
[26] www.regjeringen.no/no/aktuelt/statsrad-iselin-nybo-utfordrer-forskningsinstituttene-til-a-hente-mer-eu-penger/id2642023/

and RCN's instruments often aim to increase FP participation, particularly the FP-specific STIM-EU and PES2020 measures. In April 2019, RCN started using the same application evaluation criteria as the Commission, with the objective of familiarising Norwegian applicants with themin order to lower the threshold to apply for FP funding. Simultaneously, RCN presented its 15 new "portfolio boards", which among other things are to coordinate RCN's calls with FP opportunities, to improve the connection between research and innovation, and to contribute to renewal of both the Norwegian R&I system and society at large. In RCN's aforementioned proposal for support measures in Horizon Europe, the Agency proposed that Ministry of Education and Research should increase the quantitative objective for Norway's financial return from 2 to 2.5 per cent of the available competitive funds, which would require strengthened support measures, particularly to convince industry to increase participation. The proposal was informed by an evaluation of the STIM-EU and PES2020 measures (Åström, et al., 2018) as well as by a public hearing and subsequent consultations with stakeholder organisations.

4.4 Impact logic

After having delved into results for companies, R&D providers, R&I sector and society, we are now in a position to summarise our findings thus far into a first step of an impact logic for Norway's participation in FP7 and H2020, see Figure 4.6.

Figure 4.6 First step in reconstruction of impact logic.



Source: Technopolis.

We have through registry analyses, network analyses, web surveys and interviews determined that participation in FP projects leads to national, international, interdisciplinary and intersectoral R&I collaboration. The web surveys illustrate that national R&I instruments (in this case RCN's) also result in national, interdisciplinary and intersectoral collaboration (and in some cases also international, though generally to a considerably lesser degree), but FP projects clearly result in significantly more extensive international collaboration. The same reasoning holds for the extension of R&I collaboration networks. Engagement in international collaboration networks, benchmarking and acquisition of new partners in other countries (including in other sectors) are arguably some of the most significant added values of participating in FP projects.

By definition, R&I projects produce new knowledge that in collaborative projects is disseminated to project partners, predominantly nationally in national projects and to a significantly greater extent internationally in FP projects, as illustrated by web survey results. Project results are also disseminated openly (usually in English) through scientific and other publications, generally by university researchers, who nevertheless rather often include co-authors from other stakeholder categories.

The registry analyses show that FP projects do indeed result in researcher mobility to and from Norway, although such mobility is not a very common result, particularly when it comes to long-term secondments and particularly in H2020. In contrast, the registry analyses highlight that Norwegian participation in infrastructure projects is high and that it has increased notably in H2020 compared to FP7; Norway's participation in the H2020 Research Infrastructures subprogramme is so far almost 50 per cent higher than the overall average (up from 35 per cent above average in FP7), thus indicating that Norwegian organisations are well integrated in exploitation and hosting of European research infrastructure.

In terms of policy outputs, the objective of FP participation is international collaboration and competition in order to strengthen the quality of Norwegian R&I. Hence, also results are described in these terms. There is a continuous dialogue between ministries, agencies, R&D providers and industry representatives, and a consensus on the importance of continued participation. Significant policy coordination has taken place in relation to the FPs, particularly during H2020, and Norway has been most active in ERA-NETs in both FP7 and H2020. The H2020 pillars are clearly reflected in national policy documents, participation has increased the focus on challenge-driven R&I in Norway, and RCN's instruments often aim to increase participation, particularly the FP-specific STIM-EU and PES2020 measures. In 2019, RCN introduced the same evaluation criteria for applications that are used by the Commission.

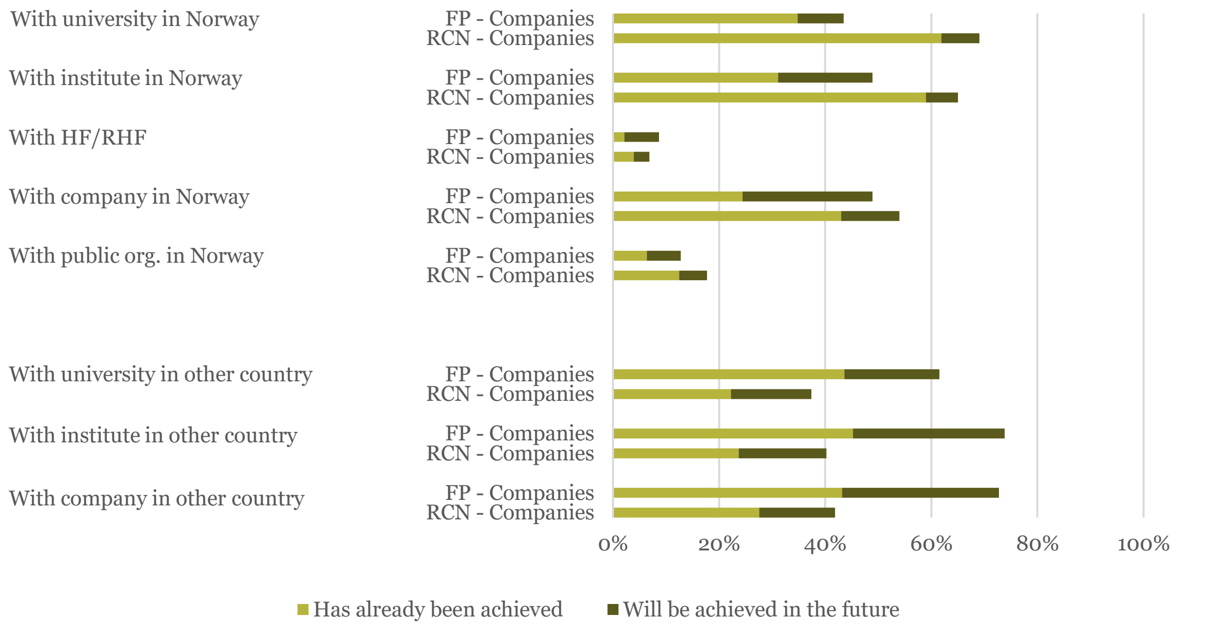
5 Impacts

Having in the previous Chapter established what results FP projects lead to, we are ready to examine the empirical foundations for the next step of the impact logic. This Chapter consequently focuses on the impacts to which FP projects have contributed based on web survey data, interviews with FP project participants, management of key FP participants and R&I policymakers, as well as registry, text mining and econometric analyses. It is important to keep in mind that many other factors (than a specific R&I project) may contribute to (or hinder) the emergence of impacts, and that the time scales involved in progressing from activities to impacts can range from a handful of years to decades.

5.1 Impacts for companies

Figure 5.1 illustrates that the long-term R&I partnerships established and maintained among companies that have participated in FP projects are stronger internationally than nationally, and that the reverse is true for participants in RCN projects. This is logical and coherent with our initial hypothesis and results presented in the previous chapter. It may be noted that the degree to which additional R&I partnerships are foreseen in the future is also consistently higher among participants in FP projects.

Figure 5.1 Impacts in terms of establishment/maintenance of long-term R&I partnerships according to companies (n=47 for FP participants, n=108 for RCN participants).



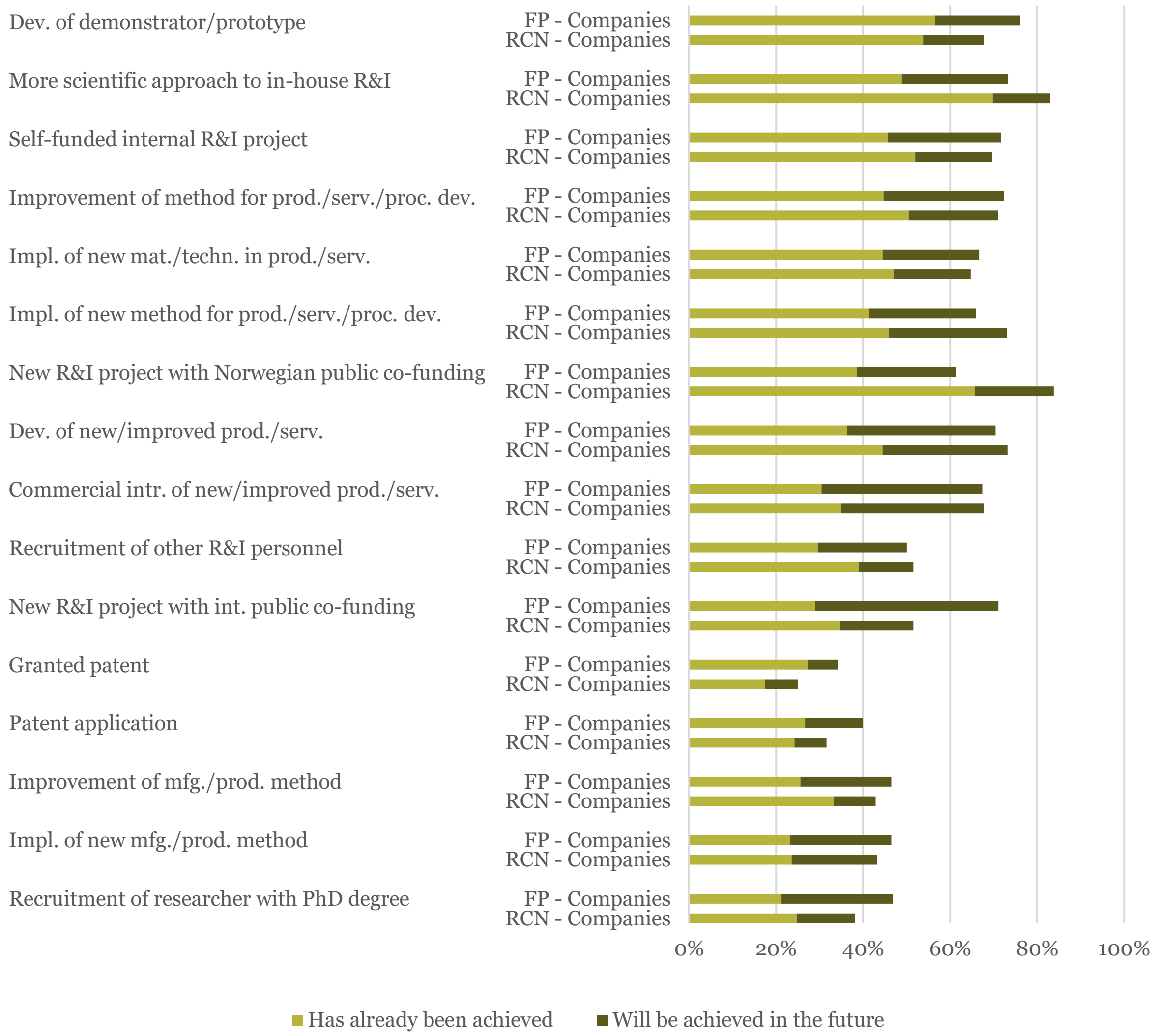
Source: Technopolis web surveys.

Figure 5.2 shows the degree of additional impacts achieved and foreseen, ranked according to achieved impacts for FP project participants. In line with the applied nature of FP projects established in Section 3.4, it is logical that development of demonstrators and prototypes is the most common impact (corresponding to TRL6–7). This said, we cannot rule out the possibility that the difference would have been smaller had we not only used RCN as the benchmark but rather IN or Enova which also fund for development of prototypes and demonstration.

Additional impacts that have already been achieved by at least 40 per cent of FP project participants are: more scientific approach to in-house R&I; self-funded internal R&I projects; improvement of existing methods for product, service or process development; implementation of new construction materials or new technologies in existing products or services; and implementation of new methods for product, service or process development. About one in five FP project participants has recruited a researcher with PhD degree and close to a third have recruited other R&I personnel. Slightly more than one company in four has applied for and been granted patents.

RCN project participants apparently experience the same types of impacts and generally in the same order – but to a higher degree. The two biggest deviations include triggering a more scientific approach to in-house R&I and doing new R&I projects with Norwegian public co-funding, which obviously are considerably more common impacts of RCN projects.

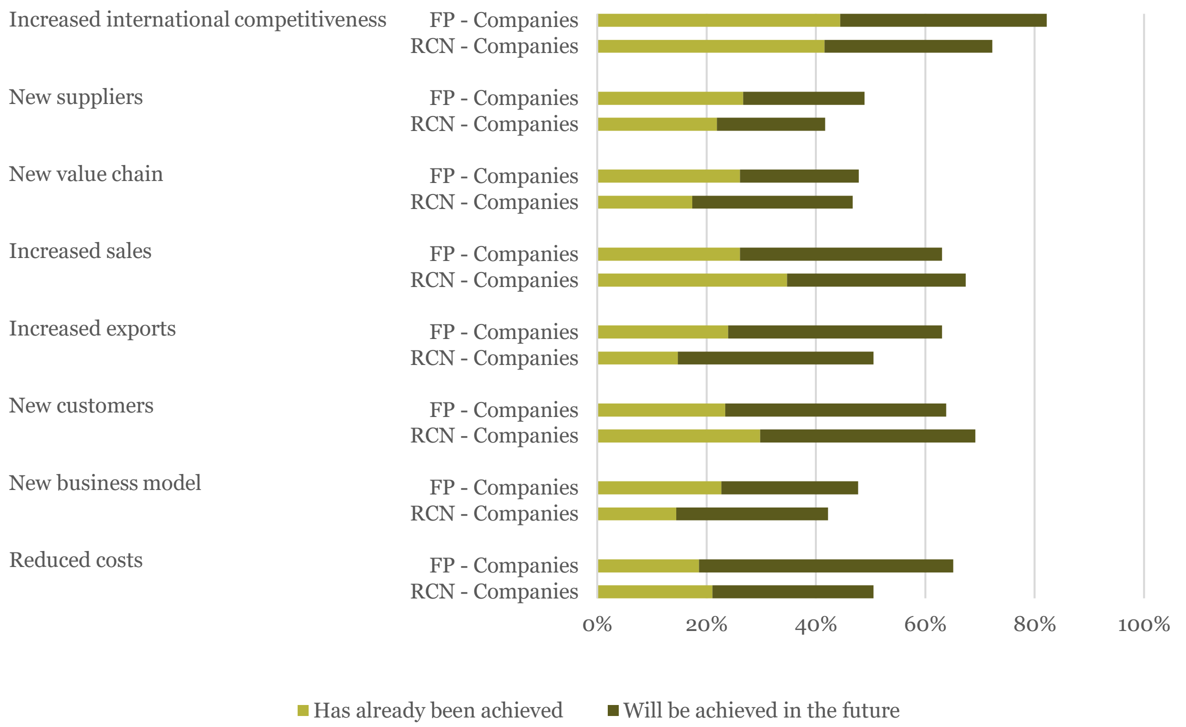
Figure 5.2 Other impacts according to companies (n=47 for FP participants, n=108 for RCN participants).



Source: Technopolis web surveys.

Figure 5.3 highlights that over 40 per cent of FP project participants assess that their project has had a positive impact on the company's international competitiveness, and around one in five companies that the project has contributed to new suppliers, new value chain(s), increased sales and increased exports.

Figure 5.3 Commercial impacts according to companies (n=47 for FP participants, n=105 for RCN participants)



Source: Technopolis web surveys.

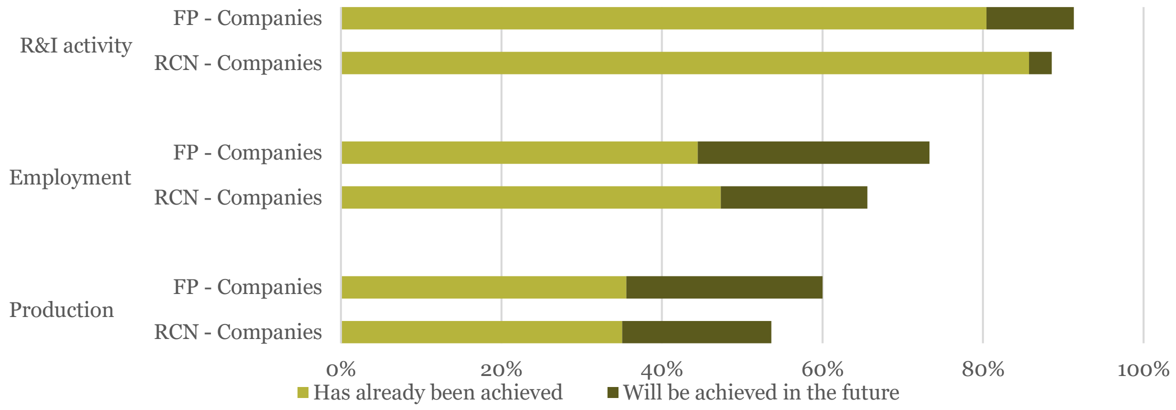
Access to funding not available in the Norwegian portfolio of R&I instruments seems very relevant for large companies. A company representative explains:

> *You get access to large consortia and large amounts of research. If you want to demonstrate something large scale, this scale is necessary.*

Interviewees point to the networking effect as most important for small companies. Large, multi-national companies already have extensive international networks and can join FP projects through subsidiaries and partners in many countries.

Company respondents were also asked to assess to what extent their project had contributed to maintained or increased R&I activity, employment and production in Norway, see Figure 5.4. While participants view impacts in these dimensions as quite substantial, there are no significant differences between FP and RCN projects.

Figure 5.4 Impacts of project in terms of maintained or increased R&I activity, employment and production in Norway according to companies (n=47 for FP participants, n=105 for RCN participants).



Source: Technopolis web surveys.

Companies engaging in R&I activities can generate new ideas, and hence new or improved products, which can be exploited commercially (with or without patenting); see sections 4.1 and 5.1 and yields a return for project participants sometime in the future. Commercial impacts are slightly greater for FP project participants than for RCN participants, but the difference is not substantial.

Web surveys nor interviews are suitable to monetise the economic impact of a large portfolio of R&I projects for Norway.[27] Measuring the return to R&D has however been done in several studies on Norwegian data, most recently and relevantly in the SkatteFUNN evaluation conducted by Samfunnsøkonomisk analyse (2018), and Statistics Norway's evaluation of the effects of a selection of R&D policy instruments on innovation and value added (Cappelen Å. , et al., 2016).

In the SkatteFUNN evaluation, the focus was on measuring effects of SkatteFUNN support on R&D expenditure (input additionality), innovation and labour productivity (output additionality). In brief, we found that every krone of support from the scheme yields two kroner of R&D expenditure, but that input additionality from Skattefunn were inversely related to firm size and experience with R&D. Furthermore, we found that SkatteFUNN contributes to more product and process innovation, as well as patenting. We also found that R&D investment enhances labour productivity in companies. Moreover, our results indicate that the effect on labour productivity is the same for RCN and SkatteFUNN projects, as for other R&D projects. The marginal return on R&D capital was estimated to be 8.2 per cent annually for public

[27] As it can be tricky for informants to isolate and monetise the impact of a R&I projects, and also for the evaluator to know if information is representative given that economic return tends to be heavily skewed.

and private funding[28]. The findings were in line with previous studies such as Cappelen et al. (2016)[29] which found an impact of NOK 1.8 million in value added and just under 2 new jobs per on million krone from RCN three years after the end of the project.

Neither the above-mentioned studies nor previous FP evaluations test the effects of Norwegian FP participation. In order to further investigate the impact of the FPs, we have undertaken an econometric analysis of the performance of companies that have received funding from FP7 and H2020 (up to and including 2017) compared with companies that have received funding from national R&I instruments.

Reason for comparing FP companies with companies with national funding is two folded. Firstly, when assessing the impact of an intervention you need to control for other factors which might have contributed to the development in company performance. As much data is needed in order to control for all possible factors, we rather compare FP companies (*treatment group*) with a group of companies that resembles FP companies (*control group*). We use participants in national R&I instruments as an indicator of R&I intensive firms in combination with sophisticated matching procedures to create a control group. Secondly, using firms that have participated in national instruments as the control group is highly relevant in the cost benefit analysis where we seek to identify the *additional* benefits of FP participation compared to national instruments. See appendix E for further details.

We find no statistically significant impact of FP funding compared to either national funding[30] or RCN funding on company income, value added, productivity, number of employees or profit.[31]

As a robustness checks, we tested whether removing outliers (the top and bottom 5 per cent of the indicators' distribution) and only considering FP7 participants, but these tests did not affect the results.

So why do we not find any positive and statistically significant impacts? One possible reason is of course that there is no difference in impacts between FP and RCN projects when it comes to company performance, meaning that it makes no difference where the money comes from.

Another possible reason is that both the web surveys and the econometric analysis sought to identify impacts from projects started in the period 2007–2018, and most H2020 projects in the sample are still on-going. It is well known that it takes several years, in some cases a couple of decades, before commercial impacts of R&I can be observed, so for many of the projects in the sample it is plainly too soon to say. (Åström & Arnold, 2019). As a case in point, Figure 3.10 shows that companies estimated 65 per

[28] This rate of return is "net" return which takes depreciation of R&D capital into account. There are alternatives to this depreciation rate and the life expectancy of a new innovation which influence the results. We rely on the estimate used in the evaluation of SkatteFUNN, which is standard in the literature and allows a comparison with previous estimates.

[29] Cappelen et al. (2016) found a net return rate of 9 per cent for private sector investment and 7 per cent for public sector investment such as the RCN (and SkatteFUNN) and argue that this is consistent with public R&I funding being channelled to projects that are believed to have positive effects beyond the purely commercial. We have tested for lower and higher rate of return; see section 6.4.

[30] SkatteFUNN, Innovation Norway and the RCN

[31] See section 5.1 and Appendix E for details

cent of FP projects would end at TL6–7, meaning that project results then need to be further developed by the company to reach TRL9 ("Actual system proven in operational environment"). Using the rule of thumb mentioned in Section 3.4, this can be expected to take at least 3–5 years, and after that another couple of years must pass before it is even theoretically possible for any improvement in company performance is registered in its annual accounts.

In H2020 there was a clear shift towards more innovation-oriented instruments and there has been a strong increase in Norwegian company participation in H2020. In the SME instrument that was introduced in H2020, the participants receive significantly more funding than what is available through Norwegian instruments which allows for commercialisation, demonstration and development of prototypes. Moreover, SMEs get access to advisory services and international investors, which can help companies rapidly to scale up their innovation and commercialisation activities (Samfunnsøkonomisk analyse AS, 2019). As the SME instrument is relatively new, the econometric analysis and the web surveys include rather few participants in the SME instrument.

Another possible reason why the econometric analysis cannot find a difference is that the matching procedure does not result in matches for all recipients of FP funding. If important FP project success stories originate from companies that are lost due to lack of matches, then they are not reflected in the results. For example, frequent FP participants and participants with large FP projects, such DNV GL and Borregaard, are for this reason lost from the analysed sample (treatment group). It is well known that R&I impacts are heavily skewed, so this could very well be a reason for the absence of impacts. Moreover, previous studies of national instruments indicate that project size matters, which could mean that we do not measure the impacts of the most successful projects. However, previous studies (for example Cappelen., et al. (2016) show that impacts relative to the size of the firm tend to be larger for smaller companies than for large ones, with the likely explanation being that one single successful project alone is too small to affect the overall performance of a large company.

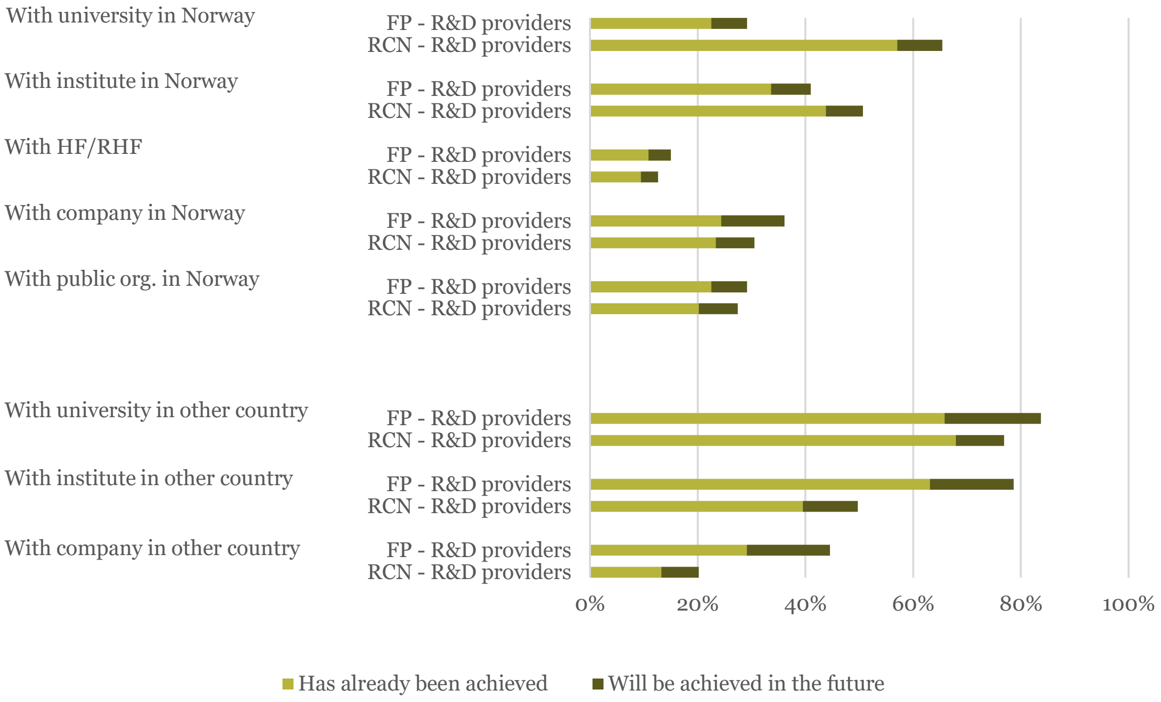
Despite the caveats in the analyses, our interpretation is that FPs impact on company performance is like that of the RCN up until 2018. This is broadly in line with a recent evaluation of Finland's FP participation, which concluded that, although noting that the direct economic impact of FP funding "appears positive", FP funding has a similar economic impact to national R&I funding (Piirainen, et al., 2018). In the CBA we have thus used previous studies on RCN data to estimate the private return to the investments brought by FP participation.

We further investigate the impact of FP association on productivity further in section 5.3.2.

5.2 Impacts for R&D providers

Whereas Figure 5.1 showed that long-term R&I partnerships are stronger internationally than nationally for company participants in FP projects, the situation is less clear for R&D providers, see Figure 5.5. While long-term R&I partnerships with universities and institutes within Norway are more common among RCN project participants, there is no significant difference when it comes to partnerships with the other stakeholder categories (though there appears to be a very slight tendency to the reverse). Moreover, when it comes to institutes and companies in other countries, long-term R&I partnerships are more likely to result from FP projects, whereas there is no difference when it comes to universities.

Figure 5.5 Impacts in terms of establishment/maintenance of long-term R&I partnerships according to R&D providers (n=125 for FP participants, n=381 for RCN participants).

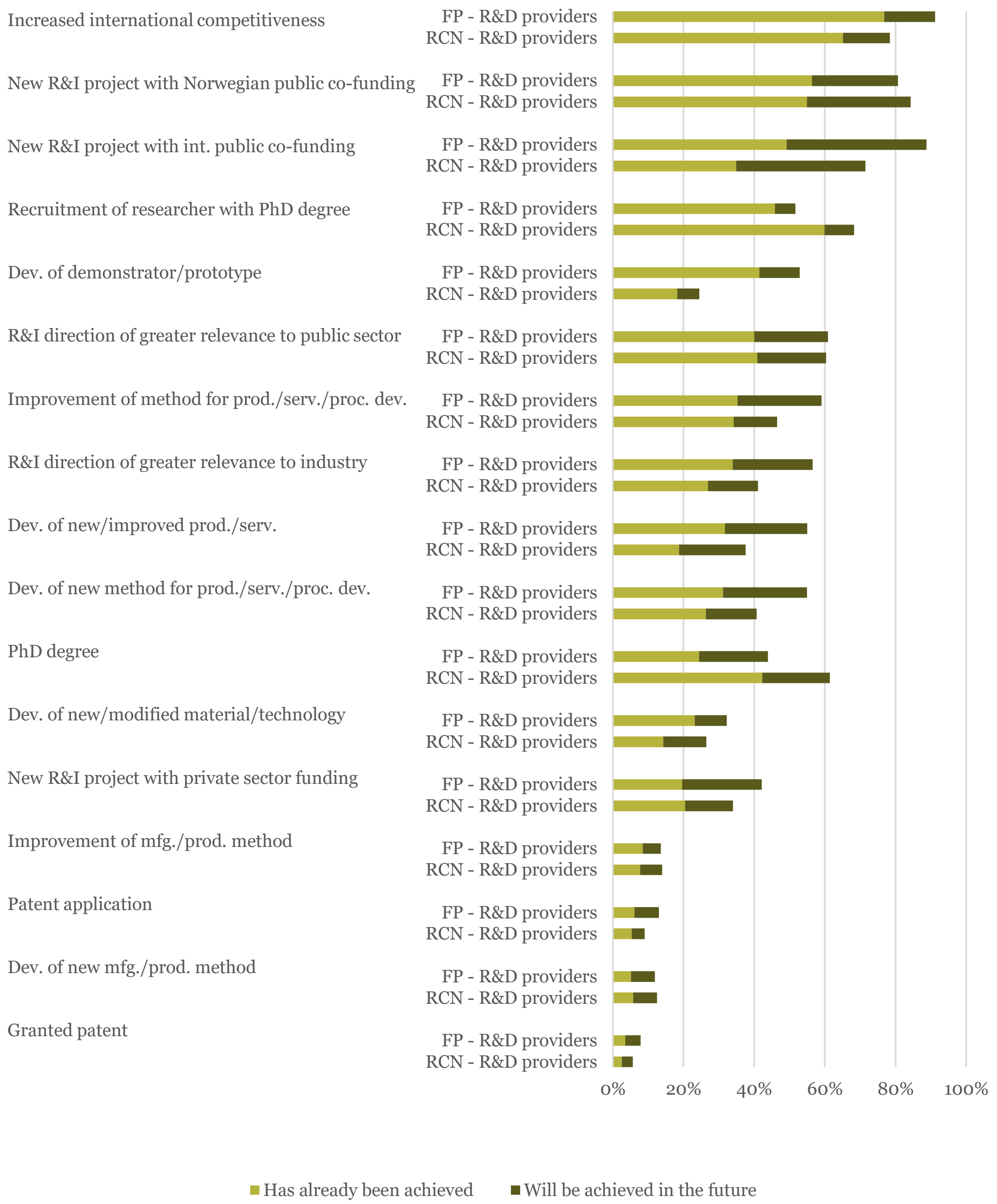


Source: Technopolis web surveys.

Figure 5.6 shows that three in four R&D providers judge that their international competitiveness has increased due to the FP project. Additional impacts that have already been achieved by at least 40 per cent of FP project participants are new R&I projects with Norwegian or foreign/international public co-funding, recruitment of researcher with PhD degree, development of demonstrators or prototypes and establishing an R&I direction of greater relevance to the public sector. The latter is a notably more common impact from FP projects than an R&I direction of greater relevance to industry. Moreover, demonstrators and prototypes are apparently more common in FP projects. By and large, the impacts are the same from RCN projects, although such projects seem more often to result in PhD degrees and recruitment of researchers with PhD degrees.

The interviews confirm that international competitiveness and international collaboration are important benefits for R&D providers. This is the case for both FP and RCN projects, but FP projects give access to larger international consortia. Competition for FP projects is also considered significantly tougher than for national projects, making FP projects more prestigious and adding more to participants' international competitiveness. For some interviewees, FP projects also have a considerable impact on their organisation's ability to attract foreign researchers and clients. One R&D provider highlights that its FP project has contributed to regulation due to new knowledge based on data from several European countries. This would not have been possible in a national project with a smaller consortium, according to the interviewee.

Figure 5.6 Other impacts according to R&D providers (n=125 for FP participants, n=381 for RCN participants).



Source: Technopolis web surveys.

5.3 Impacts for R&I sector and society

As in the previous chapter, we now go on to consider impacts that go beyond what participants themselves experience, which therefore may be considered impacts for the Norwegian R&I sector and for society (again keeping the objectives of government strategy in mind).

5.3.1 R&I competitiveness and quality

In the two previous sections we have shown that almost all survey respondents believe that FP participation has increased or will increase their international competitiveness – to a slightly higher degree than RCN projects. To what extent can this be verified by hard facts?

In H2020 we have seen a sharp increase in financial return as a share of competitive funding see Figure 3.1. An increase in Norwegian involvement indicate increased R&I competitiveness and motivation to participate.

The recent increase can also reflect a decline in these respects for other countries. For example, analyses of eCorda data reveal that annual UK participation in proposals have declined by 42 per cent (-8 374), and UK coordinated proposals have declined by 47 per cent (-3 135) between 2015 and 2018, indicating that Brexit has had a negative impact on the UK's FP involvement. Other countries (including Norway) are likely to have benefited from less UK competition.

In order to investigate the impact on R&I competitiveness we must also use other indicators of R&I competitiveness. The registry analyses provide three different methods of investigating Norwegian organisations' international competitiveness. We focus on proposals led (coordinated) by a Norwegian organisation, since the level of influence on a proposal is clearly much greater for a coordinator than for a regular partner.[32]

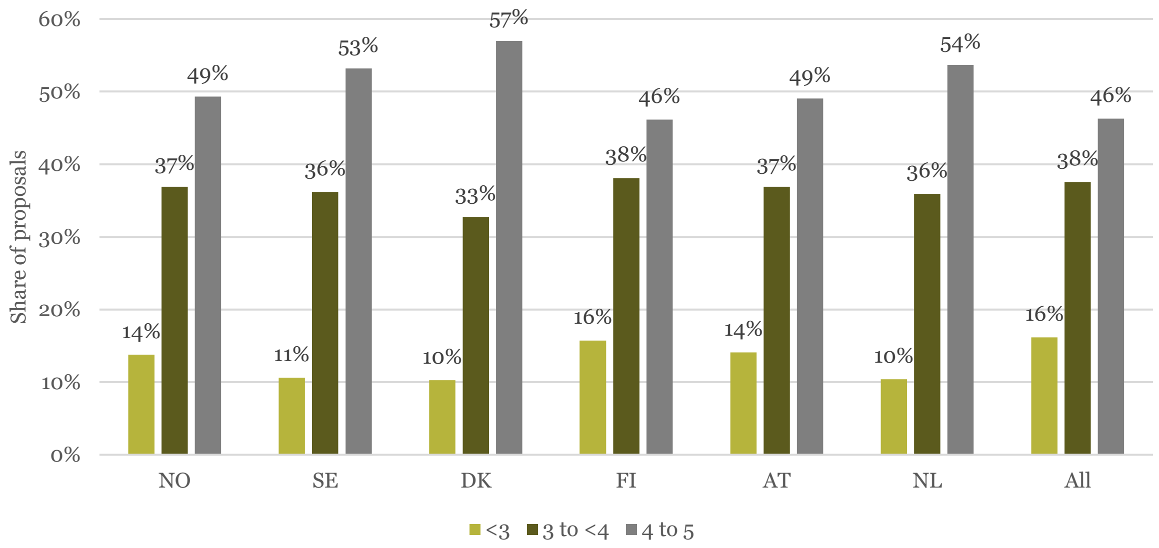
FP proposals are ranked according to three evaluation criteria: excellence; impact; and quality and efficiency of the implementation. For each, experts score the proposal between 0 and 5. These scores are only available for H2020 proposals, so comparisons are not possible with FP7, but we can compare with Norway's preferred comparator countries: Sweden (SE), Denmark (DK), Finland (FI), Austria (AT) and the Netherlands (NL), as well as with the average for all proposals.

For excellence, 14 per cent of Norwegian-led proposals scored less than 3, with only two countries (Finland and Austria) having higher proportions in this low-scoring group, see Figure 5.7. Similarly, 49 per cent of Norwegian-led proposals scored 4 or more, a lower proportion than all countries except Finland and Austria. Average excellence scores for the proposals that Norway leads have steadily increased from 3.57 (for those submitted in the first year of H2020) to 3.86 (in 2018). However, the five

[32] See Appendix A provides further details.

comparator countries have seen similar increases, so the relative achievements remain largely unchanged.

Figure 5.7 Distribution of excellence scores for H2020 proposals led by organisation in country.



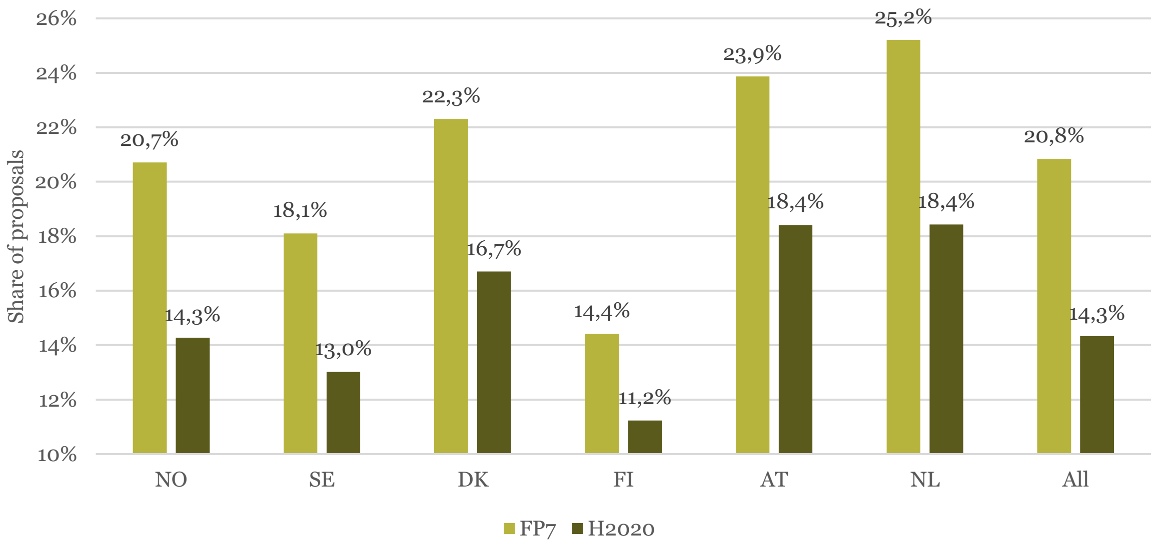
Source: Technopolis analysis of eCorda data.

Within H2020 there are four sub-programmes where Norway achieves excellence scores that are above average: InnosupSME, NMP, MSCA and SPACE. In two of these areas (NMP and Space), Norway also outperforms all comparator countries. Norway also outperforms all comparator countries on average excellence scores within the SECURITY and ADVMANU programmes. However, in HEALTH, ENV and ENERGY, Norwegian-led proposals score lower for excellence than they do in other sub-programmes, as well as less than most or all comparator countries.

Norwegian-led proposals tend to score higher for excellence when led by organisations in the HE and private sectors (eCorda HES and PRC stakeholder categories). However, this is also true for the comparator countries, and Norway ranks in the bottom half of this group of six countries for the average scores achieved by these types of organisations. Proposals led by Norwegian organisations in the public sector and the Other category (PUB and OTH) score slightly lower, on average, but better than these types of organisation in all comparator countries. The lowest excellence scores for Norway are achieved by institutes (REC) (only Sweden's institutes score lower).

eCorda data also indicate the evaluation classification for each proposal, which provides a broad indication of the relative quality of proposals. We focus on the proportion of proposals that fall within the two top categories, "Mainlist" and "Reserve" (i.e. those that are evaluated as being of sufficient quality to be funded, regardless of whether they eventually are). Data for both FP7 and H2020 proposals are available. Norwegian-led proposals were classified as mainlist or reserve in 21 per cent of cases in FP7 and 14 per cent in H2020, see Figure 5.8. In both periods, the share is below all comparator countries except Sweden and Finland and identical to the overall FP averages. However, during H2020 Norway has seen a year-on-year increase in its mainlist/reserve rate and has come increasingly close to that of the highest achieving countries (the Netherlands, Austria and Denmark), which have seen less improvement during the course of H2020.

Figure 5.8 Proportion of FP7 and H2020 proposals led by organisation in country that are classified as mainlist or reserve.



Source: Technopolis analysis of eCorda data.

During FP7, Norwegian-led proposals were most frequently mainlisted/reserved in the KBBE, JTI, SiS, SPA and INFRA sub-programmes (50+ per cent in each case). In SiS in particular, Norway outperformed all of the comparator countries. Other areas where Norway performs well in comparison with other countries are SME and ENV. At the other end of the scale, Norway is amongst the bottom two countries in PEOPLE, NMP, HEALTH, SSH and ERC.

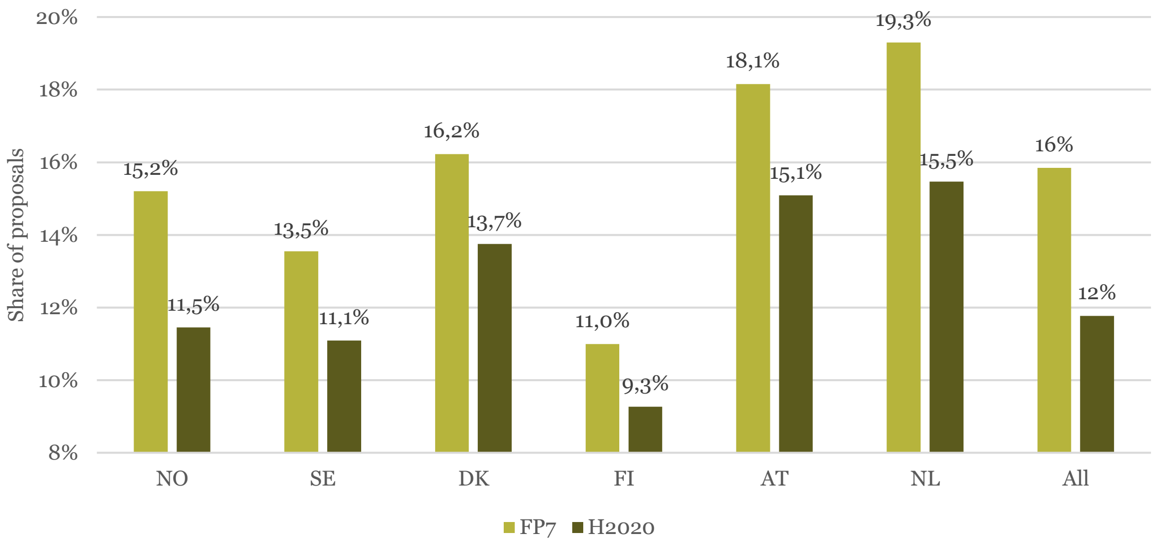
In H2020, Norwegian-led proposals were most frequently mainlisted/reserved in INFRA, SPACE and ADVMANU (30+ per cent in each case). In SPACE and ADVMANU Norway also outperformed all comparator countries. Other areas where Norwegian-led proposals achieved a high rate relative to comparators include the FOOD, ADVMAT, ENERGY, NMP and INNOSUPSME sub-programmes. At the other end, Norway ranks in the bottom two countries for INFRA, TPT, ERC, BIOTECH, HEALTH and FET.

Norwegian-led FP7 proposals that are coordinated by organisations in the public sector are most likely to be classified as mainlist/reserve (though Norwegian-led proposals were few in number). Indeed, Norway outperforms all other comparator countries. Proposals led by Norwegian institutes and companies do slightly less well, while the mainlist/reserve rate for the HE sector is below that of all comparator countries except Finland. In H2020, the public sector continues to do well (overall and compared to other countries), but company-led proposals fare less well on average than they did in FP7.

Finally, success rates (share of proposals funded) indicate the ability of Norwegian R&I to compete and succeed in international competition. Of the FP7 proposals led by Norway, 15 per cent were awarded funding, see Figure 5.9. This is below three of the comparator countries, but higher than Sweden and

Finland. The same pattern has occurred in H2020 so far, with 12 per cent of Norwegian-led proposals being funded, placing it fourth out of the six countries (and just shy of the FP average). On an annualised basis, we see a general downward trend in Norway's success rate during FP7 – a pattern shared with several of the comparator countries. The trend has reversed during H2020 with an increasing proportion of Norwegian-led proposals being successful each year between 2015 and 2018. Several of the comparator countries have also seen an upward trend, but Norway's success rates appear to be rising more rapidly.

Figure 5.9 Proportion of FP7 and H2020 proposals led by organisation in country that have been funded.



Source: Technopolis analysis of eCorda data.

Norway's highest rates of success in FP7 were in the SiS, INFRA, SPA and JTI sub-programmes (30 per cent of proposals that are successful). Relative to its comparators, Norway has been particularly successful in SiS, SME, ENERGY and ENV, and particularly unsuccessful in SSH, ERC, HEALTH and NMP. Within the sub-programmes of H2020, Norwegian-led proposals were most often successful within the SPACE and INFRA areas. Relative to comparators, Norway's success rate was highest in SPACE, ADVMANU, ADVMAT, FOOD, ENERGY, InnosupSME and ICT, and lowest in ERC, ENV and TPT.

Norwegian-led FP7 proposals coordinated by organisations in the public sector performed well above the country average, as well as above that of all comparator countries (again, proposals were few). Those led by companies and institutes were also more successful than the Norwegian average and were middle ranking amongst the comparator countries. Proposals led by the HE sector were least often successful – but this also tended to be true in other countries. In H2020, the public sector continues to do well, though not at the rates seen in FP7. Norwegian institute performance is also above average. Company and HEI success rates are both lower, in both cases placing Norway in the bottom three of the six countries.

In conclusion, survey respondents judge that their international competitiveness has increased, but this probably applies also to FP participants in comparable countries and probably at a similar rate. Thus, we may infer that Norwegian organisations' competitiveness relative to organisations in other countries at least has been maintained, which is broadly in line the overall findings of the registry analyses. Moreover, the registry analyses indicate that the international competitiveness of Norwegian proposal coordinators has increased year-on-year in H2020 after decreasing throughout most of FP7. Although these are general trends, Norway's success rate has increased slightly more rapidly in H2020 than that of the comparator countries thus suggesting a relative improvement.

When it comes to R&I quality, we noted above that Norwegian-led proposals have achieved higher excellence scores year-on-year in H2020, which we infer is an indication that the quality of the R&I conducted has also increased. However, as discussed above, other countries have seen similar increases, so Norway's relative position remains largely unchanged.

Another indication that FP projects produce R&I of high quality is that previous studies have shown that publications reporting results from FP projects are published in higher-impact journals than publications based on R&I funded through other funding sources (European Commission, 2017b) and that publications from FP projects tend to be of higher quality than other publications and among the top ones of researchers' production (European Commission, 2010).

Moreover, had Norwegian organisations not participated in FP projects, it is possible – perhaps even likely – that they would not have been able to maintain their relative position internationally (in other arenas than the FPs). There is a question of whether participation in international competition and in international projects increases international competitiveness more than participation in national competition and in national projects. Interview statements and survey results suggest that international engagement does indeed enhance competitiveness, although the differences between the impact of FP and of RCN at a project level is not as large as we had expected.

5.3.2 Impacts on productivity

We have found that FP participation lead to the development of new products and solutions (see section 5.1). This is favourable for Norway as at the company level, increased learning and innovation has the potential to increase productivity through improved product and service quality, as well as decrease production costs. At the macro level, innovation increases total factor productivity, thus international competitiveness and economic growth.[33]

[33] See for instance, Schumpeter, J. (1991), Penrose (1995) and Storey (1994) for economic theory and Crépon et al. (1998), Griffith et al. (2006) and Parisi et al. (2006) for the studies at the micro level, and van Leeuwen and Klomp (2006) for the study at the macro level.

Web surveys and informants indicate that FP raises international competitiveness and to a greater degree than RCN projects, but we have not been able to document any additional impact of FP participation on company performance up until 2018.

In order to further investigate the impact of FP on innovation and productivity relative to national instruments we investigate in what way companies participating in the FPs differ from those participating in national instruments. Many FP participants benefit from funding from national instruments. It is reasonable to see such interactions as the FPs and national instruments can play different roles in the companies' R&I work. An investigation of Samfunnsøkonomisk analyse' database on R&I instruments reveal that many FP participating companies have participated in RCN instruments, but not vice versa. Nine out of ten Norwegian FP companies have participated in at least one project with RCN funding during the period of 2007-2017[34], but only about one in ten RCN companies have participated in a FP project during the same period. Reducing the assessment period lowers the share of co-usage but share of FP companies with RCN experience is still higher than vice versa.

Further, we have investigated if FP companies are more innovative than RCN companies by combing the innovation survey conducted by Statistics Norway and Samfunnsøkonomisk analyse database on R&I instruments (See Appendix E for details).

The innovation survey is a survey, and thus not a complete data set but does include all companies with more than 50 employees. However, smaller companies are selected in order to cover a representative sample on an industry-company size spectrum. This sampling leads to a bias due to an underrepresentation of small companies in the sample, compared to that of the entire population. However, RCN and FP funded companies are quite similar in size, meaning this bias is not likely to be significant in our comparison of the two groups.

Many companies have more than one source of public support, which means that there can be cases where project results are connected to the wrong funding agency. However, both RCN and FP funded companies are active in seeking other public R&D funding, and since our aim is just as much to compare the groups, not (only) to observe the impact of a specific type of funding, we do not view this as a troubling issue. Furthermore, as mentioned, we construct our two groups such that they are not included in our sample before they receive funding. i.e. in the same manner as for the econometric analysis but without matching.

The comparison unveils differences between FP participants and participants in national instruments[35]. The FP-funded companies have over time increasingly reported that they introduced product innovations, both in terms of goods and services, see Figure 5.10.The same can be said for the RCN-funded

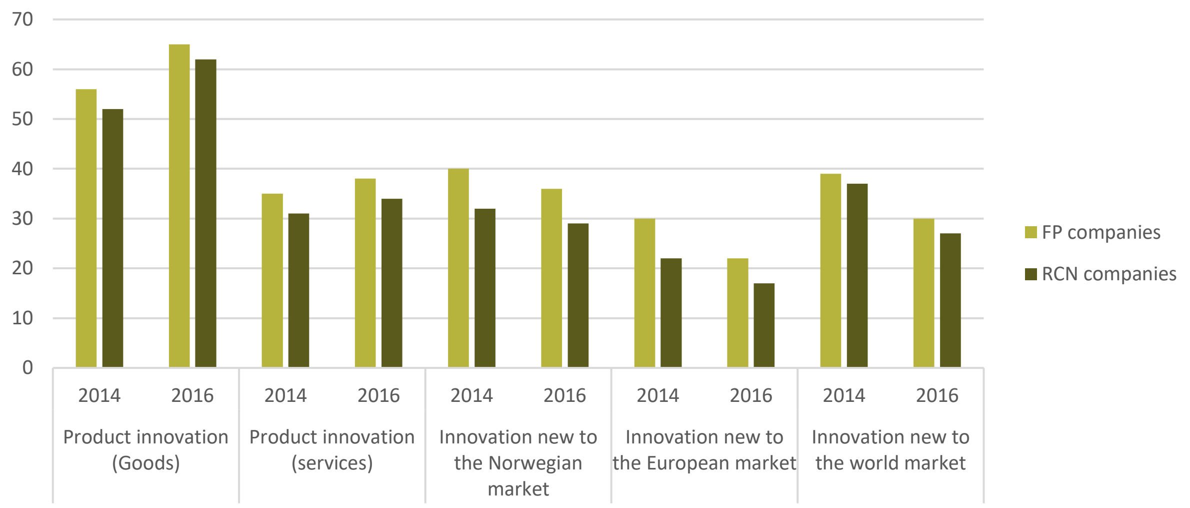
[34] Excluding PES.
[35] This sampling leads to a bias due to an underrepresentation of small companies in the sample, compared to that of the population, but as the RCN and FP funded companies are quite similar in size this bias is not likely to be present in our comparison of the two groups.

companies, but to a slightly lesser extent. The same is true of the share of companies that reported that the product innovation was new to the market.

A slightly higher share of FP-funded than RCN-funded companies has also introduced process innovations related to the production of goods and services. In terms of other process innovations – logistical and administration-oriented innovations – the two groups report quite similarly on average over time, although a larger share of the RCN funded companies report that they have introduced an administration-oriented process innovation in the 2014 and 2016 surveys.

The comparison also indicates that FP companies to a larger degree introduce product innovation that is new to the world market, the European market or the Norwegian market, while a higher share of RCN funded companies reported that it was only new to the company, see Figure 5.10. This indicate that the novelty value of the FP-funded companies' product innovations is larger. The same applies for process innovations.

Figure 5.10 Share of companies with positive response about novelty value of product innovations (goods and services and market). In per cent.



Sources: Samfunnsøkonomisk analyse AS, based on Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes. See appendix E for further information.

We cannot document if FP participation make these companies more innovative or internationally oriented if they were more innovative or internationally oriented already prior to FP participation. We do interpret the results from CIS data and pattern of co-usage as an indication of FP participants being high on the "R&I ladder" and that the FPs are particularly relevant for and foster the (re-)allocation of public and private[36] R&I resources towards highly innovative and internationally competitive projects and participants.

We have also found that participation in an FP projects increase R&I capacity building but also learning in the wider sense e.g. on international markets, regulations, governance, culture, commercialisation and how to attracts investors. Participation in an FP projects extend international collaboration and channels for companies to “stay tuned and ready” when the commercial opportunity arises. The benefits of learning and collaboration are not limited to participating companies, but represent knowledge that can be spilled over to other companies, branches and through later collaboration, labour mobility, spin-offs etc. indicated by the web surveys (section 5.3.3).

Our interpretation is that although the immediate impact of a single FP project on company performance is like that of an RCN project, web surveys and interviews point to FP increasing international collaboration and international competitiveness to a greater extent than national measures. Further, the FP fosters reallocation of R&I resources to innovative and international oriented firms, all of which can increase innovation and productivity in the long run.

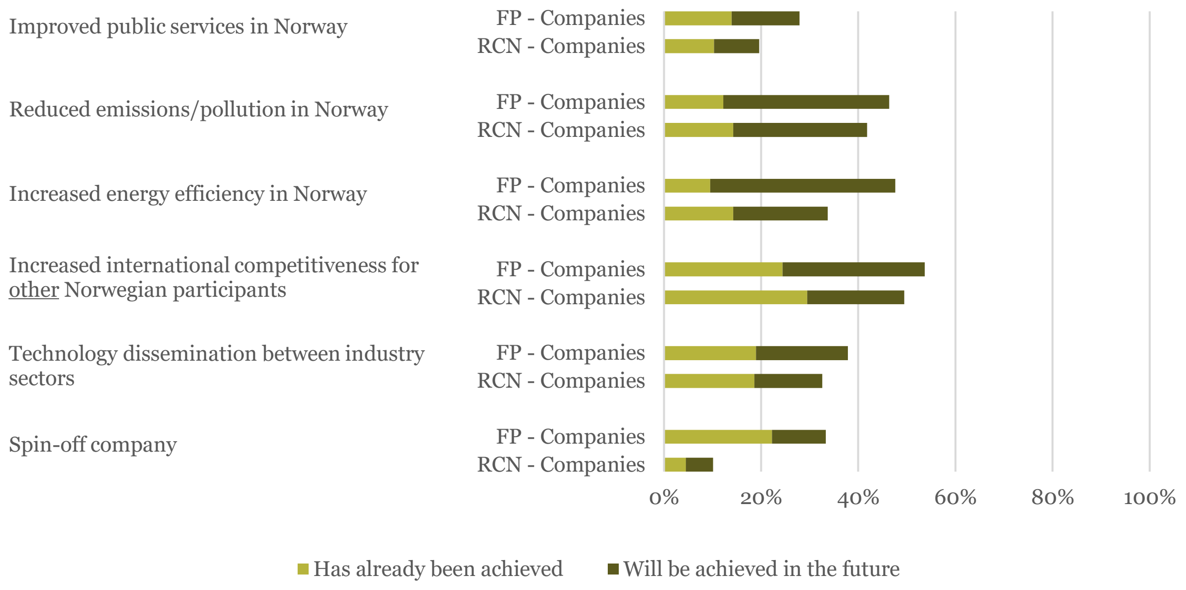
5.3.3 Other societal impacts

We have used web survey results, interviews and text analysis to identify the extent to which the FPs contribute to other societal impacts. Figure 5.11 and Figure 5.12 show that project participants estimate that there are impacts also beyond their own organisations. The most common impact seems to be in terms of increased international competitiveness for <u>other</u> Norwegian participants (meaning other than the respondent’s own organisation). Around one in five FP project participants of both stakeholder categories believe that technology dissemination between industry sectors has taken place and an equal share of companies that have participated in FP projects claims that spinoff companies have resulted. Impacts in terms of improved public services, reduced emissions/pollution and energy efficiency are apparently not considered to be common but are not insignificant either.

The spinoff companies named by company respondents are Extraction Technologies Norway AS, Mixmove AS, Aia Science AS, iDROP AS, OTECHOS Compressors AS, OTECHOS Expanders AS, OTECHOS Pumps AS and OTECHOS Engines Ltd (UK); R&D providers name Funzionano AS and Highskillz Ltd (UK). None of the Norwegian companies in this list that have submitted annual accounts have any turnover, while some have not yet submitted their first annual accounts.

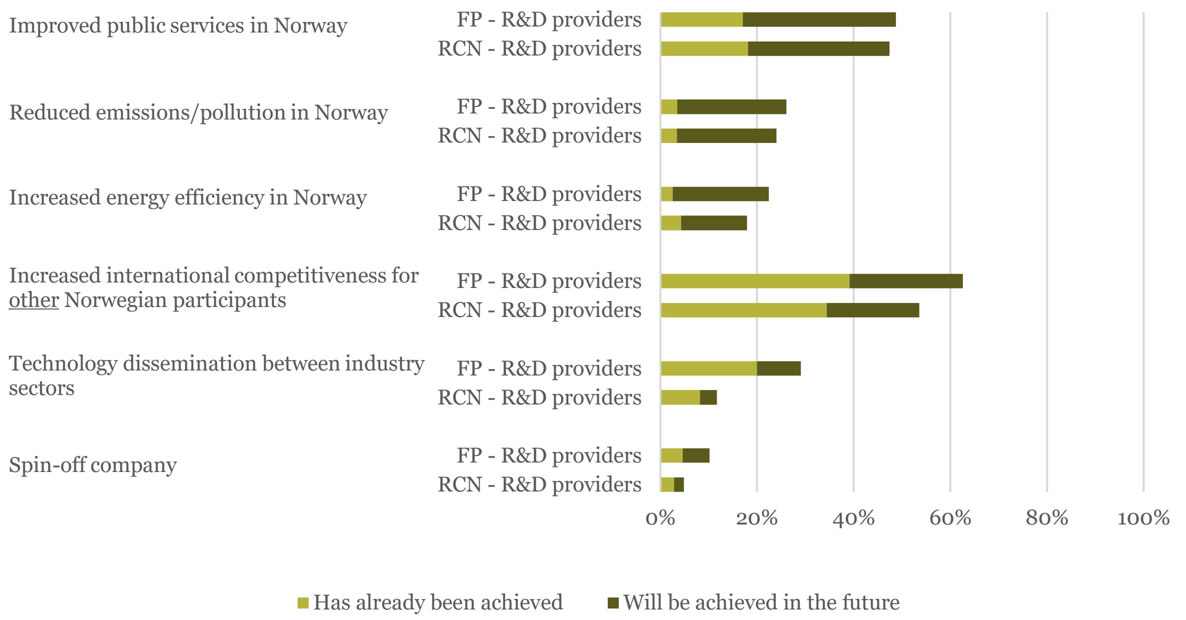
[36] Financial mechanisms vary, but private companies often have to co-fund an R&I project

Figure 5.11 Wider impacts of project according to companies (n=43 for FP participants, n=98 for RCN participants).



Source: Technopolis web surveys.

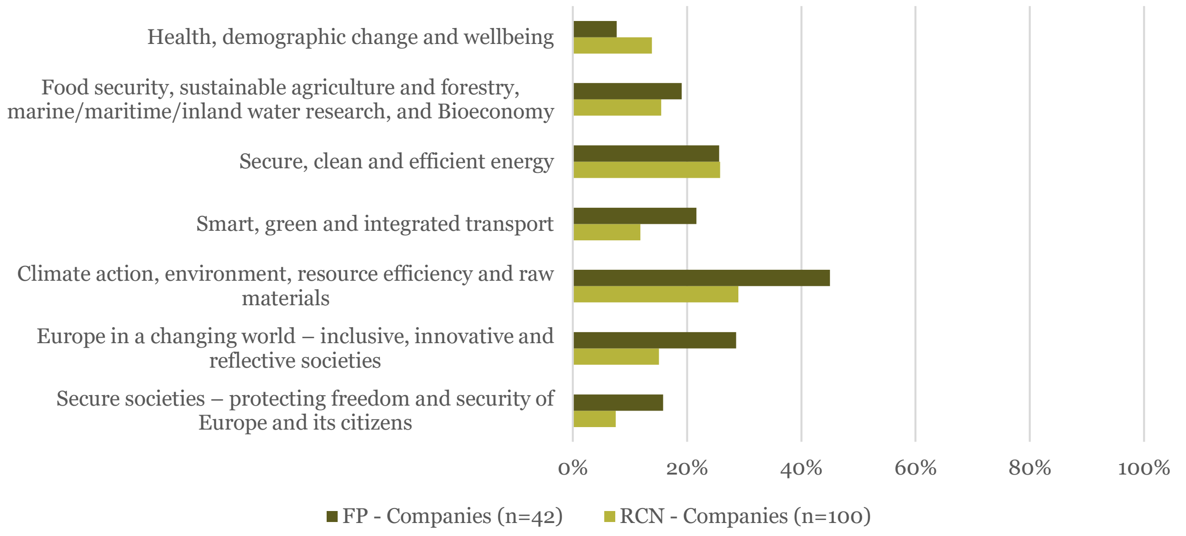
Figure 5.12 Wider impacts of project according to R&D providers (n=117 for FP participants, n=352 for RCN participants).



Source: Technopolis web surveys.

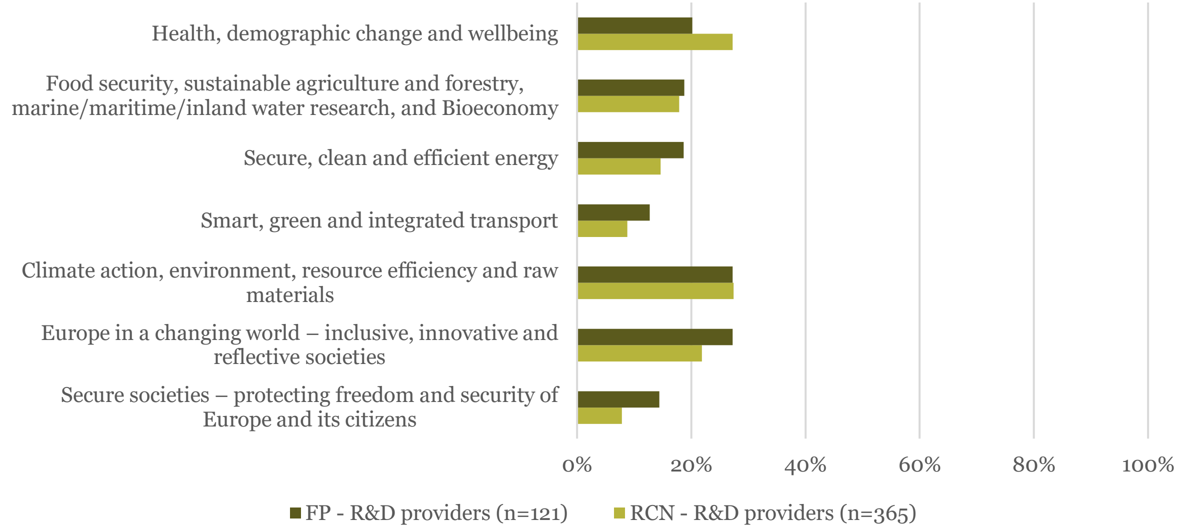
The registry analyses show that Norway's participation in projects in the Societal Challenges part of H2020 is well above average in the ENERGY, FOOD and ENV subprogrammes, slightly above average in SECURITY, at average in SOCIETY, and well below average in ENV and HEALTH (see Appendix A for details). Figure 5.13 and Figure 5.14 suggest that project participants' estimated contributions from FP and RCN projects alike to solving societal challenges are rather limited, with the exception of companies' view on the contribution of FP projects to addressing Climate action, environment, resource efficiency and raw materials (ENV subprogramme). The otherwise modest assessed contributions should probably be interpreted as an indication of respondents comprehending the vastness of the challenges and the marginal contribution of a single project. Overall, FP projects are judged to contribute a bit more than RCN projects, which may be a reflection of the challenge-oriented focus of the FPs and in particular H2020.

Figure 5.13 Contribution of project to solving societal challenges according to companies.



Source: Technopolis web surveys.

Figure 5.14 Contribution of project to solving societal challenges according to R&D providers.



Source: Technopolis web surveys.

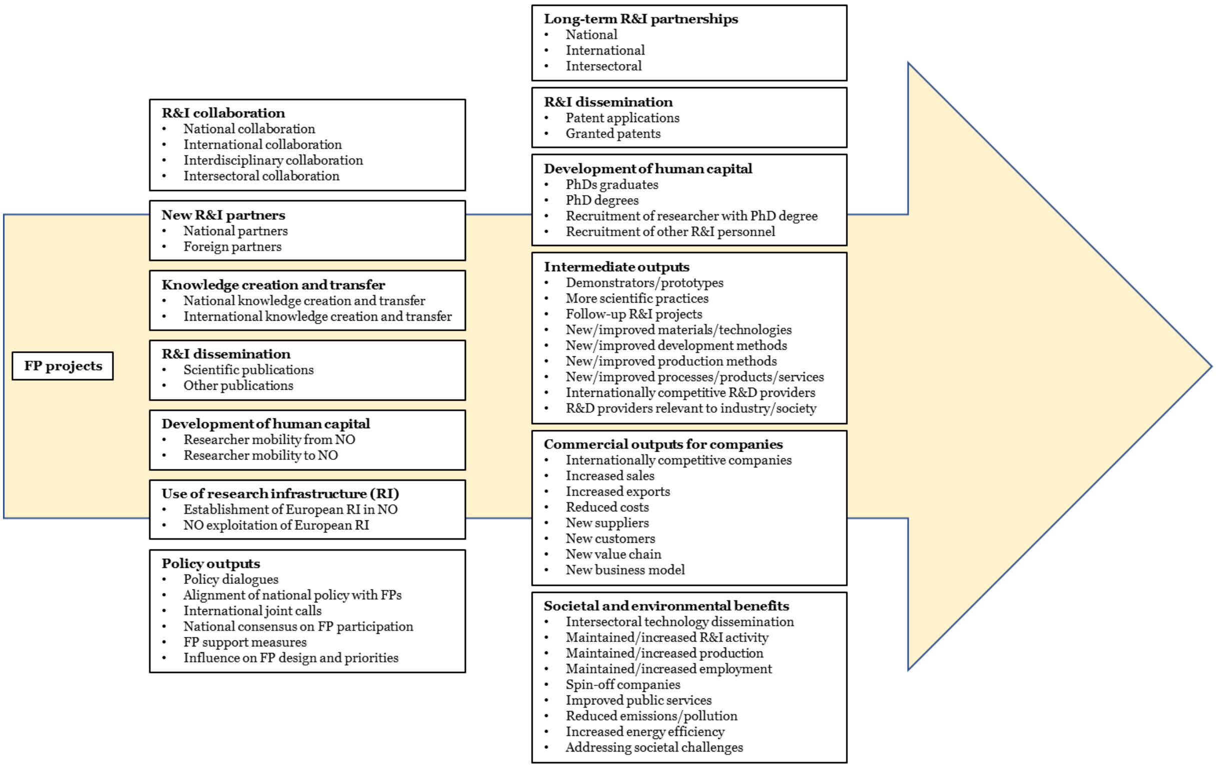
The interviews confirm the slightly different thematic foci of FP and RCN projects illustrated in the two recent figures. Given the amount of national research in the health area, several interviewees see a potential for increased contributions in this area also in FP projects (where Norwegian presence is well below average).

The text analyses of FP projects' periodic reports illustrate that several of the societal challenges appear to be addressed by these projects, most prominently Secure, clean and efficient energy (SECURITY); and Climate action, environment, resource efficiency and raw materials (ENV); and Health, demographic change and wellbeing (HEALTH) (see Appendix D for details). The text analyses also suggest that innovation and competitiveness objectives are prominent in project reports.

5.4 Impact logic

We now may summarise our additional findings into a second step of the impact logic, see Figure 5.15.

Figure 5.15 Second step in reconstruction of impact logic.



Source: Technopolis.

We have learnt from the web surveys that long-term national, international and intersectoral R&I partnerships are among the key impacts of FP projects regardless of stakeholder category. Patents are also among the impacts experienced, although we know that Norwegian organisations are not as keen on patenting as their counterparts in other countries (Åström, et al., 2017). Recruitment of PhD students and other R&I personnel, as well as PhD degrees achieved, are more common impacts of RCN projects but are reasonably frequent impacts in FP projects as well.

So-called intermediate outputs are arguably the most prominent ones. Survey results indicate that development of demonstrators and prototypes is the most highly rated impact for companies followed by more scientific approach to in-house R&I. Many companies have implemented new methods for product, service and process development; new materials and technologies; and new manufacturing and production methods, which in turn have contributed to the commercial introduction of new or improved products or services. Presumably, parts of these intermediate outputs have been honed in R&I projects following the FP projects, for companies most often self-funded internal projects and projects co-funded by Norwegian agencies.

The main impact reported by R&D providers is increased international competitiveness, which is undoubtedly an important impact also for Norwegian industry and society. Having R&D as *raison d'être*, it is not surprising to see that new R&I projects are another very common impact for R&D providers, mostly with Norwegian but to a large extent also with international/foreign public co-funding. It is interesting to note that many of the intermediate outputs reported by companies are also reported by R&D providers, which suggests that such impacts to a considerable extent have been developed in collaboration. Many R&D providers report that FP projects have contributed to their R&I activities having become of greater relevance to the public and private sectors. Together with the fact that companies report a more scientific approach to in-house R&I, this may in the longer term prove most significant for Norway.

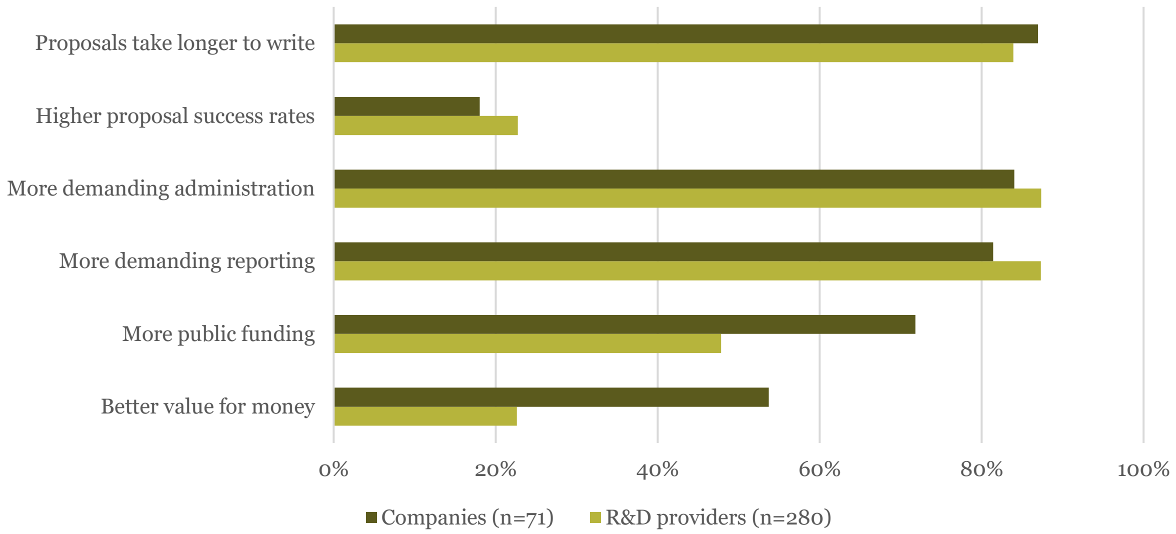
Companies have (according to their responses in interviews and web surveys) also experienced increased international competitiveness contributing to increased sales and in some cases exports due to FP projects. Some companies indicate that FP projects have contributed to reduced costs, new suppliers and customers, new value chains and new business models. Companies participating in RCN projects report similar impacts. However, our econometric analysis cannot document any difference in economic performance between companies having participated in the FPs and in national instruments.

Survey results also indicate that there are contributions to societal and environmental benefits, including: improved public services; reduced emissions and pollution; increased energy efficiency and intersectoral technology dissemination. There are also some modest reported contributions to solving societal challenges, which probably reflects the realisation that these challenges are hugely complex, and that a single project at best can expect to make an infinitesimal contribution to a part-solution.

5.5 A love-hate relationship?

To get a better feeling for the benefits of FP projects, we asked survey respondents to compare FP applications and projects with Norwegian ones, specifically exemplified by instruments of RCN, IN and SkatteFUNN (the latter for companies only). Figure 5.16 and Figure 5.17 summarise Norwegian researchers' love-hate relationship with the FPs.[37] As expected, FP proposals are considered significantly more arduous to produce and FP success rates are generally assumed to be lower than in national calls; however, not everyone agrees with the latter statement and this is objectively not always the case.[38] It is also well known that FP project administration and reporting is time-consuming. However, almost three in four companies say that they receive more public funding in FP projects and a majority believe that FP projects give better value for money on the company's own investment. R&D providers are obviously not equally enthusiastic in these respects since they typically have more favourable funding conditions in Norwegian projects.

Figure 5.16 Comparison of administrative aspects of FP and Norwegian proposals and projects.



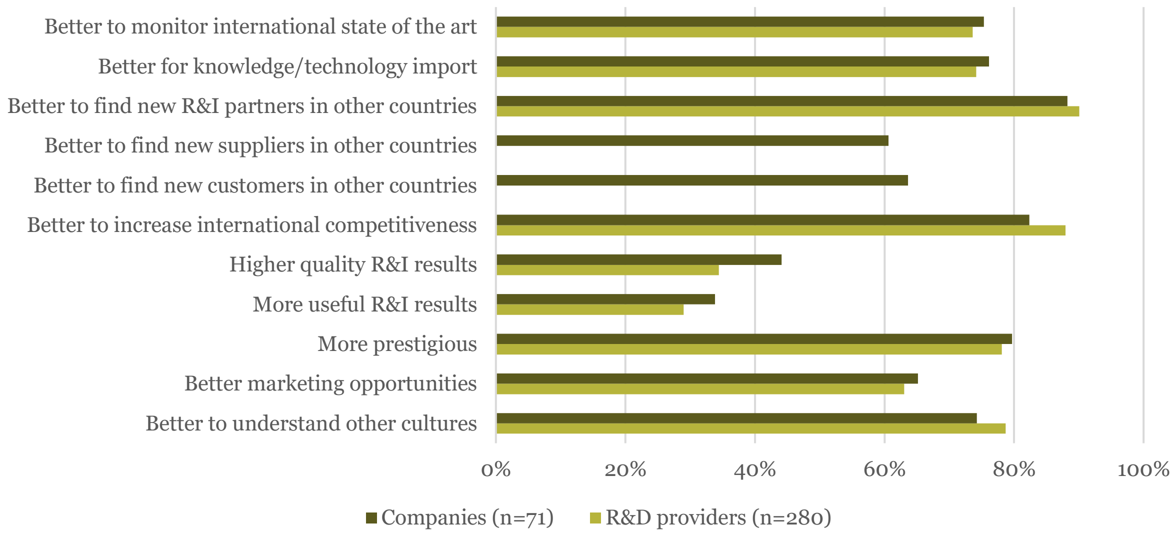
Source: Technopolis web surveys.

With the exception of the quality and usefulness of projects results, a large majority of respondents agree that FP projects are preferable to Norwegian projects, see Figure 5.17. It is particularly noteworthy – albeit perhaps obvious – that FP projects provide better opportunities to enhance the organisation's international competitiveness, to find foreign R&I partners, to monitor the international state of the art

[37] "RCN project participants" that had participated in at least one FP project have been included, and the results are the sum of To a large extent and To a very large extent.
[38] See e.g. T. Åström, N. Brown, B. Mahieu, A. Håkansson, P. Varnai and E. Arnold (2017)

and to import knowledge and technology. On the “softer” side, FP projects are more prestigious and provide better opportunities for understanding other cultures and for marketing. A clear majority of companies argues that FP projects are a better means for extending networks with suppliers and customers. In contrast, the fact that FP projects are believed to yield lower quality and less useful results is clearly a cause for concern and may be seen to contradict some of our findings above. However, it should be noted that these sentiments do not mean that results from FP projects are of low quality and of little use, only that RCN projects are perceived as being preferable in these respects. Moreover, key previous studies have concluded that quality and usefulness of FP results are high.[39] Possible reasons for the sentiments in the figure are that companies will find that FP results take more effort to exploit because they are collaboratively produced and therefore tend to be pre-competitive (a company can get closer to market introduction with national money in projects that do not involve other companies), while some R&D providers might regard FP work as lower quality because of its applied nature.

Figure 5.17 Comparison of broad impacts of FP and Norwegian projects.



Source: Technopolis web surveys.

When interpreting these two figures, it should be kept in mind that these respondents all have FP project experience, which means that they have come a long way on the learning curve on how to succeed in the FPs. This probably means that in general they are positively inclined towards the FPs, but they are

[39] See e.g. European Commission (2017b)

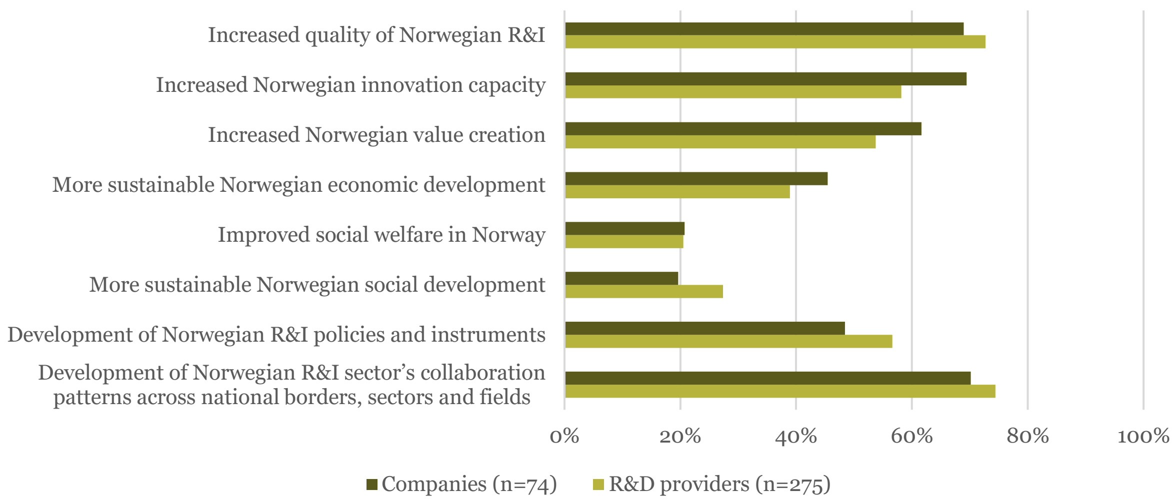
also knowledgeable of the FPs, so we like to believe that their assessments are reasonably balanced. On the other hand, we do not have a control group for these questions.[40]

Thus, despite well-known administrative disadvantages and some doubts about the quality and usefulness of project results, a majority of experienced FP project participants from industry believe that FP projects are preferable to national projects. In general, R&D providers agree and where they do not, it depends on them having more benign funding conditions nationally than in the FPs, whereas the reverse typically holds true for companies.

5.6 Fulfilment of the government's objectives

In chapters 3–5 we reconstructed an impact logic that we hope will lead us to the government's objectives. Further to build our case, we also asked survey respondents directly about the extent to which they believe that Norway's overall participation in FP7 and H2020 (i.e. not only an FP project or their own organisations' entire FP participation) has contributed to the government's objectives. Figure 5.18 shows that a majority of FP participants clearly agrees to a contribution to all (sub)objectives except: Improved social welfare; More sustainable social development; and More sustainable economic development.[41] The lowest agreement is still just a whisker from one in five company respondents.

Figure 5.18 Wider impacts of Norway's overall participation in FP7 and H2020.



Source: Technopolis web survey.

[40] We could have surveyed researchers that have never participated in the FPs, but they would by definition be uninformed of impacts of FP projects, and they could possibly also be suspected of being negatively inclined towards the FPs – so we refrained from doing so.
[41] This figure includes the responses of all "FP project participants" as well as the "RCN project participants" that answered "Yes" to the question on whether they had also participated in at least one FP project. The results shown are the sum of To a large extent and To a very large extent.

The step-by-step development of our reasoning in chapters 3–5 show that the government's objectives indeed have been achieved, albeit to varying degrees.

Participation shall increase the quality of Norwegian research and innovation and help Norwegian research and innovation succeed internationally

Registry analyses, web survey data and interviews indicate that Norway's FP participation has increased the quality of Norwegian R&I and Norwegian participants' competitiveness and thus made it possible for them to succeed internationally. While this is true, the registry analyses show that participants in other countries have seen similar competitiveness improvements, meaning Norway's relative position largely remains unchanged, although a slight improvement may have been realised in H2020. However, even though this improvement is faint we believe that this should be seen as a success. Any significant improvement relative other countries would have been remarkable, even unrealistic, to achieve. Moreover, Norway's financial return from H2020 now substantially exceeds the government's 2 per cent objective.

The improvement in terms of financial return has been on-going since mid-2017 (and it is a rather dramatic improvement over FP7 (and FP6)). Several previous evaluations have similarly concluded that FP participation fosters scientific excellence and competitiveness, thus suggesting that these are generic impacts of FP participation.[42] This evidence serves to underline the importance of the FP in generating the absolute increases in performance necessary to maintain (and sometimes improve) relative competitiveness.

Participation shall contribute to increased innovation capacity, value creation and sustainable economic development

Companies argue that their FP participation has significantly contributed to increased innovation capacity and value creation. Half the companies report taking a more scientific approach to in-house R&I following FP projects, four in ten increased international competitiveness, and around one in five commercial benefits. The previous Norwegian evaluation of FP impacts arrived at similar conclusions.[43]

Econometric analysis indicate that the impact of FP is like that of RCN and previous Europe-level evaluations have concluded that the FPs bring considerable *European* added value.[44]

Participating in an FP projects increase R&I capacity building but also foster learning on international markets, regulations, governance, culture etc. Participation in an FP projects also extend international collaboration and channels for companies to "stay tuned and ready" when the commercial opportunity

[42] E.g. European Commission (European Commission, 2010) (European Commission, 2017a), Piirainen et al. (Piirainen, et al., 2018), Danish Ministry of Higher Education and Science (2017)
[43] E.g. Godø, et. al. (2009)
[44] E.g. Fresco (2015) and European Commission (European Commission, 2017a)

arises. The benefits of learning and collaboration are not limited to participating companies, but represents knowledge that can be spilled over to other parts of the society through later collaboration, labour mobility, spin-offs, new products etc. In addition, we have found that FP have had a profound impact on the overall Norwegian R&I quality and competitiveness as well as R&I policy development and European policy coordination - both which can have long-term impact on innovation and productivity.

Participation shall contribute to improved social welfare and more sustainable social development through research and innovation that enable us to deal with major societal challenges

This is arguably the most all-encompassing and thus challenging of the four objectives and the one where the evidence of achievements is the least convincing. This is likely in part for methodological reasons, since we rely on project participants' assessments and it is natural that they are guarded when it comes to assessing the contributions of their projects to addressing such complex issues and challenges. Having said that, the evidence indicates that FP projects have contributed somewhat to improved social welfare, to more sustainable social development and to dealing with major societal challenges, but the impacts appear minute. However, a recent evaluation found that collaborating at large scale and at European level makes it possible to collectively address complex societal challenges. (European Commission, 2017b).

Participation shall help to develop our own research and innovation sector, both through further development of policies and instruments and through new patterns of cooperation across national borders, sectors and fields.

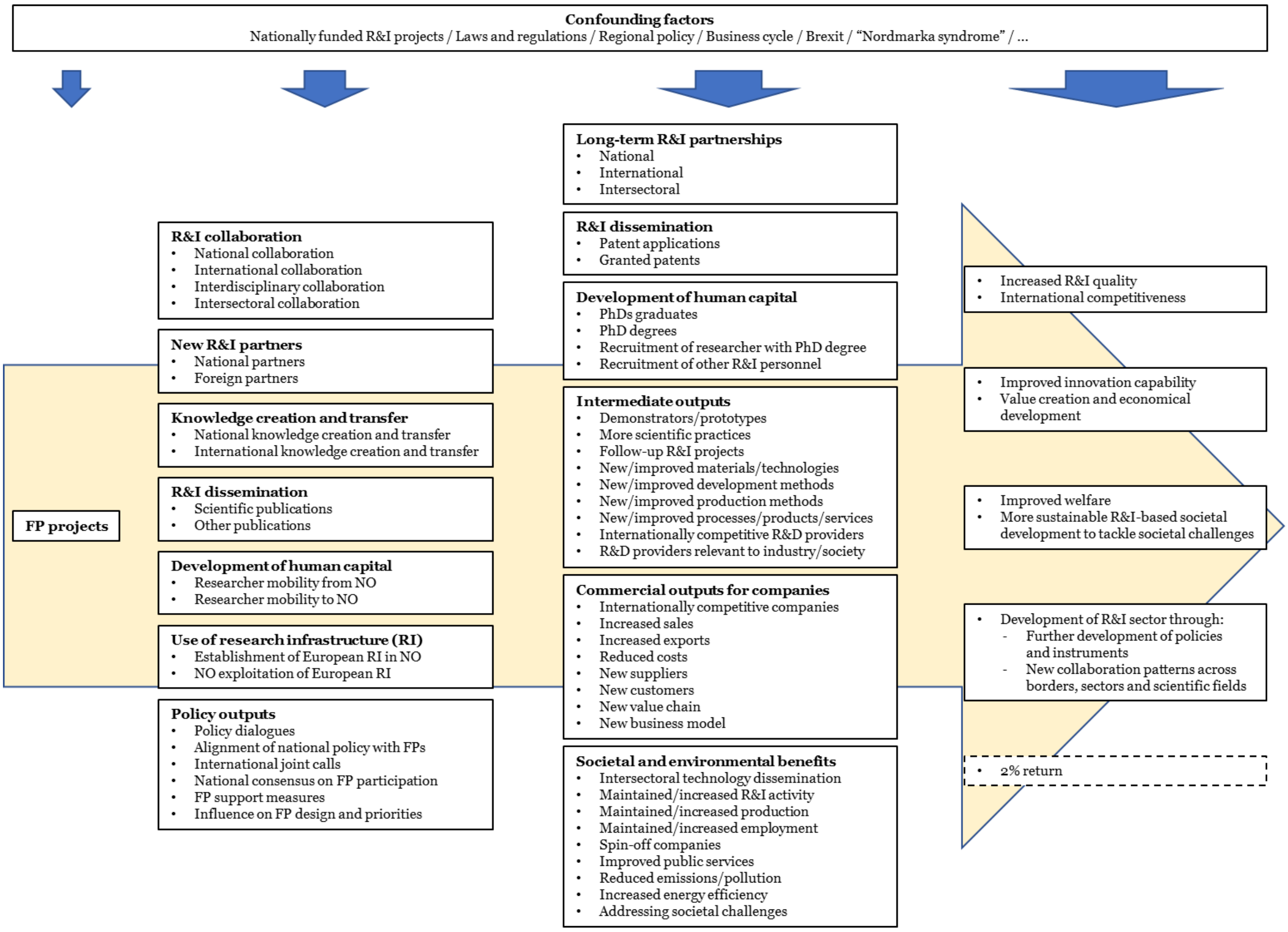
Our findings show that the Norwegian R&I sector has benefited tremendously from the country's FP association, mainly through the expansion of participants' international networks, through accessing internationally leading R&I and infrastructure, and through international benchmarking that fosters quality improvements. Norway's FP association has over time had a profound impact on the national policy dialogue, on national R&I priorities, on national R&I programmes and even on RCN's organisation and application assessment criteria. Although H2020 has left a significant mark on Norwegian priorities, it is also clear Norway has been able to influence some FP priorities. FP participation has become an integral part of Norwegian R&I policy and RCN has proposed that Ministry of Education and Research should increase its ambitions for participation in Horizon Europe – from level that only a few years ago seemed overambitious.

Having come thus far in our reasoning, we are ready to finalise the third stage of the impact logic, see

Figure 5.19. While the government's objectives to varying degrees have been achieved and can be inferred from the results and impacts of the impact logic, the impact logic needs to be complemented with other aspects that one way or another clearly have influenced developments leading up to the objectives. We call such aspects "confounding factors" and the ones added are by no means a complete listing of relevant factors. Perhaps we should have introduced confounding factors from the onset since they influence the emergence of results and impacts as well; however, there is no doubt that they become more important with time (as indicted by the wider arrows to the right). For example, it is straightforward to argue for a direct cause–effect relationship between most FP projects and international

collaboration, whereas the relationship between the same FP projects and improved innovation capability is considerably more complex and clearly influenced by a number of confounding factors, including RCN and IN projects, market demand, competitors etc. We can therefore only conclude that Norway's FP participation has *contributed to* fulfilment of the government's objectives. This version of our impact logic is in harmony with the Commission's impact logic for the entire H2020 (at EU level), meaning that if we view the Commission's impact logic through a national lens the impacts are broadly the same (European Commission, 2017a).

Figure 5.19 Final impact logic.



Source: Technopolis.

6 Cost-benefit assessment of FP7 and H2020

We have documented that FP participation contributes to the objectives defined in the Norwegian strategy for R&I cooperation with the EU (Norwegian Ministry of Education and Research, 2014). In the cost and benefit analyses (CBA) we assess whether the identified benefits for Norway outweigh the cost of association or whether similar benefits could have been realised without FP association.

We compare FP association with the baseline scenario of rather channelling the Norwegian direct cost of FP association to national instruments. As an alternative to FP7 and H2020 participation, Norway could have chosen to do “nothing”, spend the EU participation fee on something else (health, education, defence etc.), or spend the participation fee on other R&I instruments. We have used the latter as the baseline scenario, as the option of spending the funds on national R&I instruments is relevant in terms of contributing to the fulfilment of the government’s objective of increased R&D spending[45].

We have undertaken the assessment by comparing the costs and benefits of FP participation with a baseline scenario of rather channelling the Norwegian direct cost of FP participation to the Research Council of Norway (RCN).

As mentioned in section 1.2.1, also other innovation agencies fund R&I. Web surveys and interviews indicate that the RCN is the most relevant alternative to FP funding for most participants. The RCN is the relevant alternative for R&D providers, which account for about two-thirds of FP funding. Web surveys and interviews indicate that RCN, but also SkatteFUNN and Innovation Norway arealternative sources of public R&I funding to companies. Interviews with policy makers support the reasoning that the RCN is the most relevant alternative to FP association, and we therefore use RCN as the baseline. The implications of our methodological approach are discussed throughout the report and in our final remarks (chapter 8).

Another option for Norway is to rather spend Norway’s financial contribution to the FP budget on national instruments, but with intensified efforts to engage and exploit existing or new multi- or bilateral international research and innovation programmes and agreements. The Framework Programmes are unique and stand alone in the world in terms of scale, duration and budgetary framework stability (European Commission, 2017a) and there is no obvious alternative programme for Norway. The implications of using a baseline scenario in which the RCN is given the role of increasing international collaboration in national instruments is tested in the sensitivity test.

[45] The Norwegian Government wants to increase R&D appropriations to 2 per cent of GDP; see Meld. St. 7 (2014-2024): Long-term plan for research and higher education 2015–2024. R&D appropriations as a share of GDP were 1.54 in 2007 and 1.93 in 2015. Source: R&D statistics bank, NIFU.

In the assessment, the FP and RCN are treated as distinct instruments. But this is obviously an over-simplification as both consist of a broad portfolio of instruments. These portfolios are not static, either, but change over time.

We do not see this as matter for great concern, as we are particularly interested in identifying the differences between the FPs and RCN because these define what value-added the FP participation brings to the portfolio of R&I instruments available for Norwegian participants, and thus to Norwegian society.

In quantifying the costs and benefits of FP association, we use actual figures when these are available. For the baseline scenario, all costs and benefits must be estimated. We use historic RCN figures where they are available. Costs and benefits are shown in 2018-NOK and presented on a gross basis.

Costs and benefits that cannot be monetised are discussed and summarised using a qualitative discussion of the benefits and costs for Norway. In the assessment, we also test for uncertainty and identify the distributional implications.

The CBA is conducted in accordance with the Norwegian Government Agency for Financial Management (DFØ)'s guidance on cost-benefit analysis (2018) and the Ministry of Finance's circular R-109/14, "Principles and requirements for the preparation of a socio-economic analysis etc.".

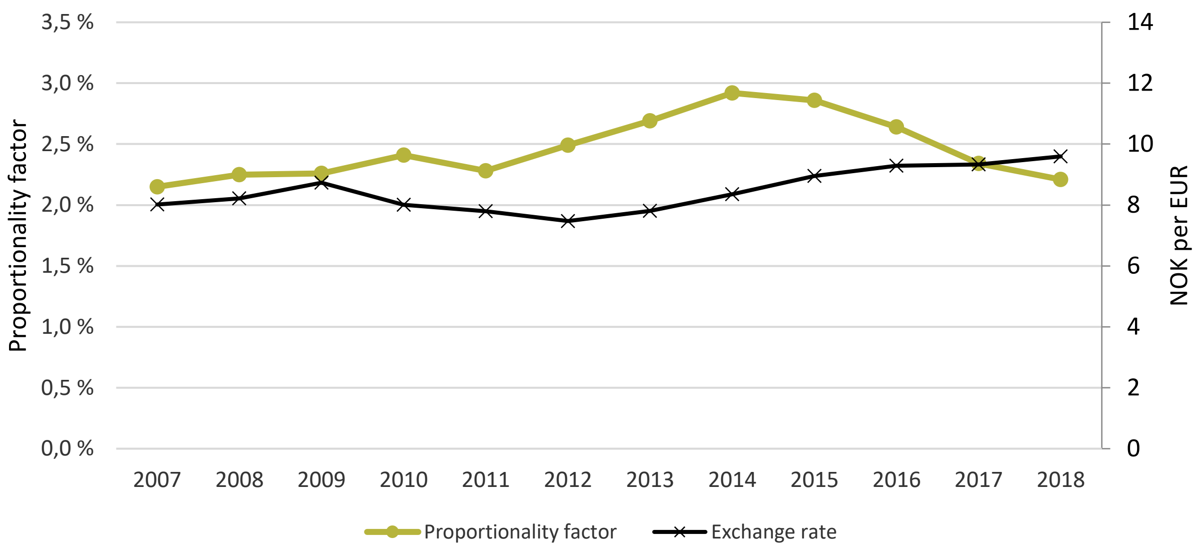
We start by assessing costs and benefits before assessing sensitivity and redistributive effects.

6.1 Cost of FP association

6.1.1 Participation fee

The FP budget is subject to political negotiation at European level. For associated members like Norway, which are not formally represented in these negotiations, the question is whether to participate or not, and Norway commits to paying its share of the programme for the entire 7-year period. The Norwegian participation fee is based on the Norwegian economy's relative size compared to that of the members of the European Union measured in terms of GDP (*the proportionality factor*), the exchange rate and the total FP budget. During the assessment period, the Norwegian proportionality factor has fluctuated between 2-3 per cent; see Figure 6.1.

Figure 6.1 Norwegian proportionality factor (left axis, in per cent) and exchange rate (right axis, in NOK)



Source: Ministry of Education and Research

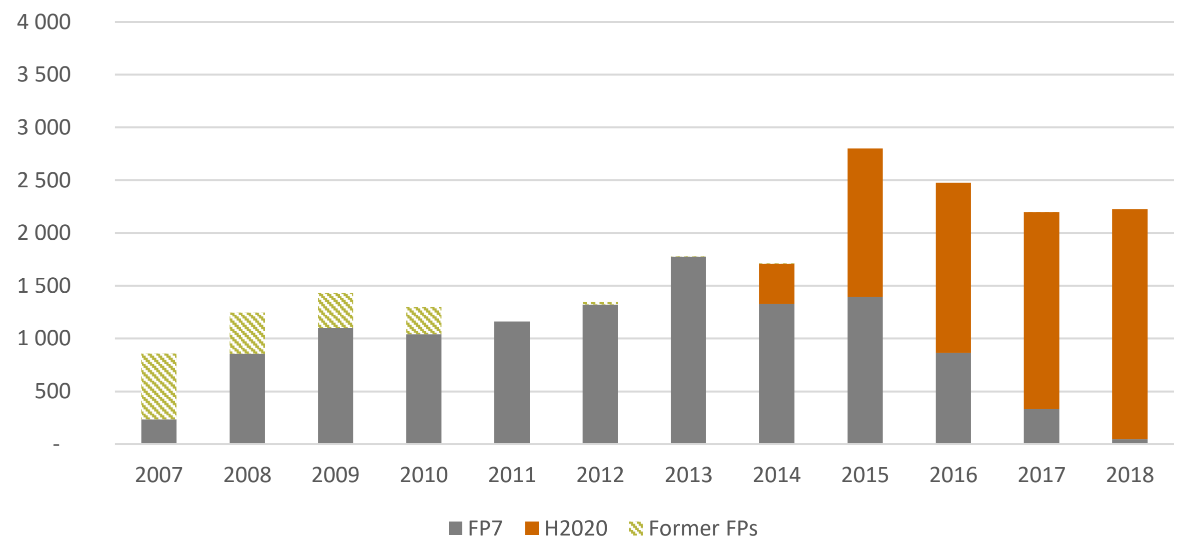
Whereas the programme and commitment period is 7 years, actual payments (and returns) are spread over a longer time period. For FP7, about 96 per cent of the return has been allocated over a 14 year period. The actual participation fee for Norway is recalculated annually, using the updated proportionality factor (based on GDP data two years before) and the expected programme cost each year covering both administrative cost and competitive funding pay-outs. The actual fee is further adjusted two years later for pay-outs that are larger or less than expected (the *outturn*).

The actual participation fee reflects changes in the proportionality factor (relative changes in Norway's GDP compared to that of the EU), currency fluctuations and the fact that actual costs are lower or higher than planned.

The total fees for participating in the FPs in the years 2007 and 2018 are shown in Figure 6.2. The fee for participating in both FP7 and H2020 was a total of NOK 19.3 billion, corresponding to an average fee of NOK 1.6 billion (measured in 2018-NOK). This amount does not cover fees for participating in FP6, which are marked as shaded in Figure 6.2 as FP6 is not the subject of this CBA.

The fee varies from year to year, but there has been an upward trend. The fee has risen since 2007 for several reasons; first, due to increased activity (i.e. implementation of FP7 and later H2020) and an increase in the total budget (H2020 is about twice the size of FP7; see Figure 2.1). Further, costs rose because of an increase in the proportionality factor (particularly high in 2014 and 2015) but have since then fallen. The "benefit" of a decline in the proportionality factor in 2017 and 2018 was largely offset by a weakening of the Norwegian krone.

Figure 6.2 Norwegian participation fee. In millions 2018-NOK. 2007-2018.



Sources: Samfunnsøkonomisk analyse AS, Norwegian Government Agency for Financial Management (DFØ) and Ministry of Education and Research

Note: FP fee includes fee of participating in EIT

In the baseline scenario we hypothetically channel the entire funding of NOK 19.3 billion to national instruments for R&I administrated by RCN (raising total funding from RCN by about 13 per cent). In addition, in the baseline scenario we also channel the cost of STIM-EU. STIM-EU is a measure to stimulate research institutes to participate in the FPs but can also be seen as co-funding for research institutes aimed at compensating for a lower share of funding in the FP than in national instruments. In the baseline scenario, such a cost would have to be allocated to national funding in order to maintain the same level of R&I activity. Table 6.1 summarises all FP cost elements, the baseline scenario, and the difference between the two. We do not include Norway's share of non-competitive funding as a cost for Norway.

6.1.2 Administration and mobilising activities

Application-based R&I instruments require resources for evaluating applications and reporting, but also for mobilising and coordinating activities.

In the case of FP, the FPs costs of programme administration are covered by the participation fee[46]. but Norwegian ministries, RCN and Innovation Norway, as well as R&D providers and industry organisations, dedicate resources to mobilising and following up on FP-related activities. Based on interviews with different stakeholders, we have estimated these annual costs as being equivalent to 50 full-time employees and NOK 20 million in direct costs (i.e. IN and RCN representation in Brussels) in 2018.

Labour costs are estimated using the average salary of public administration employees of NOK 594 300 per year[47] and overhead costs of 21 per cent. The costs of mobilising and following up on FP related activities are estimated at NOK 50 million in 2018.

Interviews indicate that resources used for FP mobilisation and coordination in Norway have risen gradually during the assessment period, driven by the ambition to increase Norwegian participation in the funding instruments and policy fora. Given the lack of actual figures, we have assumed an annual reduction of 2 per cent in such costs over the entire assessment period (corresponding to approximately NOK 40 billion in 2007). The cost of mobilising and coordinating the FP is estimated at NOK 554 million over the entire assessment period.

RCN and IN also administer various economic instruments aimed at mobilising and encouraging FP participation. The most important measures are PES and EU advisory services in Norwegian clusters. Funding amounts to a total of NOK 1.2 billion for the entire assessment period according to reporting from the various agencies[48]. The costs of instruments aimed at mobilising and encouraging FP participation have risen gradually during the evaluation period and are considered by many to be an important explanatory factor for the recent increase in Norwegian FP participation.[49]

Channelling R&I funding through national instruments would entail administrative resources for RCN. According to the RCN's annual reports and interviews, administrative costs represent about 8 per cent of total R&I funding. In the baseline scenario we assume that the marginal cost of administration declines and estimate administrative costs at 5 per cent of R&I funding, totalling NOK 1 billion over the entire assessment period.

We assume that the additional RCN funding would not have required additional administrative resources from Norwegian ministries.

[46] The EU's administrative costs or the FP are taken from the total FP budget and thus covered by the Norwegian participation fee. EU administrative costs correspond to approximately 8 per cent of the total budget (European Commission, 2011).
[47] Statistics Norway: Table 11536
[48] Samfunnsøkonomisk analyse AS' database of R&I instruments covers 2007-2018, but with respect to the RCN only 2007-2017
[49] See for example Åström et al. (2018).

The differences between the FPs and the baseline scenario regarding administration, coordination and mobilisation costs reflect the additional cost of international coordination and mobilisation for Norway and, conversely, the benefits of only having to mobilise and follow-up on one national R&I agency.

6.1.3 Cost of taxation

The participation fee, but also the public costs of mobilisation and administration in Norway are financed through taxes. The amount is distortive, meaning that the social costs associated with the public funding exceed the government's direct costs. To adjust for the efficiency loss of tax financing activities, we have added a cost of taxation equivalent to 20 per cent in accordance with the Ministry of Finance's circular R-109/14, "Principles and requirements for the preparation of a cost-benefit analysis." The cost of taxation consists of participation fee, STIM-EU, funding for mobilising and advisory services and measures.

6.1.4 Writing proposals

The FPs are highly competitive, and applicants spend significant resources on writing proposals. Time spent on writing proposals as well as the costs of FP participation (see Figure 6.3) could be spent alternatively and represents additional costs for society. Such cost applies both the FPs and to the RCN.

Interviews and web surveys indicate that writing an FP proposal is more resource-demanding than writing RCN proposals, but how much time each applicant spends on preparing an application varies widely.

Interviews and web surveys undertaken as a part of this evaluation reveal that whereas some FP participants spend a couple of weeks writing proposals, others spend months and even years.

FP and RCN participants were asked about the time spent on writing proposals in the web surveys. The average time spent on writing an FP application was 450 hours for project coordinators/project leaders and 200 hours for participants. A small number of projects which reported very high resource use bring up the average time spent. The median time spent is therefore somewhat lower: 300 hours for project managers and 100 hours for project participants; see Figure 6.3 each FP projects has on average 1.6 participants for which we assume 1 project leader and 0.6 project participants.

Given the labour cost of NOK 426 per hour (including social costs)[50] and that the cost of writing an FP application is estimated to be NOK 176 000.

We have used the actual number of applications submitted by Norwegian participants, taken from eCorda, (21 473 in all over the entire assessment period) to estimate the total cost of writing FP

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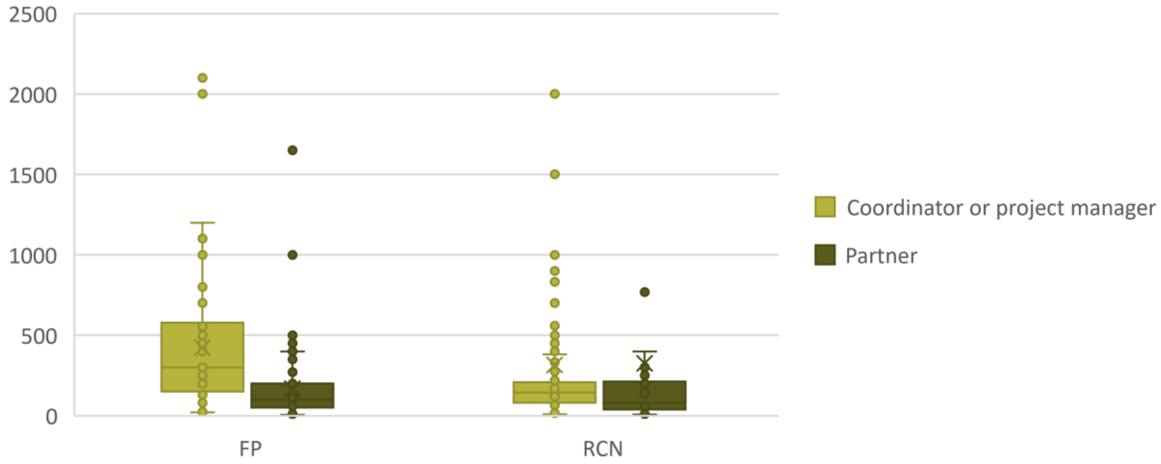
[50] The cost per man-year is based on the annual wage of scientific and technical employees (Statistics Norway: Table 11417) and overhead costs equivalent to 21 per cent of wages.

applications. We make no distinction between successful and unsuccessful applications. Over the entire assessment period, the cost of writing FP applications totalled NOK 1.1 billion.

Figure 6.3 Time spent on writing applications. Hours.



Source: Technopolis Web survey

Note: In the survey, respondents were asked to estimate the total number of hours spent on preparing the proposal. Responses were processed manually. Where respondent answered "approx. 100-150 hours" we have used the average of 125 hours.

In the baseline scenario, participants also spent resources on writing applications. Interviews and surveys indicate that resource use is higher for an FP application than for an RCN application. The median resource use reported in the web survey was 145 hours for project coordinator / project manager and 80 hours for a project partner; see Figure 6.3.[51]

How many new proposals would an increase in national R&I funding generate? In 2017, the RCN received 4 815 proposals equivalent to 496 proposals per NOK 1 billion of R&I funding. On the one hand, we could assume that additional funding would not affect the number of applications, but merely lead to an increase in the average project size, or that projects with a lower score would be awarded funding. On the other hand, an increase in R&I funding might also have a mobilising effect. For example, the RCN could introduce new (and additional) instruments that encourage new project ideas and/or new participants and partnerships. Potential participants might also be more likely to apply for funding if they believed that funding was more accessible.

[51] Our findings are in line with those of Samfunnsøkonomisk analyse AS (2018).

We assume that additional funding has such a mobilising effect, but that the marginal effect of mobilisation is declining. In the same way as for administrative costs, we assume that additional funding generates half as many new proposals as in 2017, i.e. NOK 1 billion of additional funding generates 248 new proposals.

RCN projects also includes participants, and from Samfunnsøkonomisk analyse database on R&I instruments we have found that an RCN projects has on average 2.7 participants. For the sake of simplicity, we assume that RCN proposals include the project manager and two partner who spends half as much time as the project manager. Thus, the cost of writing an RCN proposal is NOK 127 000 (about 50 000 less than an FP application).

The cost of writing RCN applications is estimated to be NOK 637 million, which is approximately NOK 0.5 billion less than for the FP through the entire assessment period.

We expect many prospective participants to start preparing a FP application, but fail to submit it. This will also be the case for RCN applications. We do not know how many FP and RCN applications there are, or if they are systematically different. We have therefore not included such costs for either FP or the baseline scenario.

6.1.5 Participation costs

There are also participation costs for a FP project, e.g. for reporting, accounting and co-funding. Both the web surveys and interviews point to such cost being higher for FP than for national projects.

Based on the web surveys, median resource use to be 150 hours per FP project (over the lifetime of a project which totals to NOK 90 000 per FP project. Over the entire assessment period, we estimate these costs to be about NOK 244 million.

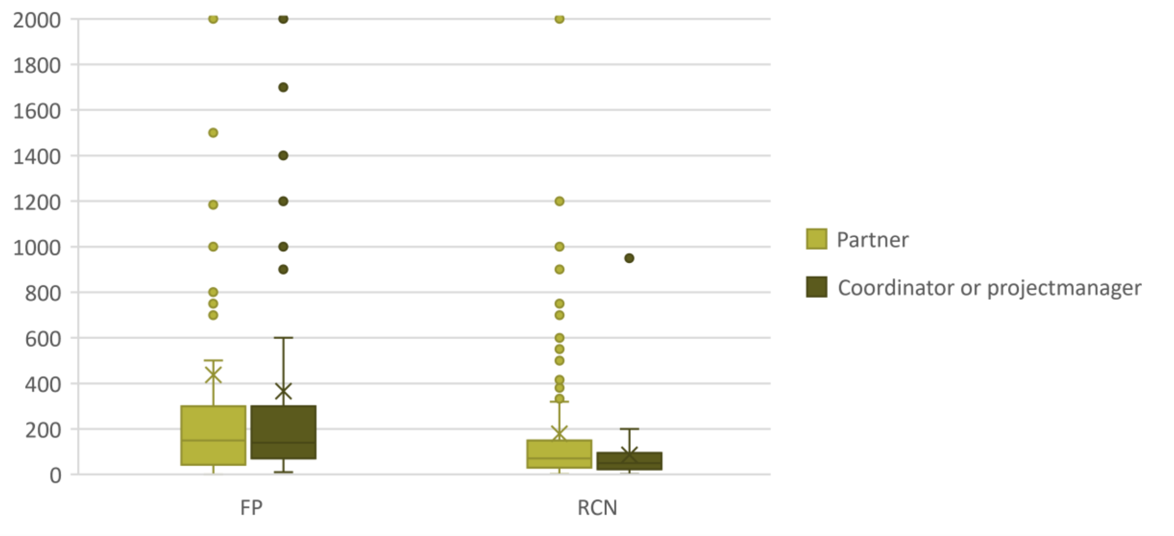
Participants also spend resources on reporting to the RCN. As in the case of applications, we do not know how many new projects additional funding would generate. In 2017, the RCN had 5 441 projects in its portfolio i.e. 560 projects per NOK 1 billion of funding. Following the same reasoning as before, we assume that the increase in funding would increase the number of projects, but by only half as many as in 2017.

From the web surveys we found that time spent on reporting to the RCN is 70 hours per project. Assuming the same labour costs as before and the same number of participants (1.6 Norwegian participants in an FP projects and 2.7 in a RCN project), the costs of reporting in the baseline scenario amount to

60 000 per project. In total this leaves us with NOK 347 million in 2018-NOK[52] which is slightly more than for FP participation.

The small difference in the costs of project reporting between the FP and the baseline scenario reflect the fact that while FP reporting is more time-consuming, there are more R&I projects to report on in the baseline scenario. R&I activities in Norway are higher in the baseline scenario than in the FP which largely off-set by each FP project being more time-consuming with regards to reporting; see next section on benefits.

Figure 6.4 Time spent on reporting. Hours.



Source: Technopolis Web survey

Note: In the survey, respondents were asked to estimate the total number of hours used for preparing the proposal. Responses were manually processed. Where respondents answered "approx. 100-150 hours" we have used the average of 125 hours.

In both the FP and the RCN, project participants must cover some of the project costs with their own funds. The financial requirements vary across programmes, sectors and time see chapter 3. In practice, however, all participants in R&I projects usually receive some public funding – with substantial differences in funding levels depending on the type of participant, instrument and funding agency. According to the eCorda data, the total size of a H2020 project is 27 per cent larger than the funds applied for, and

[52] In FP, total R&I funding in Norway is NOK 12.3 billion and NOK 19.3 billion in the baseline, see section 6.2

we assume that costs not covered by FP funding are covered privately (as in-kind, private investment etc).

We have no such figure for either FP7 or the RCN. Therefore, we apply the same rate of co-funding to both (27 per cent), and test for various assumptions in section 6.4. The cost of co-funding is lower for FP than in the baseline scenario, as FP generates less R&I activities in Norway.

When assessing publicly funded R&I programmes, induced co-funding is regarded as a positive consequence of an R&I instrument, in that the instrument increases research activities in excess of public funding. In a cost-benefit analysis, such private sector investment is seen as a cost for R&D providers and companies (and Norway), as such resources cannot be used for other value-adding activities. However, such costs could bring benefits for the participating institutions, as well as for Norwegian society later; see the next section on benefits.

The cost of co-funding is estimated at NOK 3.3 billion in the case of FP and NOK 5.2 billion in the case of RCN, resulting in a difference of 1.9 NOK billion. The difference reflects that the baseline scenario generates more R&I activities in Norway; see the next section on benefits.

6.1.6 Non-monetised costs

FP association may entail costs that cannot be monetised. As mentioned, the FP participation fee is subject to change throughout the programme period due to changes in the proportionality factor and currency fluctuations. This means that the ministries might have trouble in budgeting the costs, leaving them with reduced budgetary flexibility for other initiatives compared to the baseline scenario. However, we do not judge this cost as having been of great magnitude for Norway for the past decade, and such costs are therefore not included in the table.

In principle, national instruments can be assumed to be more suitable for building competencies and capacity in areas of strategic importance to Norway, whereas the FP is suitable for enhancing European policy goals. With much attention being paid to increasing Norwegian FP participation, one might fear that the Norwegian R&D providers put too much effort into subjects and research questions that are of little strategic interest to the Norwegian public and private sectors and as a consequence do not have the capacity to respond to national needs or absorb spillover effects. The general view amongst informants is that FPs in general cover research questions and areas of strategic importance to Norway, as Norway faces many of the same challenges as Europe. Such costs are therefore not included in Figure 6.1.

6.1.7 Total cost of FP association

The total cost to Norway of FP association (2007-2018) is estimated at NOK 31 billion. The participation fee and the cost of taxation make up most of the cost. The FP is slightly more costly to apply for, whereas the cost of co-funding and reporting is higher in the baseline scenario (as this generates more R&I activities in Norway). The difference between the FP and the baseline scenario of 46 million a year, is very small. The figures are based on various assumptions and thus associated with some degree of uncertainty. We test for uncertainties later, but what we take from this is nonetheless that the differences in cost of FP and baseline is minute.

As we seek to identify cost and benefit for Norway, we have not included Norway's "fair share" of FP administrative cost and cost of the JRC, as such costs are born by the European Commission (equivalent to 11.5 per cent of the total budget or NOK 2.5 billion for the entire assessment period).

Table 6.1 Estimated costs of Norwegian FP association, compared to the scenario with national instruments. 2007-2018. In millions of 2018-NOK.

	FPs	***Baseline scenario***	*Difference*	*Average annual difference*
Monetised costs				
R&I investment	19300	20099	-799	-67
STIM-EU	799	0	799	67
Public expenditure on PES2020 and other FP-related instruments aimed at mobilising to FP participation	1263	0	1263	105
Administrative costs for Norway (RCN)		1005	-1005	-84
Administrative cost of following- up, coordinating and promoting FP participation	554		554	46
Cost of taxation	4383	4221	162	14
Applicants' cost of writing applications	1119	637	482	40
Participant cost of reporting	244	347	-103	-9
Cost of co-funding	27662	26309	1353	113
Total cost (incl. co-funding)	30971	31527	-556	-46
Non-monetised costs				
Budgetary inflexibility			*0*	
Capacity to respond to national R&I needs			*0*	

Source: Samfunnsøkonomisk analyse AS

6.2 Benefits of FP association

6.2.1 Return and other redistributions

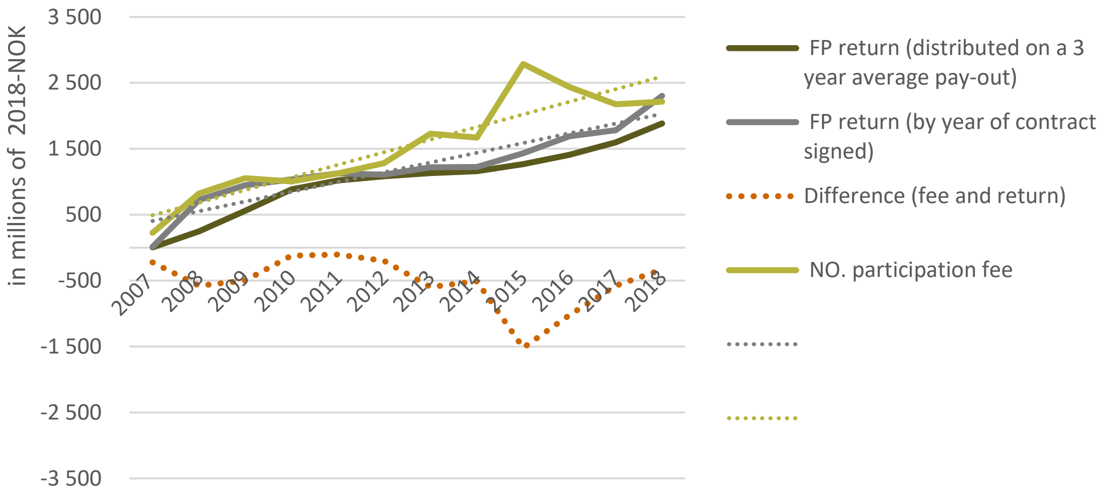
For Norway, FP financial return can be considered "income" and thus a benefit. Norwegian FP funding totalled NOK 14.6 billion in 2018-NOK over the entire assessment period, as already shown in section 6.1. Financial return as reported in eCorda and used as a basis for calculating the accumulated return as a share of competitive funding (illustrated in Figure 3.1) is calculated in EUR and based on already granted projects allocated to the year in which the contract between the project manager and EC was signed.

As the Norwegian participation fee is based on actual pay-out and we seek to estimate cost and benefit in NOK, we would need to adjust the financial return in the same way. We do not have information on the actual annual pay-out by the EC to Norwegian participants but have information on the total project size and duration of all projects in Samfunnsøkonomisk analyse AS's database on R&I instruments provided by RCN. From these data we have calculated the return in NOK based, on the annual average exchange rate in the year of project being awarded and found that on average an FP project lasts for slightly more than 3 years. We have estimated the accrued return using a 3-year pay-out period. This adjustment does not alter the pattern of the return (FP funding has risen year by year and was particularly high in 2018) but shifts the level of return slightly downwards; see Figure 6.5. FP funding to Norwegian participants may differ slightly from what is reported elsewhere due to fluctuations in currency rates and assumptions with regards to the payment pattern.

The total fee paid during the same period was NOK 19.3 billion, and we have estimated the return at NOK 12.3 billion (NOK 7.0 billion from FP7 and NOK 5.3 from H2020), equivalent to a "cash flow" deficit of NOK 7 billion over the entire period. In H2020, approximately 8 per cent of the FP budget is set aside to cover administrative costs and 5 per cent is set aside for other activities such as the Joint Research Centre. Norwegian participants have recouped all but NOK 4,5 billion of Norway's share of competitive funding during the assessment period.

The difference between financial return and fee was particularly high in 2015, which was a year of high fees (due both to extensive FP activity, but also to a relatively high proportionality factor) but rather low Norwegian participation. There might be many possible reasons for the low rate of return in the first years of H2020. Interviews suggest that inadequate assessment of project "impact" in the proposals, unfavourable condition for research institutes and engagement in non-competitive international consortia to be possible explanations. The deficit has subsequently been reduced. Over the entire assessment period, participation fees have risen more sharply than returns, as indicated by the linear trendlines.

Figure 6.5 FP fee and financial return. In millions of 2018-NOK. 2007-2018.



Source: Samfunnsøkonomisk analyse AS, eCorda, RCN

As discussed in section 6.1 the cost to Norway of FP association is not limited to the participation fee. Nor are benefits limited to the FP funding.

FP participants in research institutes can also receive STIM-EU funding to partly cover their R&I project costs. STIM-EU can be viewed as redistribution by the Norwegian state (RCN) to Norwegian participants, in the same manner as Norwegian R&I funding in the baseline. This funding is thus included as a benefit in that the net cost to Norway is merely the cost of taxation (20 per cent). Compared to the baseline, the net cost of STIM-EU is zero.

R&I funding in Norway is similarly included in the baseline scenario, to enable a comparison of the two. However, it should be borne in mind that funding for Norwegian R&I activities is a fiscal cost like traditional investment, with the potential to benefit Norwegian firms and society in the future. In a CBA, the net cost to Norway is the cost of taxation and funding to foreign participants.

For the past decade, about 99 per cent of RCN funding has been channelled to Norwegian beneficiaries[53]. We do not know how the funds would have been distributed in the absence of FP, but we assume that the RCN would have striven to include international participants to a greater extent. We have therefore assumed that 4 per cent of the funding would have been used for R&I activities outside Norway,

[53] Samfunnsøkonomisk analyse AS' database of R&I instruments

whereas the remainder would have been used in Norway to fund research. Total R&I funding (i.e. benefit) is then NOK 19.3 billion (7 billion more than for the FP).

For the past few years, the FPs have generated less R&I activities *in* Norway than the baseline scenario. The total worth of R&I funding in Norway is higher in the baseline scenario (NOK 24.5 billion incl. co-funding) than in the FP case (NOK 16.4 billion incl. co-funding). The relevant question, however, is not the value of research and innovation activities an R&I instrument generates but what benefit this research brings to society.

6.2.2 Private sector benefits

Companies engaging in R&I activities can generate new ideas, and hence new or improved products, which can be exploited commercially (with or without patenting; see sections 4.1 and 5.1) and yields a return for project participants sometime in the future.

As mentioned, we find no statistically significant impact of FP funding compared to either national funding[54] or RCN funding on company income, value added, productivity, number of employees or profit.[55] Our findings are in line with a recent Finnish evaluation of the effects of Finnish participation in the framework programmes (Piirainen, et al., 2018).

We have thus applied the same rate of return to both FP- and RCN-funded R&I activity in the private sector. We apply a rate of return of 8.2 per cent, a life expectancy of 13 years for an innovation and a depreciation rate of 4 per cent, in line with the Ministry of Finance's circular R-109/14 “Principles and requirements for the preparation of a cost benefit analysis”. This yields a return of 82 per cent i.e. an investment of NOK 100 yields a net return of NOK 82. This rate of return and life expectancy are applied to all private sector R&I funding including private co-funding. Again, based on total FP project size, we assume that NOK 100 of R&I support induces NOK 27 of private co-funding. Participation in FP is on average beneficial for companies, as an investment of NOK 27 with an additional NOK 100 of public funding yields NOK 104 on average. Be aware that this is an average rate of return. Some R&I investments will generate far more, whereas others will generate less (or nothing).

We apply the historical distribution of R&I funding to the FP (i.e.24 per cent to the private sector) and the RCN adjusted for the increase in international participation of 4 per cent (i.e. 18 per cent to the private sector).

Private sector return is estimated at NOK 3.0 billion for the FP and NOK 3.7 billion for the baseline scenario and included in Table 6.3.[56] The difference between FP and the baseline scenario is small which is a consequence of FP generating less R&I in Norway but share of R&I private sector is higher

[54] SkatteFUNN, Innovation Norway and the RCN
[55] See section 5.1 and Appendix E for details
[56] Total R&D funding in Norway is higher in the baseline, but private sector participation is slightly lower.

than in the baseline scenario. The estimate is based on our assumptions and relates to a representative collection of firms; private return for single participants may be higher or lower. What follows from our assumptions, however, is that R&I programs that are relevant for private sector participants (thus being closer to market) bring direct benefits to Norway and such benefits increase as private sector participation grows even if total R&I in Norway is lower.

6.2.3 Return to society

Norway benefits both directly and indirectly from increased quality and international competitiveness in the R&D sector. Norway can benefit directly from exports of knowledge products in the same manner as for other products and services. The production and sale of knowledge products to Norwegian firms are considered costs unless they generate higher productivity, reduced costs and greater wellbeing in Norway sometime in the future. However, interviews suggest that exporting products is not a major motivating factor for FP participation by R&D providers, but that participation in FP has a learning and reputational value.

Perhaps, most importantly, Norway benefits indirectly from increased quality and international competitiveness in the R&D sector through spillovers from R&D providers to other parts of society through subsequent collaboration, education, spin-offs etc. Similarly, Norway also benefits from spillovers from private sector to other parts of society through subsequent collaboration, labour mobilisation, spin-offs etc. For example, one discovery at one university or in a company can trigger new research, inspire new research projects or find new applications in other firms, sectors or countries. Another possible external effect of investment in R&I is improved products leading to lower prices, improved utility, health etc. The external benefits of research and development are difficult to monetise but believed to be positive and the main rationale for public investments in R&D[57].

Neither our data nor other national studies can provide insight as to the magnitude of the external effect for Norway and if the external effects differ with regards to source of funding[58]. A variety of international studies on the external benefits of research have been undertaken, but estimates vary greatly across sectors and countries and are very sensitive to data sets and methodological choices[59] indicating that there is not universal social rate of return. For example, Hall et al. (2010) review the literature on R&D return find social return to be substantially greater than private rates of return, but also quite asymmetric among trading partners and industries. Baumol (2002) also argues that the possible spillovers of R&D may *vastly* exceed the private gains, whereas Bottazzi and Peri (2003) study regional spillovers using European panel data and find that positive externalities exist, but that the effects are small.

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[57] See for example DEA (2017) for a litteratur review on the the effects of reserach and innovation
[58] Samfunnsøkonomisk analyse AS attempted to document the external effects of SkatteFUNN econometrically as part of the recent evaluation of the scheme. The team employed “distance to R&D” approach, but the results of this econometric analysis were inconclusive.
[59] See for example Griliches (1998), Hall et.al. (2010) and DEA (2017).

We cannot know whether international findings are relevant for Norway, or whether there are differences with regard to source of funding. We must, however, assume that the social effects from R&D are positive - otherwise Norway would be economically worse off from investing in R&I in general. Following the established methodology of CBA, we do not monetise elements that are subject to a high degree of uncertainty. The return on investment in R&D undertaken by R&D providers and the external effects of investing in R&D are thus not monetised in Table 6.3.

6.2.4 Non-monetised benefits

As seen in the previous section, R&I funding to Norwegian participants and private sector benefits are not assumed to cover the cost of participating in the FP. A strict comparison of monetised costs and benefits indicate that net cost of FP association is negative, as is for RCN and for R&D instruments in general see Table 6.3. This follows from both FP and RCN first and foremost target the R&D sector and as we have not monetised return to society. Public funding to R&D largely relies on the assumption of R&D investments bringing positive effects to society. Rather than elaborating on the benefits of investment in R&D as such, we focus on the difference between the FPs and the baseline.

Chapter 3.5 includes a detailed analysis of the benefits of participating in the FPs. This section summarises and underlines the benefits by focusing on the identified differences between the FP and the baseline scenario.

Increased learning and competence building

R&I investment fosters R&I capacity building through the undertaking of R&I activities (*learning by doing*), but also indirectly through project cooperation and other knowledge sharing activities (*learning from others*). Web surveys indicate that the FPs leads to more international, interdisciplinary and intersectoral collaboration than national instruments. Norwegian companies and researchers benefit from being part of international consortiums of highly ranked researchers and innovative companies and other partners[60], which allows for validation, benchmarking and questioning of current practice and methods.

As mentioned earlier, four out of five web survey respondents (companies and R&D providers) answer that they assume that FP projects provide them with greater opportunities to enhance the organisation's international competitiveness, and more specifically to monitor the international state of the art, to import knowledge and technology, and understand other cultures than national instruments do.

Through FP participation, Norwegian participants gain access to more knowledge and R&D infrastructure than in the baseline scenario. Project size varies greatly, but FP projects are generally larger than RCN projects in terms of funding. For example, the median size of a Norwegian participant's share of

[60] Studies have found that research consortia in FP often include institutions with high scores on conventional indicators of academic success and persistently high success in EU framework programmes (NIFU, 2016).

an FP project is about 5 times the average size of an RCN project; see Table 6.2. FP projects are generally also larger than IN and SkatteFUNN projects, whereas Enova projects tend to be very large (see appendix E).

Table 6.2 Value to Norwegian participants in thousands of 2018-NOK. Co-funding is not included.

	Max	Average	Median
FP7	64 053	3 373	2 269
H2020	244 675	4 693	2 672
RCN	133 356	1 278	732

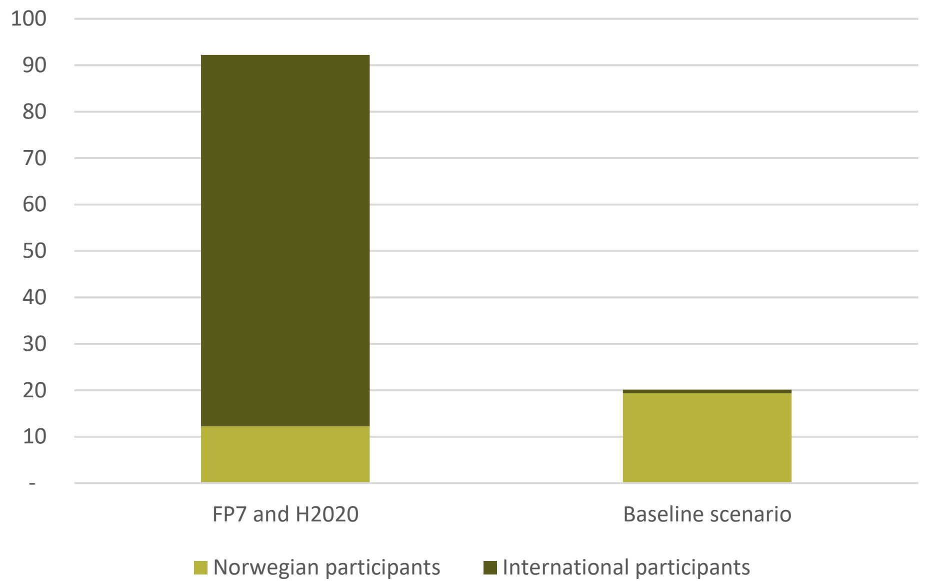
Source; Samfunnsøkonomisk analyse AS, eCorda
Funding per observation (participant and project). Only covers grants and not institutional funding to research institutions, network activities, STIM-EU or PES, or funding from Enova instruments categorised as energy efficiency.

Further, and more importantly, FP projects typically involve more partners and the total value of all FP projects that Norwegian organisations participate in extends far beyond the funding share of the Norwegian participants. H2020 projects with Norwegian involvements includes on average 18 international partners (eCorda), whereas an RCN projects on average include 2,7 project members, predominately from Norway (Samfunnsøkonomisk analyse AS database on R&I instruments[61]).

The total value of FP funding to projects with Norwegian involvement is about 7.5 times higher than the Norwegian funding share; see Figure 6.6, in which we have included the total value in NOK of FP projects and the total value of alternatively channelling funds to national instruments. Although we cannot expect Norwegian participants, or other parts of the Norwegian community, to absorb and benefit from all the knowledge generated in all FP projects, it does indicate that the accessible pool of knowledge and R&I infrastructure is significantly larger in the case of FP participation than in the baseline scenario. Through FP projects, Norwegian participants gain access to more knowledge and R&I infrastructure than through national instruments, including knowledge and R&I infrastructure not available in Norway.

[61] Average cross projects in 2017. Only covers grants and not institutional funding to research institutions, network activities, STIM-EU or PES, or funding from Enova instruments categorised as energy efficiency.

Figure 6.6 Value in millions of 2018-NOK of research to Norwegian and international participants in projects with Norwegian involvement. Co-funding is not included.



Source; Samfunnsøkonomisk analyse AS, Technopolis, eCorda
Note: Funding for R&I in Norway is based on R&I generated in Norway (excl. co-funding). Funding for R&I internationally in the FP case is based on the total size of projects with Norwegian involvement. See appendix E for further details.

Learning i.e. the process of acquiring new, or modifying existing, knowledge and skills, is a driving factor for innovation and productivity[62] and the development of society[63], and just as we assume the learning effect of participating in a FP funded projects to be stronger than for the baseline scenario, we assume that the impact on R&I quality, innovation and productivity is greater.

Learning is cumulative, in that knowledge acquired can be utilised later or on other R&I questions and processes. The same applies to participation in FP projects. Previous studies (e.g. NIFU, 2016) and our findings demonstrate that participation in one project might lead to future cooperation (with or without FP funding), because of both the personal links and the reputational effect of FP projects. The learning and networking effect of FP participation can thus prevail long after the lifetime of an FP project and FP programme.

In the absence of FP association, Norwegian participants could participate in single FP projects on a third country basis, but according to our informants such participation is more difficult to organise. One can also expect that in the absence of FP, Norwegian policy makers and RCN would have to strive to

[62] See e.g. Thune et. al. (2011) for a literature review on learning and competence building
[63] See e.g. Stiglitz (2015) The Learning society

increase international collaboration in national instruments or to set up multi- or bilateral research agreements. According to our informants, such a strategy could also prove difficult in practice. We therefore assume that the accessible pool of knowledge, R&I infrastructure and international consortia and impact on learning would be significantly reduced in the absence of FP association.

We judge the benefit for Norway to be significant and conclude that not participating in the FPs could have a long-term impact on learning. This benefit is marked + in in Table 6.3.

Enhanced quality in the R&D sector

Data collected as part of this evaluation largely indicate that FP association increases R&D collaboration and exposes participants to international competition to a greater extent than national instruments. Consequently, increased quality and competitiveness in the R&D sector can spillover to other parts of society, as already earlier discussed. Enhanced R&I capacity and quality means that Norwegian R&I suppliers contribute to a greater extent to the global pool of knowledge. Benefit for Norway depends not only on the level of international R&I competitiveness, but also on the research's relevance for Norwegian society, on the ability of R&I systems to transfer new knowledge and technology and on absorptive capacity in Norway.

We judge the benefit of enhanced capacity and quality in the R&D sector to be positive for Norway, even if the impact in monetary terms for Norway is highly uncertain. This benefit is marked + in Table 6.3.

Access to international markets

Web surveys and interviews suggest that FP projects expand international collaboration to a greater extent than national instruments, and CIS data indicate that FP participants in general are more internationally oriented than participants in national instruments.

Extension of international collaboration may prove useful for subsequent FP association, but may also provide immediate and long-term benefits to Norway in terms of exports. Participating in FP projects and related activities can further serve as a gateway to the European market, which is Norway's largest and most important trade area[64]. Although gaining access to suppliers and customers does not seem to be the main motivating factor for many FP participants, it is important for one in five FP participants. The interviews suggest that gaining access to customers and suppliers is particularly important for companies with international ambitions, international start-ups (*"born globals"*), companies active in global value chains and/or companies operating in markets with entry barriers (e.g. defence and health). We consider the benefit of FP association on exports to be greater than the benefit in the baseline scenario,

[64] Over the period 2007-2018, exports to EU countries accounted for 66-68 per cent of Norway's mainland exports on an annual basis (and 88-82 per cent of all exports). Table 08800 (SSB)

even if we cannot monetise the benefit[65]. In the absence of FP association, Norwegian R&D providers and companies would lose an important channel for international cooperation and possible future exports.

The economic benefit of gaining access to international markets is difficult to monetise, but we judge the effect for Norway to be positive. This benefit is marked + in Table 6.3.

Access to R&I instruments not available in Norway

We have not evaluated single FP instruments nor carried out detailed mapping of the extensive FP and RCN portfolios. FP covers instruments that overlap those available nationally, but even when measures are similar, the evaluation panel and competition differ, allowing for diversification in the portfolio of instruments available to prospective Norwegian participants. Through the FP, Norwegian participants also gain access to different R&I instruments from those available in Norway. For example, H2020 includes the InnovFIN SME Guarantee Facility which make it possible to increase the scale of IN lending instruments. Moreover, firms can access funds that are significantly larger (either in scale or share of funding) than those available through Norwegian instruments which, according to the interviewees, enables more rapid commercialisation, demonstration and development of prototypes. By means of SME instruments, H2020 also provides participant access to advisory services and international investors, which can help companies to attract more funding and to scale up innovation and commercialisation activities (Samfunnsøkonomisk analyse AS, 2019). As a reminder, Norway has done well in the SME instruments.

The FP also allows countries to bundle R&I funds in large R&I infrastructure projects. Norway's participation in the H2020 Research Infrastructures subprogramme indicates that Norwegian organisations are well integrated in the exploitation and hosting of European research infrastructure. Participation in R&I infrastructure projects is not merely a sign of relative quality but means that Norwegian R&I players have access to R&I infrastructure which can allow for further contributing to solving national and international challenges also in the future.

Not participating in the FP would deprive Norwegian participants of access to instruments not available in Norway and of opportunities to strengthen their position in the European R&I system. The economic benefit of diversification at instrument level is difficult to monetise, but we judge the benefit to be positive. This benefit is marked + in Table 6.3.

[65] Data on exports are not available in the accounting data and thus not tested for in the econometric analysis.

Contribution to policy innovation, development and coordination

Our analysis has also documented that FP association gives Norwegian policy makers and innovation agencies access to European policy arenas and fora, which makes benchmarking, knowledge sharing and policy innovation possible. Over time, Norway's FP association has had a profound impact on the national policy dialogue, national R&I priorities and even on the RCN's organisation and application assessment criteria. Norway has also been able to influence FP priorities. We assume that this has impacted national R&I policy and society in a positive way.

Informants also point out that FP association gives Norwegian policymakers access to arenas and fora that allow for policy coordination and international knowledge-sharing on other policy issues (e.g. energy, transport, health). Such benefits are considered by many interviewees to be particularly important because Norway is not an EU member.

European FP (or FP-related) policy arenas would not be open to Norway in the absence of FP association, and interviews indicate that it is reasonable to expect that it would be more difficult (and sometimes even impossible) to also include Norway in other European R&I-related policy arenas, as the FP is becoming increasingly intertwined with other EU programmes. Several informants and this assessment largely rely on FP participation data (eCorda data), as indicators of Norwegian R&I quality across time and relative to other countries. A practical consequence of not participating in Horizon Europe is that Norwegian policymakers will lose valuable data that enable benchmarking used in national R&I policy development.

We judge the benefit for Norway to be significant. This benefit is marked + in in Table 6.3.

Development and distribution of solutions to improve welfare and solve societal challenges

The FP is designed to improve social welfare and to deal with major societal challenges, but so are national instruments administered by RCN. Neither interviews with project participants nor the web surveys indicate that FP projects contribute to a greater extent than RCN projects. The web survey indicated that FP projects perform slightly better with regard to energy efficiency and climate change, but this finding could have been altered if projects with IN or Enova funding were included.

H2020's focus on societal challenges means that its overall project portfolio complex societal challenges on a large scale and at European level to be addressed. We have found that FP projects tends to be larger and the web survey indicates that FP fosters international, interdisciplinary and intersectoral collaboration and technology transfer to a greater extent than RCN instruments. The FPs also make European policy coordination possible and address complex issues by experimenting with R&I instruments and testing new ways to involve stakeholders. One can thus expect the FPs to be better positioned and able to contribute to solving complex societal challenges than national instruments. Interviews and other studies[66] support this reasoning. We judge the benefits to be positive, but highly uncertain.

Increased innovation and productivity

Web surveys and interviews indicate that FP are better suited to increasing international collaboration, commercialisation, competitiveness and export than RCN measures, but econometric analysis cannot verify any significant difference between FP and RCN participants with respect to company performance up until 2018. Our interpretation is that although the immediate impact of an FP project on company performance is equal to that of an RCN project, FP project participation fosters international collaboration and R&I competence and solutions as well as learning in the wider sense, which with time may be commercially valuable.

Analyses of innovation statistics indicate that FP companies are slightly more innovative and internationally oriented than RCN companies. We cannot document whether FP participation makes these companies more innovative and/or internationally oriented, or whether they were already more innovative or internationally oriented prior to FP participation. This tells us, however, that the FPs foster reallocation of R&I resources towards highly innovative and internationally competitive companies, with the potential to increase productivity with time.

Such benefits do not only apply to project participants, but may spill over to other parts of the Norwegian economy through labour mobility, collaboration, spin-offs etc. The Norwegian private sector may also benefit both directly and indirectly from gaining access to European markets, policy development and coordination as well as from increased capacity, quality and competitiveness in the Norwegian R&I sector.

We judge the benefit to Norway to be significant. This benefit is marked + in Table 6.3.

6.2.5 Total benefit of FP association

Table 6.3. summarises monetary and non-monetary benefits. Non-monetary benefits are marked as +. The total benefit of FP association (2007-2018) is estimated to be NOK 16 billion, whereas the total benefit in the baseline scenario is NOK 23 billion. The difference between the FP and baseline scenario is NOK 6 billion during the entire assessment period or NOK 0.6 billion on an annual average. The difference between the FP and baseline scenarios is mainly due to FPs generating less R&I activities *in* Norway.

[66] See for instance European Commission (2017b)

Table 6.3 Benefits of FP association, baseline participation and the difference between the two. In millions of 2018-NOK. 2007-2018

	FPs	***Baseline scenario***	*Difference*	*Average annual difference*
Monetised benefits				
Funding for R&I (in Norway)	12255	19327	-7072	-589
Funding for STIM-EU	799		799	67
Business return on investment in R&D	3059	3618	-559	-47
Societal return on investment in R&D	N/A	N/A	N/A	N/A
Total benefit	16113	22945	-6832	-569
Non-monetised benefits				
Capacity building and learning			+	
Access to R&I instruments not available in Norway			+	
Access to international markets			+	
External effects of quality increase in the R&D sector			+	
Policy innovation, development and coordination			+	
Development and distribution of solutions to societal challenges			+	
Innovation and productivity			+	

Source: Samfunnsøkonomisk analyse AS

6.3 Benefits outweigh costs of FP association

Given our assumptions, the total cost of FP association for Norway in the period 2007-2018 was 31 billion 2018-NOK, the same as if investment had been in national R&I instruments instead. The total benefit of FP association (2007-2018) is estimated to be NOK 16 billion whereas the total benefit in the baseline scenario is NOK 23 billion. The net cost of FP association is 6 billion less than for national instruments, or NOK 0.5 billion annually on average. The net cost of FP association mainly reflects FP bringing less R&I funding in Norway.

As discussed in the previous chapters, we assume that the learning and network effect (and thus impact on productivity and well-being) is higher for FPs than for national instruments, and that the effects will prevail long after the lifetime of a FP project (and the Framework Programme itself). Other non-monetary benefits of FP association also included access to knowledge, policy fora and R&I infrastructure that are not available in Norway. In our view, the non-monetary benefits are significant and when accounting for the significant non-monetised benefits, we judge that participation in FP7 and H2020 (to date) to has been very beneficial for Norway (i.e. exceeding the net cost of FP association compared to baseline scenario of NOK 0.5 billion per year).

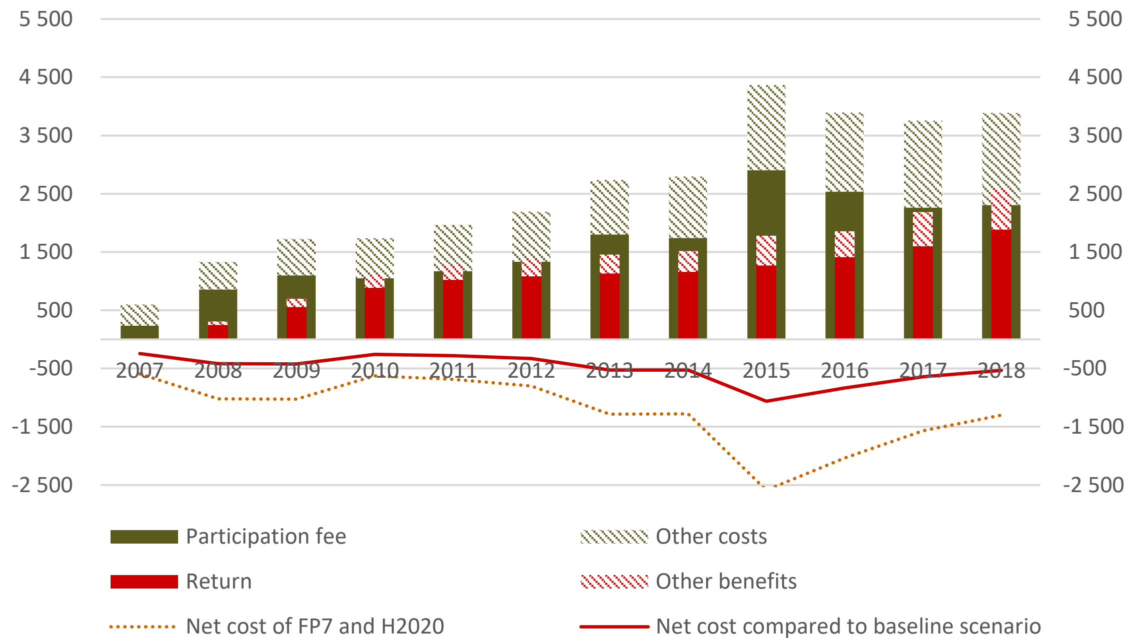
Table 6.4 Estimated costs and benefits of FP association. In millions of 2018-NOK. 2007-2018.

	FPs	***Baseline scenario***	*Difference*	*Average annual difference*
Monetised costs and benefits				
Total cost (incl. co-funding)	30971	31527	-556	-46
Total benefit (incl. redistribution)	16113	22945	-6832	-569
Net cost	-14858	-8583	-6276	-523
Non-monetised costs and benefits				
Budgetary inflexibility			0	
Capacity to respond to national R&I needs			0	
Capacity building and learning			+	
Access to R&I instruments not available in Norway			+	
Access to international markets			+	
External effects from quality increase in the R&D sector			+	
Policy innovation, development and coordination			+	
Development and distribution of solutions to societal challenges			+	
Innovation and productivity			+	
Preferred alternative	***1***	***2***		

Source: Samfunnsøkonomisk analyse AS

Figure 6.7 illustrates annual monetised costs and benefit elements and the net cost of the FPs compared to the RCN. The figure illustrates the magnitude of the participation fee relative to other cost elements, and similarly to the return and other monetised benefit elements. Costs and benefits are based on estimates and the numbers do not perfectly reflect the net cost of FP association in a particular year. The financial return has been adjusted to reflect the periodisation of the participation fee, whereas the cost of administration and mobilisation is included according to the year of activity. The figure nonetheless illustrates that both monetised costs and monetised benefits rose during the assessment period and that the increase in financial return seen for the past three years has reduced the net cost of FP association compared to the baseline scenario. It should be borne in mind that the figure does not include non-monetised benefits which is assumed to be significant.

Figure 6.7 Monetised costs and benefits of FP association. In millions of 2018-NOK. 2007-2018.



Source: Samfunnsøkonomisk analyse AS

6.4 Sensitivity test

We have used actual figures in the cost-benefit assessment where they were available, but we have had to rely on estimates for many cost and benefit elements. It is thus useful to do a sensitivity analysis to examine how the net cost is affected by variations in our assumptions.

We test for various assumptions regarding monetised costs and benefits such as the RCN's administrative costs, co-funding, private sector return on investment in R&I and FP funding to Norwegian participants. The sensitivity test illustrates the isolated impacts of various cost and benefit elements on the net cost of FP association compared to the baseline scenario. We have not considered dynamic effects or what is required to alter the assumptions. Findings are shown in Figure 6.8 as average amounts in NOK per year to enable comparison with the sensitivity analysis undertaken as a part of the CBA of Horizon Europe (chapter 7).

We have altered the RCN's assumed administrative costs to 2 per cent as compared to 5 per cent (referred to as alternative 1 in Figure 6.8) and 8 per cent as compared to 5 per cent (referred to as alternative 2). The former represents a hypothetical case in which the RCN is very effective in allocating the additional funding. One way of doing this is to merely increase the funding to awarded projects. This represents a hypothetical case in which the RCN spends relatively more administrative resources, for example on designing completely new R&I instruments, on increasing stakeholder involvement or mobilising international participants in RCN projects.

Changes in assumptions about administrative cost do alter the net cost of FP association compared to the baseline scenario, but not substantially.

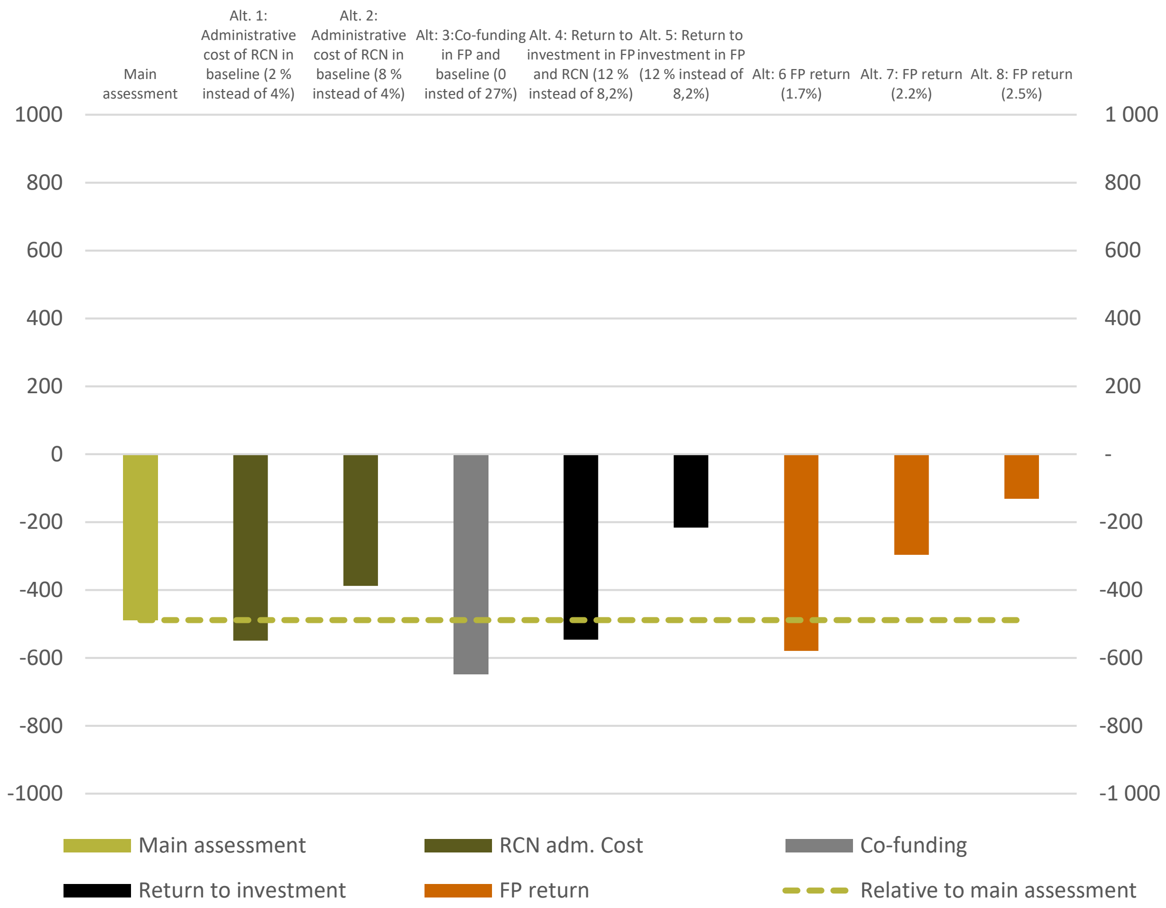
We have also varied the degree of co-funding reported in eCorda. The ability of FP and RCN instruments to trigger co-funding follows partly from the financial requirements but is also an empirical question. In the main assessment, we have applied the same level of co-funding in both the FP and the baseline scenario (27 per cent). In this section we have estimated the net cost of FP association if neither the FP nor the RCN leads to any additional co-funding (referred to as alternative 3 in the figure). Altering the level of co-funding affects both cost and benefit elements. As R&I in Norway is slightly higher in the baseline scenario, lower co-funding reduces the profitability of the FP scenario compared to the baseline scenario but only to a moderate degree.

The return on R&I investment is clearly uncertain. In the main assessment we have used a rate of return of 8.2 per cent per year. Alternative 5 illustrates the impact when the rate of return is higher (12 per cent) in both the FP and RCN. Altering the net rate of return on a company's R&I investment has a minimal impact on net costs. In an alternative scenario in which we assume that the learning effect of FP participation increases the return on investment (12 per cent instead of 8.2 per cent) for FP projects, but not for the RCN, will improve the profitability of FP association.

FP financial return noticeably impacts profitability. In the main assessment we have used actual FP return, but for comparison we have also tested for the alternative in which FP return was 2.2 per cent over the entire assessment period (in line with the current accumulated return in H2020 and referring to alternative 6) and 1.7 per cent (in line with actual return in FP7 and referring to alternative 7). A return of 2.8 per cent would have made participation in the FP7 and H2020 (to date) equally cost effective as the baseline (alternative 8).

The sensitivity analysis illustrates that net cost is sensitive to changes in our assumptions, but the impact on net cost is still very moderate compared to the total costs of FP association (NOK 30 billion). The sensitivity test also illustrates the obvious fact that the FP return for Norwegian participants is the most important element. From a cost-benefit perspective it makes sense for Norway to strive towards a "decent" return.

Figure 6.8 Sensitivity analysis. Net cost of FP compared to baseline scenario. In millions of 2018-NOK. Average annual difference 2007-2018. Only monetised costs and benefits.



Source: Samfunnsøkonomisk analyse AS.

6.5 Distributional consequences

Governmental policies often have important *redistributional* consequences. Whilst some participants may benefit from a policy, some may become worse off, even if the net effect is zero.

Schemes implemented to enhance R&I obviously entail a redistribution from “all” (through taxation) to the recipients of the funding. This applies to the FP as well as to national R&I instruments, where funding is redistributed from companies (and individuals) not undertaking R&I activities to those who do.

Both FP and RCN funding are accessible to all applicants, but instruments are application-based (as opposed to “neutral” rights-based instruments such as SkatteFUNN). In the case of the FP, decisions on funding are left to the European Commission, whereas for national instruments, decisions are left to the RCN (governed by national priorities).

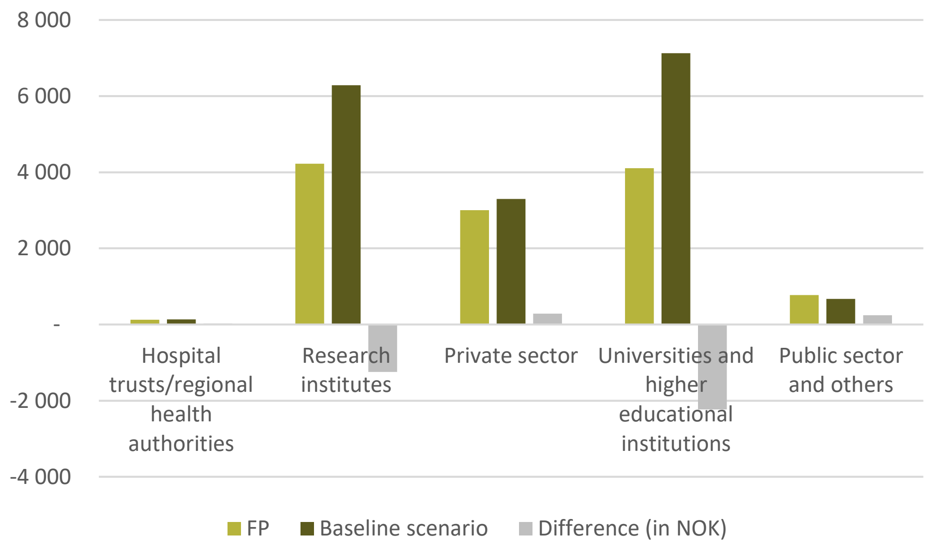
The number of applicants is greater for the FP than for national instruments, which, all else being equal, increases competition. In theory, it is possible for all FP funding to be awarded to participants outside Norway.

Based on actual return in 2007-2018, total funding (in NOK) from the FPs to Norwegian participants (12.3 billion 2018-NOK) is lower than that in the baseline scenario (19.3 billion 2018-NOK).

We do not know how funds would have been distributed in the baseline, but comparing sectoral distribution of FP funding with the historic RCN distribution (2007-2017) reveals that the private sector has "gained" from FP association whereas higher education institutions and also research institutes have "lost" from FP association (see Figure 6.9).

At institutional level, FP companies and R&D providers are generally larger and more frequently located in the Oslo metropolitan area and the Trøndelag than RCN companies. FP firms are generally slightly more innovative and internationally oriented than RCN participants. An isolated effect of FP association is thus reallocation of funding to companies and R&D providers with these characteristics. The distributional consequences are amplified for R&D providers, as part of the institutional funding is contingent upon international income.

Figure 6.9 Distributional consequences. Total funding for R&I activities. In millions of 2018-NOK. 2007-2018



Source: Samfunnsøkonomisk analyse AS.

7 Cost-benefit assessment of Horizon Europe

In the previous chapter we presented our cost-benefit analysis (CBA) of the seventh and eight framework programmes. In this section we present our CBA of the ninth framework programme, Horizon Europe. As previously, we estimate economic costs and benefits for Norway and use national R&I instruments as the baseline scenario.

In quantifying the *ex ante* costs and benefits of FP association, all costs and benefits must be estimated. Costs and benefits are shown in 2018-NOK.

The assessment is undertaken at a time when the final budget and instrument design of Horizon Europe have yet to be agreed upon. We must thus rely on current expectations and experiences drawn from the previous FPs. Also, national R&I measures are inclined to change. The Norwegian Ministry of Trade, Industry and Fisheries has initiated an in-depth analysis of the organisation of Norwegian R&I policy and the aftermath of this work may bring about changes in the national R&I system.[67] And as earlier mentioned, RCN has just recently started using the same application evaluation criteria that are used by the Commission, and made organisational changes to improve the connection between research and innovation in order to contribute to a renewal of both the Norwegian R&I system and society at large.

Our analysis is based on interviews undertaken in the spring of 2019, written information available in the autumn of 2019 and findings from the CBA of FP7 and H2020.

We start by assessing costs and benefits before assessing sensitivity and redistributive effects.

7.1 Costs of FP association

A budget of EUR 94.1 billion was proposed by the European Commission in June 2018. The final budget may be altered in the on-going negotiations. The European Parliament has proposed increasing the overall budget (to EUR 120 billion), whereas the British withdrawal from the EU and the determination of several countries to protect the EU's cohesion budget funding development in poorer regions point rather to the final budget being lower (Wallace, 2019). In the CBA we assume the budget to be EUR 94.1 billion in current prices, but test for a higher and lower budget in the sensitivity test.

The EEA has estimated that the proportionality factor for Norway for 2020 will be 2.66 per cent if the UK is excluded and 2.27 if the UK is included (Norwegian Ministry of Education and Research, 2019). The latter proportionality factor applies for the final years of H2020 as the UK has already agreed on this FP. In the CBA of Horizon Europe, we assume UK will leave the EU, but in the sensitivity test we also investigate the scenario in which the UK participates on similar terms to Norway.

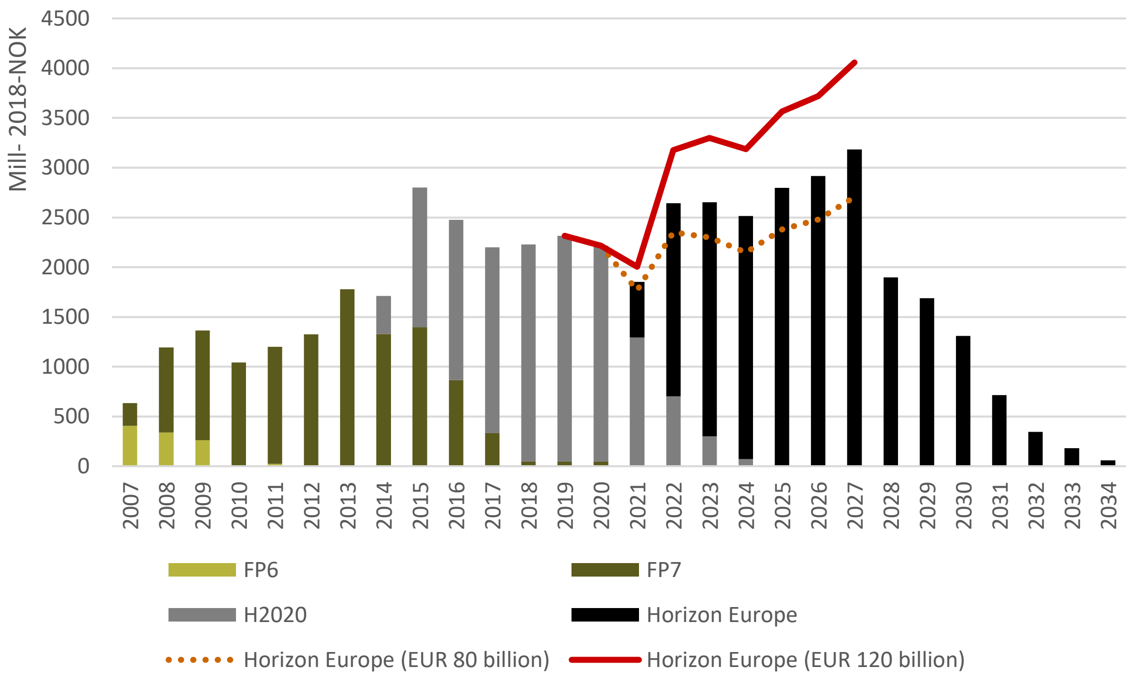
[67] Deloitte (2019) and Norwegian Ministry of Trade, Industry and Fisheries www.regjeringen.no/vmg

The Norwegian participation fee can be estimated at NOK 25.3 billion for the entire programme in nominal prices and 22.3 billion in 2018-NOK assuming an exchange rate of EUR 1 = NOK 10.1 (October 2019) for the entire period and an inflation of 2 per cent.

The commitment period is 7 years, but we expect that payment will follow a pattern like that of FP7 in which 96 per cent of the total funds were allocated during a period 14 years see Figure 7.1. Given our assumptions, the actual fee will continue to increase but growth is estimated to slow from 6.4 per cent annually in the period 2007-2018 (including FP6) to 4.1 per cent annually in the period 2018-2027 and decline thereafter. Given these assumptions, the Norwegian participation fee will increase also in the years to come. We estimate that the annual participation fee will increase to NOK 3.2 billion (measured in 2018-NOK) in 2027. The Norwegian FP participation fee will decline thereafter unless Norway decides to participate in the subsequent framework programme.

In Figure 7.1 the orange line indicate participation fee until 2027 in case on FP being EUR 80 billion (total fee of NOK 21.5 billion) and the red line in case of FP budget being EUR 120 billion (total fee of NOK 32 billion). The actual payment may be either higher or lower than our estimate, given changes in the proportionality factor, which in turn will depend upon the Norwegian GDP relative to other participant countries, currency fluctuations and how FP activities are distributed.

Figure 7.1 Norwegian participation fee. Actual (2007-2018) and estimated (2019-2034). In millions of 2018-NOK. 2007-2034.



Source: Samfunnsøkonomisk analyse AS, European Commission and Norwegian Ministry of Education and Research
Note: The estimated fee for Horizon Europe is based on a Horizon Europe budget of EUR 94.1 million, a stable exchange rate of 1 EUR = 10.1 NOK, a payment period as in FP7 and an annual inflation rate of 2 per cent.

In the baseline scenario we hypothetically channel the entire funding of NOK 22.3 billion to national and NOK 2.2 billion in STIM-EU to the RCN.

In H2020, administrative costs corresponded to 8 per cent of the total programme budget[68]. In the European Commission budget for Horizon Europe, the administrative costs are set at 6.5 per cent. Administrative costs as well as other funds that are not available for competition (5 per cent) are paid for by European Commission and not included as a separate cost element in the CBA for Norway.

Norway's administration costs reflect resources that Norwegian ministries, IN and the RCN use to coordinate, mobilise, implement and report on FP projects and activities. We assume that such costs grow with increasing R&I funding and we have utilized the ratio between such cost elements and total R&I in 2018. In order to account for the EC's simplification efforts and RCN efforts to familiarize Norwegian participants with FP requirements, we assume a scale and learning effect of 10 per cent (applies to writing FP proposals and reporting); see Table 7.1 which summarises all cost elements.

Channelling R&I funding through national instruments would involve RCN administrative resources. In the case of FP7 and H2020, we assume RCN's administrative costs to be 10 per cent but given ongoing efforts to reduce administrative costs also in Norway, we assume RCN administrative costs to be 8 per cent in the coming years. As before, we assume that the marginal cost of RCN administration declines. In the baseline scenario we have thus assumed that the additional funding would increase administrative resources by 4 per cent of the additional R&I funding, totalling NOK 1 billion over the entire assessment period.

The difference between the FP and the baseline scenario regarding administration, coordination and mobilisation costs reflects the additional costs of international coordination and mobilisation and, conversely, the benefits of having to administer and mobilise to an already operating national R&I agency.

In both FP and RCN scenarios, project participants must co-fund some of the project costs. As we do not have information about financial requirements in Horizon Europe, we apply the same rate of co-funding as in the case of FP7/H2020 and RCN (27 per cent). The cost of co-funding is lower in the case of the FP compared to the baseline scenario, as the FP is assumed to generate less R&I activities in Norway (see next section on benefits).

From what we know of Horizon Europe, we expect research topics and questions to be of relevance for Norway. As in the case of FP7 and H2020, we do not expect FPs to limit Norwegian capacity to respond to national R&I needs, as Horizon Europe at large will include instruments and cover issues of relevance to Norway. After a long period of favourable economic conditions and strong growth in public spending in Norway, we expect growth in public spending to be more modest in the years to come. If the FP

[68] As given in the European Commission budget proposal (European Commission, 2011)

budget continues to increase, this will reduce budgetary flexibility even more. We still view this as merely a fiscal issue rather than a cost for Norway but discuss the matter further in our final remark (chapter 8).

The total costs of Horizon Europe are estimated at 38 billion 2018-NOK. The difference from the baseline is negligible. The costs of administration (in Norway) and of writing applications and participating in the FP are not insignificant but represent a relatively small portion of all costs. The FP is slightly more costly to apply for and participate in, whereas the private sector costs of participation (reporting and co-funding) are higher in the baseline scenario, as this generates more R&I activities in Norway.

Table 7.1 Estimated costs of Norwegian FP association. Horizon Europe. In millions of 2018-NOK.

	FPs	***Baseline scenario***	*Difference*	*Average annual difference*
Monetised costs				
R&I investment (Incl. STIM-EU for RCN)	22 397	24 563	-2167	-310
STIM-EU	2 167		2167	310
Public expenditure on PES2020 and other FP- related instruments aimed at promoting FP participation	1 525	-	1525	218
Administrative costs for Norway (RCN)	-	983	-983	-140
Administrative cost to follow- up, coordinate and promote FP participation	494		494	71
Cost of taxation	5 316	5 109	207	30
Applicants' cost of writing applications	1 169	779	390	56
Participant cost of reporting	255	424	-169	-24
Cost of co-funding	4 426	6 367	-1941	-277
Total costs (incl. co-funding)	37 749	38 224	-476	-68
Non-monetised costs				
Budgetary inflexibility			*0*	
Lack of capacity to respond to national R&I needs			*0*	

Source: Samfunnsøkonomisk analyse AS

7.2 Benefits of FP association

7.2.1 Return and other redistributions

As in the case of FP7 and H2020, FP funding and STIM-EU can be regarded as “income” and thus benefits. In the case of FP7 and H2020 we already had information on Norwegian participation and obviously we do not have such information regarding Horizon Europe.

The current stage of the Horizon Europe design process does not allow for an in-depth analysis of the potential for Norwegian participation. However, some observations based on the specific focus of the upcoming FP can be made.

Pillar 1 in Horizon Europe covers instruments for “outstanding research” similar to those in H2020, with European research council (ERC), Marie Sklodowska-Curie Actions (MSCA) and research infrastructure. Norwegian participation in Pillar 1 accounts for a significant portion of Norwegian return in FP7 and H2020 (approximately 20 per cent) and we also expect Norwegian participants to be well positioned to succeed in this pillar of Horizon Europe. A recent study on opportunities and barriers to participation in ERC finds that there are significant opportunities for greater ERC engagement (application and success) in Norway. Kolarz et. al. (2019) have for example found there to be a large pool of researchers with suitable publication track records, a diverse track of prior research grant experience, a range of other research-related skills and experiences (including internationally) and a strong focus on basic science. Many ERC applicants report that they would consider applying again, and many non-applicants also note they would consider applying in the future.

Although the instruments will be different, there will be a strong focus on global challenges and thematic issues in Pillar 2 of Horizon Europe. So far, five mission areas and six clusters have been identified; see Table 7.2 Although much remains to be known with regard to the practicalities, the EU is seeking to combine ground-breaking research and innovation, broad stakeholder involvement and policy innovation to solve “wicked” problems. The identified clusters and missions include themes in which Norwegian participants from all R&I sectors have done well historically (see chapter 3).

Table 7.2 Cluster and missions in Horizon Europe

Cluster	Missions
Health	Cancer
Culture, creativity and inclusive society	Adaptation to climate change including societal transformation
Civil security for society	Healthy oceans, seas, coastal and inland waters
Digital, industry and space	Climate-neutral and smart cities
Climate, energy and mobility	Soil health and food
Food, bioeconomy, natural resources, agriculture and environment	

Source; European Commission

The currently available information suggests that the instruments under Pillar 3 will be quite different from those of H2020. Pillar 3 will focus on breakthrough, disruptive and "deep-tech"[69] innovations. Instruments under Pillar 3 in H2020 will change, and/or be moved to Pillar 2 or even outside of the Framework Programme (see Figure 2.7). For example, phase 1 of the SME instrument, in which many Norwegian firms have participated, will no longer be a part of Horizon Europe. It might be included in other programmes such as COSME (Samfunnsøkonomisk analyse AS, 2019).

We do not see a lack of Norwegian R&I capacity and quality as an obstacle to Norwegian participation in Horizon Europe. As seen from the previous section, registry analysis indicate that Norwegian R&I competitiveness has increased over the past years and Norwegian organisations' competitiveness relative to organisations in other countries has been at least maintained or even slightly improved. The FPs has become an integral part of the R&I policy instruments and work of the RCN, IN and others.

FP funding represents a relatively small share of Norwegian research organisations' total R&I funding, indicating that in general there is sufficient capacity in the Norwegian R&I system. For example, for research institutes and universities in Norway, FP funding only made up 0-5 per cent of all R&D funding (RnD statistical bank, 2019).

All in all, we expect Norwegian participants also to play a role in Horizon Europe. In the CBA we apply a moderate return of 2.2 per cent (equivalent to the accumulated return in the third quarter of 2019), but we also test for higher and lower returns in the sensitivity analysis. The RCN recommends increasing the 'return' target from the current 2 per cent to 2.5 per cent in Horizon Europe (The Research Council of Norway, 2019) and also the FFA (union of research institutes) see potential to increase institute participation.

A return of 2.7 per cent would mean that Norway recoups its "fair" share and 2.8 per cent is needed to make participation in Horizon Europe as beneficial as the baseline scenario (only taking monetised costs and benefits into consideration).

Benefits of Horizon Europe is summarised in Table 7.3.

7.2.2 Return on private sector investment in R&I

R&I activities bring private sector benefits and, as in the case of FP7 and H2020, we apply a rate of return of 8.2 per cent, innovation life expectancy of 13 years and a depreciation rate of 4 per cent, in line with the Ministry of Finance's circular R-109/14 "Principles and requirements for the preparation of a cost-benefit analysis". This yields a net present return of 82 per cent, i.e., on average an R&I

[69] Deep tech refers to cutting edge technologies that are developed on the basis of tangible scientific discoveries or meaningful engineering innovations focusing on addressing complex problems that influence the real world. Deep technologies include such technologies as AI, autonomous systems, robotics, clean tech, etc. The pilot programme under H2020 targeted areas such as micro- and nanotechnologies, artificial intelligence and advanced robotics (Samfunnsøkonomisk analyse AS, 2019)

investment of NOK 100 generates a private sector return of NOK 82 (in net present value). Again, be aware that this is an average rate of return. Some R&I investments will generate far more, whereas others will generate less (or nothing).

This rate of return and this life expectancy are applied to all private sector R&I funding (incl. co-funding equivalent to an additional 27 per cent of public funding) for both the FP and the baseline scenarios.

We do not know how RCN funds will be distributed in Horizon Europe nor in the absence of Horizon Europe i.e. baseline scenario, but we expect that RCN would endeavour to include international participants. As in the cases of FP7 and H2020, we assume that 4 per cent of the RCN funding is allocated to international participants. The RCN increasing focus on innovation may lead to an increase in private sector participation in the baseline scenario in the years to come. In estimating private return, we assume private sector participation in Horizon Europe to be 29 per cent (i.e. same as for H2020 up until 2018) and 22 per cent in RCN (up from 18 per cent in base line scenario of FP7/H2020).

The private sector return on investment in R&D is thus estimated to be NOK 5 billion in case of Horizon Europe and the baseline scenario. The difference is insignificant.

As discussed in chapter 6, we have not monetised return to society in Table 7.3. We must, however, assume that the return on investment for society is positive for both FP and RCN.

7.2.3 Non-monetary benefits

The European Commission highlights that Horizon Europe can be thought of as an “evolution, not revolution” (European Commission, 2018). Many concepts, instruments and themes will remain, and we expect that the non-monetised benefits will be the same as those identified in FP7 and H2020. By participating in Horizon Europe, we expect that Norway will continue to benefit from the expansion of participants’ international networks, through accessing internationally leading R&I consortia and R&I infrastructure not available in Norway.

Horizon Europe will continue to focus on innovation and commercialisation and contribute to solving complex societal challenges (i.e. health, climate, environment). Also with regard to Horizon Europe, the contribution of any single project will be highly uncertain, but we see a risk that by not participating in Horizon Europe, Norwegian research organisations and companies will lose an important arena for international competition and collaboration, and for getting access to and contributing to the development of new technologies and solutions aimed at societal challenges. Compared to the baseline scenario, no FP association could make it more difficult for Norwegian players to act when new market opportunities arise. Further, and perhaps equally important, Norway will lose the opportunity for R&I benchmarking, learning and continued policy learning and European policy coordination.

Table 7.3 Estimated benefits of FP association. Horizon Europe. In millions of 2018-NOK.

	FPs	*Baseline scenario*	*Difference*	*Average annual difference*
Monetised costs and benefits				
Funding for R&I (in Norway)	16 393	23 581	-7187	-1027
Funding for STIM-EU	2 167		2167	310
Business return on investment in R&D	4 944	4 899	45	6
Societal return on investment in R&D	N/A	N/A	N/A	N/A
Total benefit	23 504	28 480	-4976	-711
Non-monetary benefits				
Capacity building			+	
Access to R&I instruments not available in Norway			+	
Access to international markets			+	
External effects of quality increase in the R&D sector			+	
Policy innovation, development and coordination			+	
Development and distribution of solutions to societal challenges			+	
Innovation and productivity			+	

Source: Samfunnsøkonomisk analyse AS

7.3 Norway expected to benefit from Horizon Europe participation

For Norway, the total cost of participating in Horizon Europe is 38 billion 2018-NOK, similar to that in the baseline scenario. The total benefit of participating in Horizon Europe is NOK 23.5 billion, whereas the total benefit of investing in national R&I instruments is NOK 28.5 billion. Net cost of FP compared to that of the baseline scenario is estimated to 0.6 million NOK annually on average.

As in the case of FP7 and H2020, the difference in administrative costs are modest, and the difference is mainly attributable to lower generation of R&I activities *in* Norway. However, FP association brings additional external and quantifiable benefits compared to the baseline scenario. In our view, the non-monetised benefits are significant. Again, we expect the non-monetised effects to be greater than the net cost i.e. to exceed NOK 0.6 billion annually on average.

Table 7.4 Costs and benefits of FP association in Horizon Europe. In millions of 2018-NOK. 2021-2035

	FPs	***Baseline scenario***	*Difference*	*Average annual difference*
Monetised costs and benefits				
Total costs (incl. co-funding)	37 749	38 224	-476	-68
Total benefits (incl. redistribution)	23 504	28 480	-4976	-711
Net cost	-14 245	-9 745	- 4 500	-643
Non-monetary costs and benefits				
Budgetary inflexibility			0	
Capacity to respond to national R&I needs			0	
Capacity building			+	
Access to R&I instruments not available in Norway			+	
Access to international markets			+	
External effects from quality increase in the R&D sector			+	
Policy innovation, development and coordination			+	
Development and distribution of solutions to societal challenges			+	
Innovation and productivity			+	
Preferred alternative	***1***	***2***		

Source: Samfunnsøkonomisk analyse AS

7.4 Sensitivity test

In the CBA of Horizon Europe, we have had to rely on previous experience and estimates, but the future is obviously highly uncertain. It is useful to perform a sensitivity analysis to examine how profitability is affected by variations in our assumptions, as shown in Figure 7.2. The sensitivity tests illustrate the isolated impacts of various monetised cost and benefit elements on net profit. We have not considered dynamic effects or what is required to alter the assumptions. In the figure we have presented the net cost as an annual average (7-year period), allowing, direct comparison with the CBAs of FP7 and H2020.

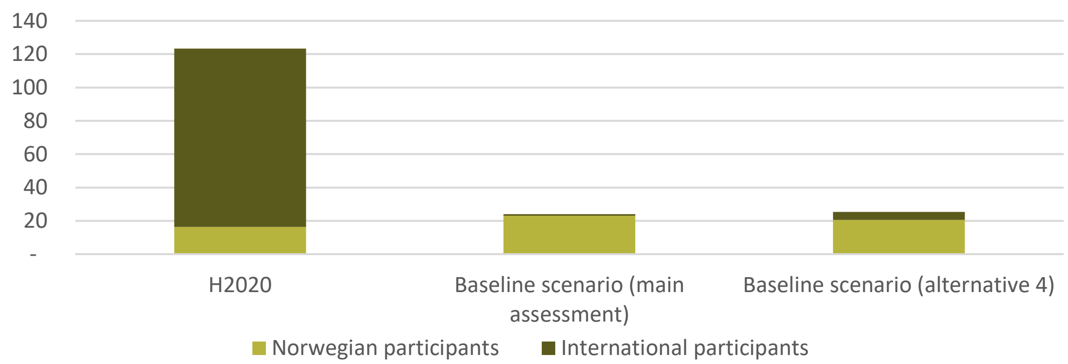
We have varied assumptions about the administrative costs of the EU, currency exchange rates, returns and UK participation.

Financial return is the most important factor for profitability. In the main assessment we have used the most current rate of return (2.2 per cent), but for purposes of comparison we have also tested the case in which FP return is 2 per cent (corresponding to the current strategy objective and referred to as alternative 1 in Figure 7.3) and 2.5 per cent (corresponding to the RCN ambition and referred to as alternative 2). Figure 7.3 illustrates the direct effect on profitability.

We have also tested for changes in assumptions with regard to EU bureaucracy (referred to as alternative 3). In this alternative scenario, the FP's administrative costs are 4 per cent of R&I funding (rather than 6.5 per cent, but still with 5 per cent for JRCs) increasing available competitive funding (assuming that the total budget remains unchanged). In this alternative we also assumed that application and reporting procedures would be simplified, and we include a scale and learning effect of 30 per cent (and not 10 as in the main assessment). Reduced EU bureaucracy would increase returns and reduce costs and thus increase profitability compared to national instruments.

In the sensitivity test for FP7 and H2020 we tested for a scenario in which the administrative cost of RCN was higher, which could reflect the scenario in which RCN had to spend relatively more resources on stakeholder involvement. Another case in which the marginal administrative cost would increase is if the RCN is obliged to adopt the role of administrating various bi- or multilateral R&I agreements and increase international participation in national instruments as an alternative to FP association. It this alternative, referred to as alternative 4 the figure, we assume that the cost of administration of RCN funding increases from 4 per cent marginally to 10 per cent, and that the share of R&I funding to Norwegian participants declines from 96 per cent to 88 per cent, reflecting that 20 per cent of the national funding is assigned to foreign participants. In such a scenario FP is more cost efficient than the baseline. Further, the total project size in which Norwegian participants participate would still be much larger than in the baseline scenario; see Figure 7.2.

Figure 7.2 Value in billions 2018-NOK of research to Norwegian and international participants in projects with Norwegian involvement. Main assessment and sensitivity (alternative 4). Total for duration of Horizon Europe.



Source: Samfunnsøkonomisk analyse AS, Technopolis, eCorda

Note: Share of FP funding to foreign participants, based on experience from FP7 and H2020. For the baseline scenario, international participation is assumed in RCN funded projects is to be 4 per cent of the Norwegian R&I funding. For the alternative scenario (alternative 4), international participation in RCN instruments is assumed to be 15 per cent of R&I funding.

Changes in the proportionality factor and exchange rate will also have a direct effect on the participation fee. We have recalculated the net cost of FP association if rather using an exchange rate of 1 EUR=9 NOK (alternative 5) and EUR 1=NOK 12 (alternative 6). Weakening of the krone would increase the participation fee, but also the return in NOK to Norwegian participants. If the rate of return is lower than the proportionality factor, as it has been in the past, the net cost for Norway is merely the cost of taxation of the difference. If the rate of return is higher than the proportionality factor, Norway benefits from a weaker kroner, and vice versa.

So it is with regards to the proportionality factor. As long as the Norwegian return rate (2.2 per cent as of March 2019) is lower than the proportionality factor (2.66 in EU27 and 2.27 in EU28), the isolated effect on an increase in the proportionality factor and/or weakening of the krone will be that FP association will become less favourable compared to national instruments (considering monetised costs and benefits), and vice versa.

For example, the proportionality factor will decrease in case of UK participation, if the UK participation mean cost-sharing and not an overall increase in the FP budget. UK participation will reduce the Norwegian fee and increase profitability, assuming no change in the rate of return (alternative 7), reflecting the fact that more countries will share the total FP budget.[70] However, it must be expected that UK membership will affect UK participation and Norwegian rate of return (all else being equal). In the second UK scenario (alternative 8) we have adjusted the rate of return by the relative difference between the EU27 proportionality factor and the EU28 proportionality factor[71] from 2.2 to 1.9 per cent. In this scenario, the net cost of FP association will be slightly improved. The reason is that Norway will benefit (purely in terms of costs and benefits that can be monetised) from any changes due to lowering the Horizon Europe budget or Norway's proportionality factor, as long as the rate of return is lower than the proportionality factor.

A higher proportionality factor will increase participation fees, and without a similar increase in return, the net cost of FP association will worsen. Nonetheless, given the non-monetised benefits, FP association may still be worthwhile. It is also important to bear in mind that a strong increase in the proportionality factor reflects a situation in which the Norwegian economy grows faster than the EU Member States. For Norway, the isolated effect of an increase in GDP must be considered beneficial and outweigh any "cost" increase in the FP participation fee.

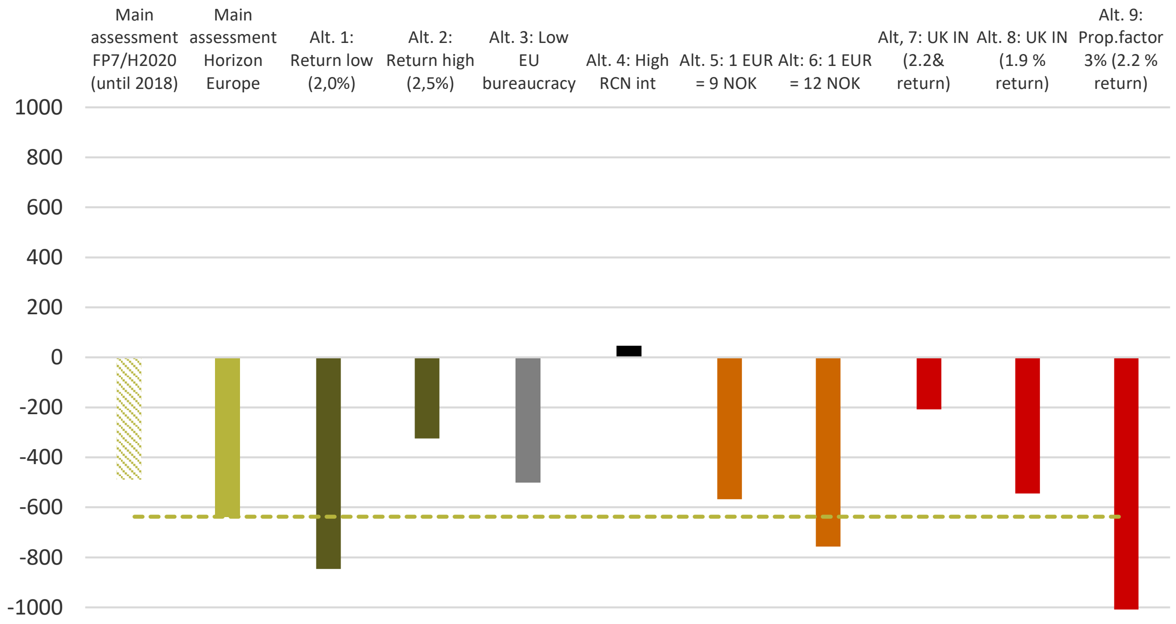
[70] For simplicity, we have assumed that the total budget of Horizon Europe remains at the same level, irrespective on the number of associated countries.
[71] A proportionality factor of 2.66 and financial return of 2.2 per cent in the case of the UK not participating, and a proportionality factor of 2.27 and financial return of 1.9 in case of UK participation.

We would thus argue that with regards to the FP association, changes in the proportionality factor and exchange rate is first and foremost of budgetary relevance.

Assuming that STIM-EU is merely funding aimed at compensating for the difference in funding condition between FP and RCN – lowering or increasing STIM-EU will have no major impact on the net cost of FP. The cost of STIM-EU is seen as important factor in increasing Norwegian institute participation. We have not included dynamic effects of changes in STIM-EU on Norwegian FP association and thus return, but rather point to the recent evaluation of the mobilisation instruments.[72]

The sensitivity analysis illustrates that net cost is sensitive to changes in our assumptions, but the net cost is still moderate compared to the total costs of FP association and the non-monetised benefits as is not included. Any changes in the form of a "simplification" of the FPs that brings down time spent on administration, application and reporting lowers the net cost of FP association compared to baseline scenario and any changes in order to increase international participation in national measures would on the contrary improve net cost of FP participation compared to the baseline. The sensitivity test also illustrates the obvious fact that the FP return for Norwegian participants is the most important element.

Figure 7.3 Sensitivity analysis. Net cost of FP compared to baseline scenario. In millions of 2018-NOK. Annual average Horizon Europe. Only monetised costs and benefits.



Source: Samfunnsøkonomisk analyse AS.

[72] See Åström et. al. (2018)

7.5 Distributional consequences

As in the cases of FP7 and H2020, Horizon Europe will have distributional consequences compared to the baseline scenario. As we have applied the same sectoral distribution as in the case of FP7/H2020, the private sector will "gain" from FP association whereas higher education institutions and also research institutes will "lose" as a result of FP association compared to the baseline scenario. At institutional level, distributional consequences are amplified for R&D providers, as some of the basic funding is assumed to continue to be contingent upon international income. The distributional consequences could, however, prove to be quite different. As mentioned, the RCN is seeking to improve the connection between research and innovation with the consequence of increased private sector participation in RCN instruments.

8 Final remarks

Norway became associated with the FPs through the EEA agreement, which entered into force on 1 January 1994. The FPs are essentially public R&I instruments aimed at promoting R&I in order to build capacity and to increase research quality, productivity and well-being. The FPs are unique in terms of scale, duration and budgetary framework stability (European Commission, 2017a). The overall budgets have increased but the Horizon Europe budget is still subject to negotiation.

For associated members like Norway, the question is whether to participate or not. Norway's financial contribution to the FPs is calculated based on its GDP and is paid in cash. The fact that the cost is explicit, and the financial contribution is growing has contributed to a clear policy focus on making the most of the FP association.

In this evaluation we have investigated the impacts and profitability of participation in FP7 (2007-2014) and H2020 (until 2018), but also estimated the profitability of participation in Horizon Europe (2021-2028).

8.1 FP association is beneficial for Norway

In chapters 6 and 7 we have compared FP association with a baseline scenario of spending the direct cost of FP association on national instruments operationalised as RCN's instrument portfolio. By doing so, we have assessed the impact of FP association to date and what might happen if Norway decides not to participate in Horizon Europe.

The FPs are first and foremost policy instruments designed to foster capacity building on an EU level. The FPs also mean that countries can merge their R&I resources in competence and infrastructure projects that are larger than is feasible with national instruments, thereby possibly achieving more wide-ranging impacts and solutions to societal challenges.

Our initial hypothesis was that for a participant country such as Norway, participation in FP is a means of increasing international collaboration and exposing national R&I sectors to international competition, which ,with time, may increase research quality, innovation capacity, productivity and exports. Through the FPs, Norwegian participants gain access to knowledge, networks and R&I infrastructure not available in Norway.

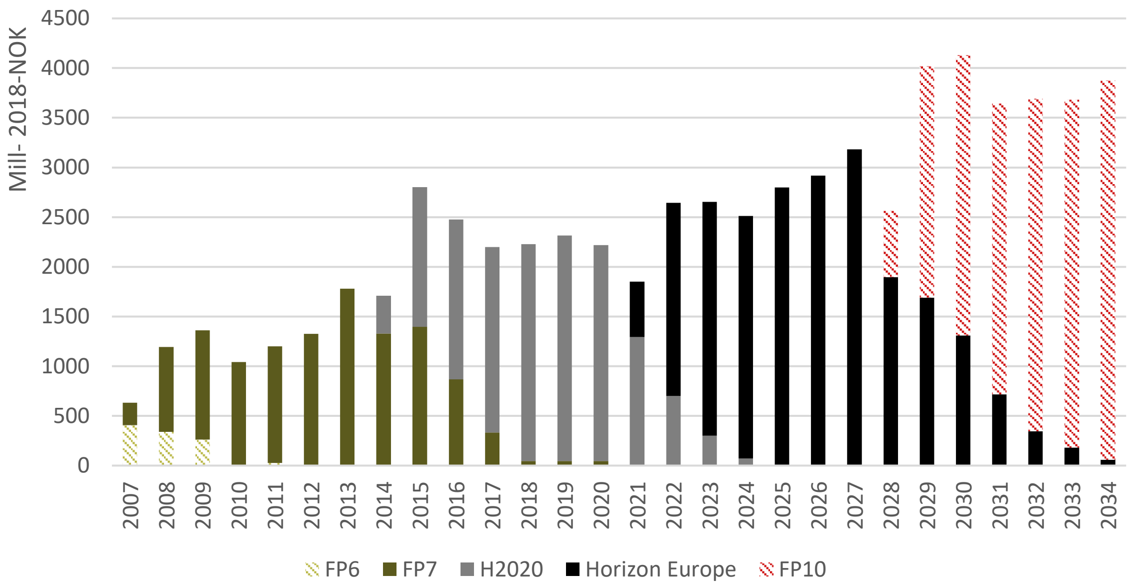
The second hypothesis was that international instruments are more costly than national instruments, due to the need for international policy coordination and the risk of mismatch between international policy objectives and the national ability to respond to these objectives (with the potential consequence of low national rate of return).

Starting with the second hypothesis, we have found that a strict comparison of monetised costs and benefits reveals that the FPs have been and are expected to continue to be more costly for Norway to participate in than national instruments.

The Norwegian participation fee varies from year to year, but there has been an upward trend from about NOK 630 million in 2007 (including FP6) to NOK 2.2 billion in 2018, and we have estimated that the participation fee will continue to increase. For illustrative purposes we have in Figure 8.1 included a subsequent FP with a total budget 20 per cent higher than the proposed Horizon Europe budget, to give an idea of the scale of future fee.

Given our assumptions, the participation fee will continue to increase, but growth is forecast to slow down from 6.4 per cent annually in the period 2007-2018 (including FP6) to 4.1 per cent annually in the period 2018-2027. Actual costs will obviously depend on the on-going negotiations as well as the exchange rate and proportionality factor (see Figure 8.1).

Figure 8.1 Norwegian FP participation fee. Actual (2007-2018) and forecast (2019-2034). In millions of 2018-NOK. 2007-2034.



Source: Samfunnsøkonomisk analyse AS, European Commission and Ministry of Education and Research
Note: The estimated fee for Horizon Europe is based on a Horizon Europe budget of EUR 94.1 million, stable exchange rate of 1 EUR = 10.1 NOK, payment period as in FP7 and annual inflation rate of 2 per cent. For illustrative purposes the figure also includes a tenth FP with a total budget 20 per cent higher than Horizon Europe's.

Given our assumptions, a comparison of all cost and benefit elements (including taxation, reporting, administration cost etc.), participation in FP7 and H2020 (up until 2018) has been about twice as expensive as national instruments, with a difference equal to NOK 6.3 billion 2018-NOK for the period of 2007-2018 or 0.5 million 2018-NOK annually (on average). We have estimated Horizon Europe participation to also be less profitable than the baseline scenario, with a difference equal to 4.5 billion 2018-NOK, also at NOK 0.6 billion annually (on average during the commitment period).

We have found that costs of administration for Norway in case of FP association is a like that of the baseline scenario. The difference between the FPs and the baseline scenario mainly reflects the cost of Norwegian returns (i.e. R&I activity in Norway) is lower in case of FP association than in the baseline scenario.

In the CBA of Horizon Europe, we have utilized a modest rate of return of 2.2 per cent (equivalent to the current accumulated return in H2020). A return of 2.7 would mean that Norway recoups its “fair” share of competitive funding, but a financial return of 2.8 per cent will make participation in Horizon Europe as cost-effective as the baseline scenario according to our assumptions. [73]

Figure 8.2 shows estimated cost and benefit elements, returns and the net cost of FP association compared to the baseline scenario until 2034 (which is the payment period of Horizon Europe). Again, we have included a fictitious FP10 in order to illustrate the net cost when the FPs are taken as a given. It is important to bear in mind that it does not makes sense to measure the net cost of FP association in a particular year. The figure nonetheless illustrates the magnitude of the FP participation fee relative to other cost elements, and correspondingly Norwegian return relative to the financial return on investment for companies.

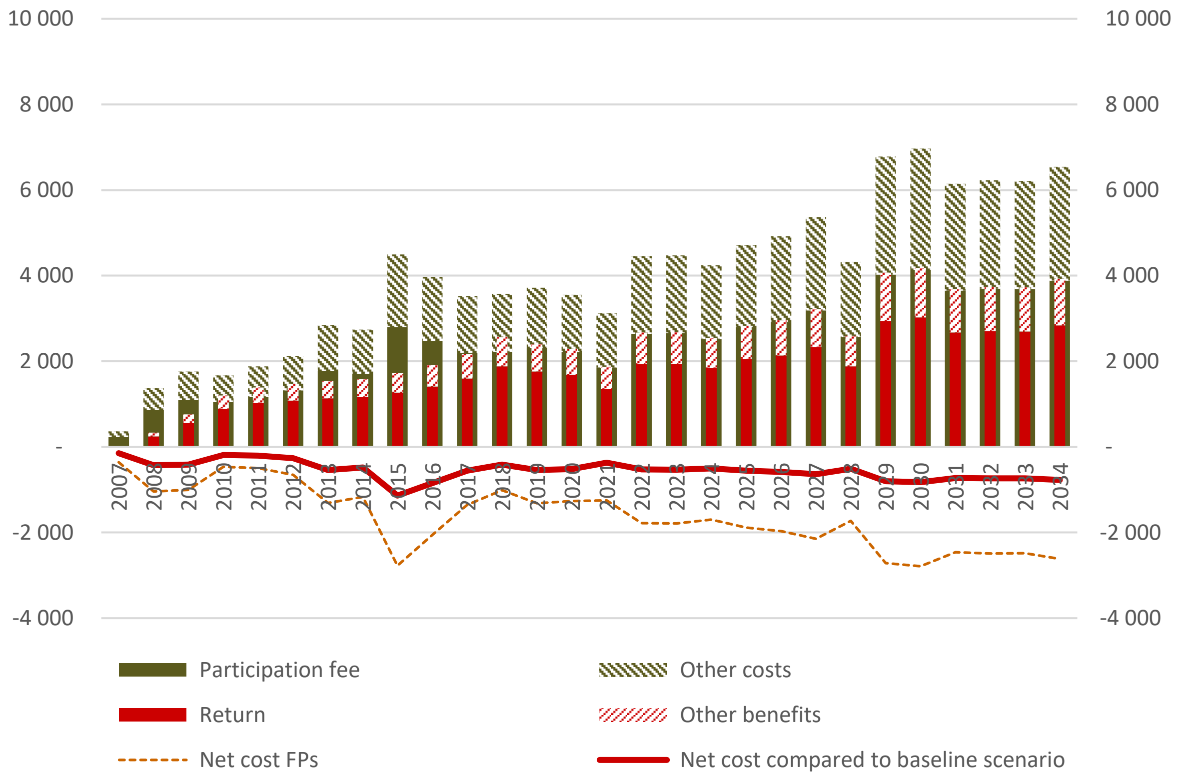
Figure 8.2 also illustrates that both costs and benefits have and is expected to continue to rise based on our assumptions. Assuming a financial return of 2.2 per cent, the net cost of FP association compared to baseline is relatively modest. The figure does not include non-monetised benefits which is assumed to be significant.

As a remainder we have not included Norway’s “fair share” of FP administrative cost and cost of the JRC, as such costs are born by the European Commission assumed to be 11.5 per cent of the total Horizon Europe budget (i.e. approximately NOK 0.4 billion a year on average for Horizon Europe).

It should also be borne in mind that whereas some historic cost and benefit elements are based on actual figures, many are based on estimates[74]. Altering the underlying assumptions will affect the net cost of the FP compared to that of national instruments. The sensitivity analysis reveals that the most important cost/benefit element is the FP return – and that a higher return improves the net cost of FP association. Any changes in the form of a “simplification” of the FPs that brings down time spent on administration, application and reporting lowers the net cost of FP association compared to baseline scenario and any changes in order to increase international participation in national measures would on the contrary improve net cost of FP participation compared to the baseline.

[73] A financial return of 3 per cent of competitive funding will cover the Norwegian participation fee while a return of 4.7 per cent will cover all FP-related costs (including cost of taxation), both of which imply that Norway does not bear any of Horizon Europe’s administrative costs (set to 11,5 per cent including cost of JRC)
[74] See chapters 6 and 7 for a detailed explanation of assumptions and sensitivity tests.

Figure 8.2 Monetised costs and benefits of FP association, and net cost of FP association compared to baseline scenario. FP7-FP10. In millions of 2018-NOK. 2007-2034.



Source: Samfunnsøkonomisk analyse AS

Note: The estimated fee for Horizon Europe is based on a Horizon Europe budget of EUR 94.1 million, stable exchange rate of 1 EUR = 10.1 NOK, payment period as in FP7 and annual inflation rate of 2 per cent, proportionality factor of 2.66 per cent and return of 2.2 per cent. For illustrative purposes the figure also includes a tenth FP with a total budget 20 per cent higher than Horizon Europe's.

FP association brings important benefits which cannot be quantified in monetary terms and this brings us to **the first hypothesis**. Both the FP and the national R&I instrument portfolio cover instruments for excellent research, designed to address societal challenges, and business-oriented instruments designed to foster innovation and commercialisation. A comparison of beneficiary characteristics (size, age and industry) indicate that there is no sharp division of labour between the FPs and the RCN along these dimensions. The RCN does to a lesser degree fund R&I activity in small companies, but small firms are well represented amongst IN and SkatteFUNN users. Nor are the thematic foci substantially different.

Data collected confirm that main benefit of FP association relates to the instruments ability to foster increases international collaboration and learning and exposes participants to international competition to a greater extent than national instruments do. Moreover, through the FPs, Norwegian participants gain access to knowledge, networks and R&I infrastructure not available in Norway.

Capacity building and learning are important factors for innovation, productivity and other aspects in the development of society. For a small country like Norway the benefits of international collaboration and knowledge sharing can be significant. As we view the impacts on learning and collaboration to be stronger in FP projects than in the baseline scenario, we expect the long-term impact on innovation, productivity and well-being to be higher than in the baseline scenario.

Higher R&I quality and international competitiveness gained by Norwegian researchers can boost exports of knowledge-based products but, most importantly, bring external effects to society through various channels, including R&I collaboration, labour mobility, innovations, publications, spin-off companies etc. As we assume that the learning effect is stronger in the FPs than in national measures, we also assume the impact of R&D quality and competitiveness to be stronger and thus also the impact on the rest of the Norwegian economy – although we cannot know for sure.

We have also found that FP association gives Norwegian policymakers and innovation agencies access to European policy arenas and fora, which makes benchmarking, knowledge sharing and policy innovation possible. Over time, Norway's FP association has had a profound impact on the national policy dialogue, national R&I priorities and R&I programmes, and even on the RCN's organisation and application assessment criteria. Informants suggest that Norway has also been able to influence FP priorities. We assume that this has impacted the national R&I policy and system in a positive way that will increase productivity and thus well-being in Norway over time. Informants also point out that FP association gives Norwegian policymakers access to arenas and fora that allow for policy coordination and international knowledge-sharing on other policy issues (e.g. energy, transport, health). Such arenas are considered by many interviewees to be particularly important, as Norway is not an EU member.

The FPs, particularly H2020, focus on solving societal challenges, but such efforts have also been incorporated in national instruments (via policy learning amongst other things). At project level, web surveys results indicate that FP projects have indeed contributed to improved social welfare, more sustainable social development and to coping with major societal challenges, as have FP projects. It is natural that the contributions of the individual project to addressing such complex issues and challenges are minute. We have, however, found that FP association leads to more international, interdisciplinary and intersectoral collaboration than national instruments. Moreover, FP projects are generally larger than national projects and (as argued above) have a stronger learning effect. One can thus expect that by participating in the FPs Norway can contribute to solving complex societal challenges by making it possible for Norwegian companies and researchers to play a role and by participating in various fora for coordination and knowledge sharing.

We judge that Norway's FP association has and will continue to contribute to the four objectives in the government's FP strategy, and bring significant non-monetised benefits that outweigh the net costs of FP association. Learning and networking effects are important contributions to enhancing Norwegian R&I quality and competitiveness and to maintaining Norway's relative position on a European level. Learning and networking effects are also considered important for a small country like Norway, and a non-EU participant.

As learning and innovation and even R&I collaboration are cumulative by their nature, not participating in the next framework programme could have long-term implications for Norway's R&I competitiveness.

In the CBA, we have assumed that benefits increase proportionally with R&I funding for both the RCN and the FPs. We have, however, found additionality to be lower for national instruments than for FP projects. Experience also suggests that there is an diminishing marginal effect of R&I instruments, as recently documented in the evaluation of skatteFUNN (Samfunnsøkonomisk analyse AS, 2018). If this assumption also holds also for the RCN, every additional NOK channelled to the RCN[75] generate less additional benefits compared to every NOK channelled to the FPs. In consequence, Norway could benefit from FP association even without taking the additional learning and network effects of FP association into account.

Although the magnitude of the benefits of FP association are difficult to monetise, we judge the risk of no FP association to be greater than the net cost of participating, as we expect it to be difficult to fully compensate for the benefits of FP association in national instruments. FP projects are generally larger than RCN projects. The RCN could adjust its funding practice to be more in line with the FPs (or Enova), with the consequence of funding fewer projects and participants, but we expect it to be much more difficult to maintain the level of international competition, learning and international collaboration that we expect to see in the Horizon Europe.

Norwegian participants could participate in single FP projects on a third country basis in the case Norway decides not to associate itself with Horizon Europe but based on experience from the previous FPs such participation may be difficult to organise in practice on a large scale. Norwegian policymakers as well as the RCN could also strive to increase international collaboration and participation in RCN projects. However, such a strategy also could prove difficult (and costly) to pursue on a scale equivalent to the FPs. We have used the RCN as the baseline scenario but expect it would be equally difficult to fully compensate for the benefits of FP association through SkatteFUNN and national instruments funded by IN, Enova and others.

Further, Norwegian policymakers, innovation agencies and stakeholders will not have access to fora and tools used for benchmarking, policy innovation and European policy coordination.

That continued FP association is the preferred alternative in the cost benefit analyses must not be taken as an argument for channelling all national R&I funds to the FPs (or other international research programmes), or taken as a sign of deficiencies in the RCN or other national agencies. Our assessment is based on the FPs continuing to complement the R&I instrument portfolio and constitute a modest part of the total R&D funding available to Norwegian organisations.

[75] RCN R&I funding totalled NOK 8.5 billion excl. institutional funding for research institutes in 2018

In our view, FP participation represents a sensible and valuable diversification of Norwegian R&I policy, and it is our clear recommendation that Norway should associate itself with Horizon Europe. Given that learning and competence building, and R&I collaboration are cumulative by nature, not participating in Horizon Europe could have long-term implications for Norway's absolute and relative R&I competitiveness.

8.2 Higher return increases benefits

As we cannot estimate the magnitude of the non-monetised benefits, we cannot determine when FP association ceases to be beneficial.

The sensitivity analysis performed reflects the obvious fact that higher returns increase the profitability of FP association even without taking non-monetised benefits into consideration. From a cost-benefit perspective, it is thus reasonable that the Norwegian FP policy includes returns target for Norway, both because higher returns will increase monetised benefits for Norway and also because it is through active project participation that most non-monetised benefits arise.

With much attention and resources being paid to increase Norwegian FP association, one might fear that Norwegian R&D providers might put too much effort into subjects and research questions that are of little strategic interest to the public and private sectors in Norway, and as a consequence might not have the capacity to respond to national needs or absorb spill over effects. The general view amongst policy informants is that FPs *at large* cover research questions and areas of strategic importance to Norway, as Norway faces many of the same challenges as Europe. For as long as this holds true, we expect Norway to continue to benefit from FP association.

8.3 Changes in the proportionality factor and currency are mainly of fiscal relevance

The FP participation fee has increased from around NOK 630 million in 2007 (including FP6) to NOK 2.2 billion in 2018. The overall programme budget is still subject to negotiation but given the proposed budget of EUR 94 billion for Horizon Europe, the fee will increase also in the years to come, but at a somewhat slower pace than seen for the past decade. The Norwegian participation fee grew 6.4 per cent as an annual average during the period 2006-2018 and will grow by about 4.1 per cent up until 2027 based on our assumptions.

The actual participation fee may increase beyond our forecast in the event of the final budget being higher, but also as consequence of a higher proportionality factor and a weakening of the krone. Changes in the proportionality factor and exchange rate will affect net costs for Norway – if the proportionality factor continues to be higher than the financial return (in per cent). Annual fluctuations in proportionality factor and exchange rate are first and foremost a budgetary issue, however.

A weakening of the krone would increase the participation fee, but also the return in NOK to Norwegian participants. If the rate of return is lower than the proportionality factor, the net costs for Norway will increase, but merely by the cost of taxation of the difference between fee and return. If the rate of return is higher than the proportionality factor, Norway benefits from a weaker kroner.

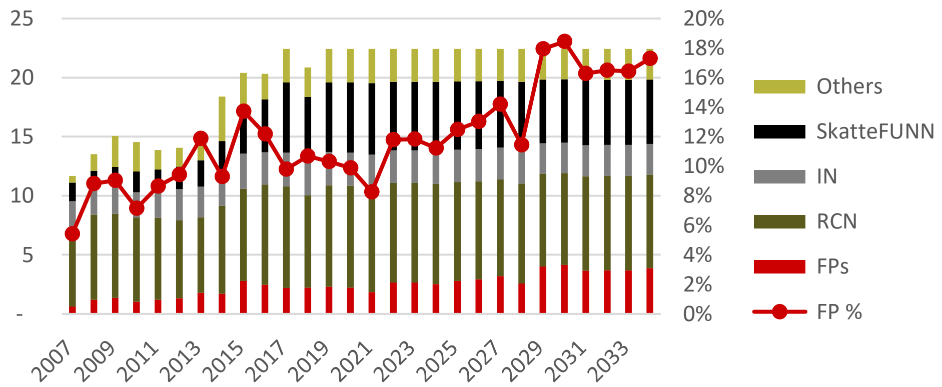
A higher proportionality factor will also increase the participation fee. Such an increase reflects a situation in which the Norwegian economy grows faster than the economies of the EU Member States. For Norway, the isolated effect of an increase in GDP must be considered beneficial and outweigh any “cost” increase in the FP participation fee.

8.4 Increase in participation fee raises strategic issues

After a long period of favourable economic conditions and strong growth in public spending in Norway, we expect public spending to be more modest in the years to come[76]. Assuming that total Norwegian public spending on R&I instruments (incl. fee of FP association) remains unchanged – a continued FP association and growth in FP funding obviously imply less funding for national R&I instruments.

Figure 8.3 illustrates the scale of public funding for competitive R&I instruments (incl. FP6, FP7, Horizon Europe and the fictitious FP10). Assuming no growth in total spending for grant-based R&I instruments and the FPs participation cost as earlier, the fee for participating in the FP would increase from 5 per cent in 2007 to 14 per cent in 2027. The administrative cost of national R&I instruments is for the sake of simplicity assumed to be 10 per cent for all national innovation agencies/instruments. Institutional funding to research institutes is not included.

Figure 8.3 Public spending on national competitive R&I instruments incl. FP participation fee. Assuming no growth 2019 onwards. Spending in NOK (in columns) and share of FP relative to total spending (in per cent). Per R&I measure/ agency. 2007-2034. In mill. 2018-NOK.



Source: Samfunnsøkonomisk analyse AS, FoU statistikkbanken

Note: FPs cover FP6 to fictitious FP10. For Horizon Europe we assume a Norwegian proportionality factor of 2.66, a Horizon Europe budget of EUR 94.1 million, a stable exchange rate of 1 EUR = 10.1 NOK, a payment period as in FP7 and an annual inflation rate of 2 per cent. The fictive FP10 is 20 per cent larger than Horizon Europe. Spending on national instruments beyond 2019 is assumed to follow the same distribution as in 2018.

[76] See e.g. Long-term Perspectives on the Norwegian Economy (Meld. St. 29, 2016-2017).

A development in this direction raises some strategic issues. The first one is how to ensure an appropriate level of Norwegian participation. In the CBA, we have assumed a sectoral distribution of funding in Horizon Europe as in FP7 and H2020, but this need not be the case. R&D providers and companies respond differently to policy instruments.

For R&D providers, the capacity and availability of public funding determine the level of R&I activity. While universities have relatively strong financial incentives to participate in the FPs (acceptable H2020 cost coverage and a substantial bonus on the H2020 funding granted), financial incentives have traditionally been weaker for institutes following lower funding rates in FP projects and a negligible bonus on H2020 in institutional funding.[77] Without public co-funding to make FP participation economically attractive to institutes, then universities, companies and others would have to account for a larger share of Norwegian FP participation.

For private companies, public R&I funding reduces the cost of an R&I investment and thus lowers companies' required return on their own R&I investment. The FPs increasingly cover instruments of relevance to companies, and we have found that companies with FP experience view FP participation as good value for money. Nonetheless, private sector participation in Horizon Europe requires the existence and mobilisation of R&I-intensive companies with internationally competitive business ideas with the potential to solve societal challenges (or missions), and/or innovative ideas with break-through and disruptive potential.

A second strategic issue is how to design the portfolio of national R&I instruments. In the analysis, the FPs and RCN instruments are treated as single instruments, which is obviously an over-simplification. Both portfolios are complex, change with time and are interdependent. Norway can continue to lobby for a simplification of FP administration (for example reporting and application procedures) and for the European Commission to include research topics and questions of strategic importance to Norway. Such work from "within" the FPs would lower barriers to participation and possibly increase the relevance and benefit of FP association. If participation in the FPs is taken as a "given", national instruments ought to be continuously and purposefully adjusted to adapt to the FPs, as the opposite is obviously more difficult. In principle, national instruments can be used to mobilise and qualify for FP participation and to ensure that, one the one hand, the knowledge generated in the FP projects is shared to the Norwegian society, and on the other, to address specific Norwegian competence needs and research solutions that are not (sufficiently) addressed by the FPs.

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[77] See for example Åström (2017).

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Acronyms

Framework sub-programs and actions	
ENERGY	Secure, clean and efficient energy
ENV	Environment (including Climate Change)
ENV	Climate action, environment, resource efficiency and raw materi-als
ENV	Environment (including Climate Change)
ERC	European Research Council
FET	Future and Emerging Technologies (FET)
Fission	Nuclear Fission and Radiation Protection
FOOD	Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
HEALTH	Health, demographic change and wellbeing
ICT	Information and Communication Technologies
JTI	Joint Technology initiatives
JRC	Joint Research Centre
INFRA	Research Infrastructures
INNOSUPSME	Innovation in SMEs
KBBE	Food, Agriculture, and Biotechnology
LEIT-ADVMAT	Advanced materials
LEIT-ICT	Information and Communication Technologies
MSCA	Marie-Sklodowska-Curie Actions
NMP	Nanosciences, Nanotechnologies, Materials and new Production Technologies
PEOPLE	Marie-Curie Actions
SEC	Security
SECURITY	Secure societies - Protecting freedom and security of Europe and its citizens
SiS	Science in Society
SME	Research for the benefit of SMEs

SOCIETY	Europe in a changing world - inclusive, innovative and reflective Societies
SP1-JTI	Joint Technology Initiatives (Annex IV-SP1)
SPA	Space
SSH	Socio-economic sciences and Humanities
TPT	Smart, green and integrated transport
eCorda sector classification	
HES	Higher or Secondary Education Organisation), PRC
OTH	Other
PRC	Private for Profit Organisation – excl. education
PUB	Public Body – excl. research and education (eCorda classification)
REC	Research Organisation
Norwegian organisations	
IMR	Institute of marin research (Havforskningsinstituttet)
IN	Innovation Norway (Innovasjon Norge)
NIBIO	Norwegian Institute of Bioeconomy Research (Norsk institutt for bioøkonomi)
NILU	Norwegian Institute for Air Research (Norsk institutt for luft-forskning)
NMBU	Norwegian University of Life Science (Norges miljø- og biovitenskapelige universitet)
NTNU	Norwegian university of science and technology (Norges teknisk-naturvitenskapelige universitet)
RCN	Norwegian Research Council (Forskningsrådet)
UIB	University of Bergen (Universitet I Bergen)
UIO	University of Oslo (Universitet i Oslo)
UiT	The Arctic University of Norway (Norges arktiske universitet tild. Universitetet i Tromsø)

Appendix A Registry analyses

Introduction

In this appendix we set out the results of the registry analyses of Norwegian participation in the EU Framework Programmes, covering all of FP7 (2007-2013) and the first four years of H2020 (2014-2018). A summary of key findings from these analyses are presented in the main report, while this appendix provides a more detailed breakdown of statistics.

The registry analyses are intended to provide information and evidence to support the wider assessment of how Norwegian participation in the EU FP contributes to reaching Government objectives, and in particular to help address the following two aims:

- Participation shall increase the quality of NO research and innovation, and help NO research and innovation succeed internationally.
- Participation shall help develop our own research and innovation sector, both through further development of policies and instruments and through new patterns of cooperation across national borders, sectors and fields.

After a note on the approach taken, the analysis begins (Section A.3) by providing a broad overview of **Norwegian participation in FP7 and H2020** (so far), for context, including trends over time and comparisons with comparator countries. It goes on to present evidence to support the assessment the goals mentioned above, namely how Norwegian participation in the FP has contributed towards: (i) the goal of **increasing the quality** of Norwegian research innovation and helping it to **succeed internationally** (Section A.4); and (ii) to the development of the Norwegian research and innovation sector through new **patterns of cooperation** across national borders, sectors and fields (Section A.5.

Methodological notes

The analyses presented below are mainly based on **eCorda databases** of proposals and grants covering the entirety of FP7 and the first four years of H2020 (data extracted 13 March 2019).

Where we present **annualised data** relating to proposals, this is based on the relevant call deadline year. For projects, annualised data is based on the start year of the relevant grants. There are a relatively small number of proposals and projects that fall outside of the 2007-13 and 2014-18 period of FP7 and H2020 respectively[78]. For simplicity these rows are not shown as part of the annual breakdowns, however these proposals and projects are included within FP7 and H2020 overall totals shown.

[78]Across all countries there are 13 FP7 proposals with a call deadline in 2014, 48 H2020 proposals with a call deadline in 2013 and 1,642 H2020 proposals with a call deadline in 2019. Similarly, there are 87 FP7 projects started in 2014 or 2015 and 2,421 H2020 projects that start in 2019 or 2020.

It should be noted that some H2020 proposals that do not currently appear within the grants database may have been awarded grants after the current data extract. Success rates and funding for 2018 may therefore increase slightly as a result of future updates to the databases.

The participation of Norway (NO) in FP7 and H2020 is compared with the performance of five selected **comparator countries**: Austria (AT), Denmark (DK), Finland (FI), the Netherlands (NL) and Sweden (SE). Throughout the section, we use shading to indicate the highest three countries (out of the six considered) on any given metric. This is intended to help visualise the locations of greatest activity or success, as well whether Norway sits in the top or bottom half of this sub-set of countries.

Given the different sizes of the comparator countries, we also present normalised results, which have been weighted based on national research capacity. Specifically, we weight country participation data by the number of researchers, using UIS figures on the total number of R&D personnel (FTE) in each country. For FP7, an average is taken of the years 2007 to 2013, while for H2020 the average for 2014 to 2016 (latest available data) was used (see Table 0.1).

Table 0.1 Total R&D personnel (FTE) per country – used for weighting of participation data.

	NO	SE	DK	FI	AT	NL
FP7 (2007 – 2013 average)	36,361	78,617	55,942	55,207	59,934	105,499
H2020 (2014 – 2016 average)	42,208	85,905	59,394	49,975	71,627	128,780

A note on terminology

Proposals vs Applications: A proposal to the Framework Programme will often be submitted from a consortium of organisations. Each organisation's involvement in that proposal is termed an "application" in this analysis. The total number of proposal applications is therefore greater than both the total number of unique proposals submitted and the total number of unique organisations involved.

Projects vs Participations: Similarly, a project will often involve more than one organisation. Each organisation's involvement in that project is term a "participation" in this analysis.

Multi- vs Single-Partner Proposals: Around two-thirds of proposals to H2020 involve just one organisation[79], who is - by default - the proposal coordinator. This is somewhat different to a situation where several organisations are involved, and where the proposal and the consortium are coordinated by a lead partner. We term these two types of proposal "single-" and "multi-partner (MP)" respectively.

[79] This is particularly the case in certain areas (e.g. most ERC, MSCA and SME instrument proposals involve one organisation).

All proposals are included within the analysis unless the text specifically indicates that “multi-partner” proposals (only) are the unit of analysis. For example, when analysing coordination rates, we focus only on “multi-partner” proposals (i.e. we exclude all proposals that involve just one organisation).

Organisational types - The main stakeholder categories available in eCorda are: HES (Higher or Secondary Education Organisation), PRC (Private for Profit Organisation (excluding education), REC (Research Organisation), PUB (Public Body (excluding research and education) and OTH (Other).

Norwegian participation in FP7 and H2020

Introduction

Below, we provide **information on Norwegian participation in FP7 and H2020** (the extent, type, scale and location of involvement). This analysis does not relate to a specific government goal being assessed through this study and is instead intended as wider context for these assessments.

Norwegian involvement in FP7 and H2020 proposals

As the following table shows, Norwegian applicants were involved in over 7,000 FP7 **proposals** (4.5% of the total). This number has been surpassed already in H2020, with Norwegian involvement in over 8,500 proposals in the first four years of the FP (4.2% of H2020 proposals). All of the five comparator countries considered have been involved in higher numbers (and proportions) of FP7 and H2020 proposals than Norway. However, it is worth noting that most of these countries have seen a more significant decrease in their share of all proposals (FP7 to H2020) than did Norway. Only Denmark has seen a slight increase (the country was involved in 5.9% of FP7 proposals and 6.1% of H2020 proposals).

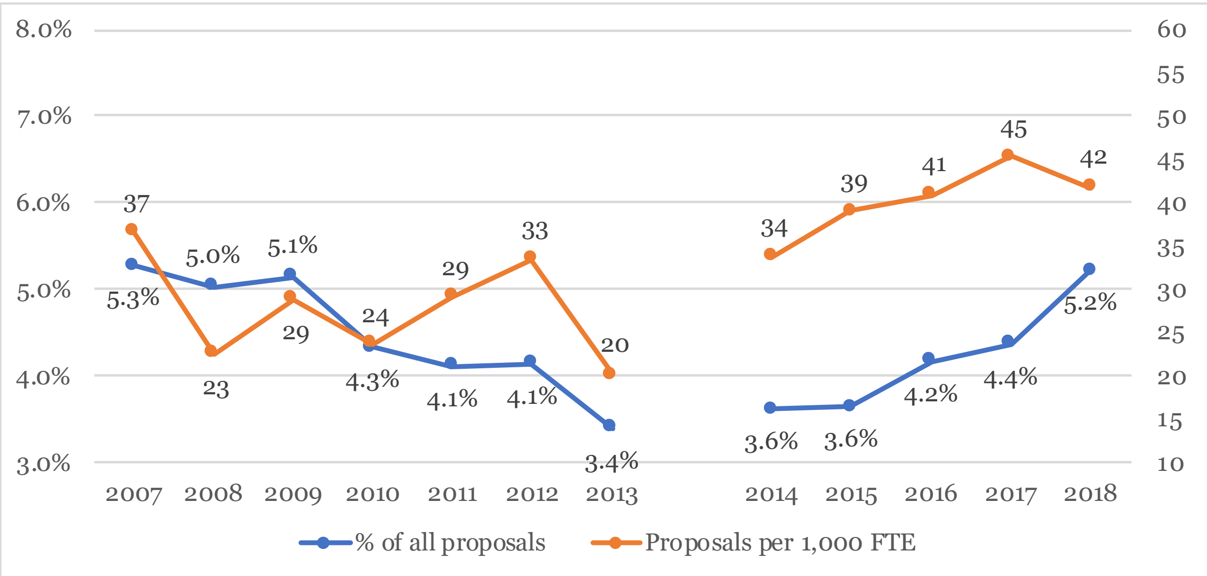
The final rows in the table show the weighted number of proposals (per 1,000 R&D personnel) that each country has been involved in during FP7 and H2020. On this measure, Norway compares more favourably, ranking third amongst the six countries during both programme periods.

Table 0.2 Involvement in FP7 and H2020 Proposals

	NO	SE	DK	FI	AT	NL	All
Proposals FP7	7,078	15,259	9,316	9,667	12,093	23,053	158,562
Proposals H2020	8,531	15,543	12,610	11,108	13,044	25,956	205,362
% of all proposals FP7	4.5%	9.6%	5.9%	6.1%	7.6%	14.5%	100%
% of all proposals H2020	4.2%	7.6%	6.1%	5.4%	6.4%	12.6%	100%
FP7 Proposals per 1,000 FTE	195	194	167	175	202	219	
H2020 Proposals per 1,000 FTE	202	181	212	222	182	202	

The following figure shows a more detailed breakdown of Norwegian proposal involvement each year (based on the year of call deadline). This shows (orange line) no clear pattern in the number of proposals Norway was involved in during each year of FP7, but a steady increase during the first four years of H2020 (with a slight dip then in 2018). The proportion of all proposals that have Norwegian involvement (blue line) tended to decline across the FP7 period and has then increased year on year during H2020 so far, reaching a high of 5.2% in 2018, not seen since the first year of FP7.

Figure 0.1 FP7 and H2020 Proposals with Norwegian involvement – per year



Source: Technopolis, eCorda

The number of individual Norwegian **applications in proposals** was 9,658 during FP7 (1.5% of all proposal applications). As the following table shows, this has already been surpassed in H2020, with 11,815 Norwegian applications (1.6% of the total). There has been a slight increase in the share of all applications accounted for by Norway between FP7 and H2020. Only Denmark and the Netherlands (amongst the comparators) have seen bigger increases, while the proportions accounted for by Sweden and Austria have actually fallen slightly between the two programmes.

All of the five comparator countries have higher numbers (and proportions) of applications in FP7 and H2020 proposals than does Norway. However, when these figures are weighted by the respective R&D populations of these countries, Norway compares a little better. There were 266 Norwegian applications per 1,000 FTE during FP7 (third highest amongst the six countries shown) and 280 per 1,000 FTE during H2020 (fourth highest).

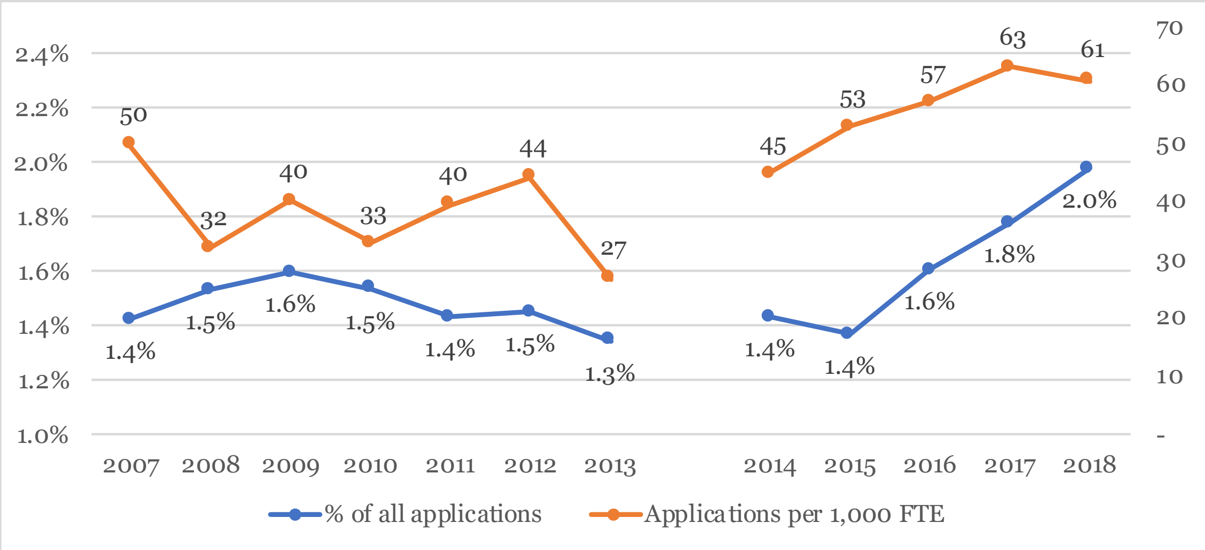
Table 0.3 Applications within FP7 and H2020 Proposals

	NO	SE	DK	FI	AT	NL	All
FP7 applications	9,658	20,663	12,068	13,330	16,303	33,247	656,159
H2020 applications	11,815	21,068	16,828	15,620	17,940	40,360	725,856
% of all applications FP7	1.5%	3.1%	1.8%	2.0%	2.5%	5.1%	100.0%
% of all applications H2020	1.6%	2.9%	2.3%	2.2%	2.5%	5.6%	100.0%
FP7 applications per 1,000 FTE	266	263	216	241	272	315	
H2020 applications per 1,000 FTE	280	245	283	313	250	313	

Source: Technopolis, eCorda

The following figure shows a more detailed breakdown of Norwegian applications each year (based on the year of call deadline). This shows (orange line) no clear pattern in the number of Norwegian applications during FP7, but a steady increase during the first four years of H2020 (with a slight dip then in 2018). The proportion of all applications accounted for by Norway (blue line) rose and then fell during FP7, but has then increased across much of the H2020 period, reaching a high of 2.0% in 2018.

Figure 0.2 Norwegian applications in FP7 and H2020 Proposals – per year



Source: Technopolis, eCorda

The following table shows the distribution of Norwegian **applications in FP7 proposals across the sub-programmes** (only those programme areas with more than 1% of Norwegian applications are shown). Over half (51%) of Norwegian FP7 applications were accounted for by just four areas: ICT, research for the benefit of SMEs, Marie Curie actions and the KBBE programme. The other twelve programmes shown account for another 48% of the total.

The final column in the table shows the distribution of all applications (i.e. from all countries) for comparison. Where Norway has an above-average concentration of applications in a sub-programme, this is shaded in the Norwegian column. This includes particularly high concentrations (compared to the average) in the SME, KBBE, ENV and Energy programmes. By comparison, Norway has a particularly below-average concentration of applications in the People and Health programmes.

Table 0.4 Applications within FP7 Proposals – by sub-programme

FP7			NO	All Countries
COOPERATION	ICT	Information and Communication Technologies	17%	21%
CAPACITIES	SME	Research for the benefit of SMEs	14%	8%
PEOPLE	PEOPLE	Marie-Curie Actions	13%	17%
COOPERATION	KBBE	Food, Agriculture, and Biotechnology	8%	6%

IDEAS	ERC	European Research Council	8%	8%
COOPERATION	ENV	Environment (including Climate Change)	7%	5%
	NMP	Nanosciences, Nanotechnologies, Materials and new Production Technologies	5%	6%
	HEALTH	Health	5%	6%
	ENERGY	Energy	4%	3%
	SSH	Socio-economic sciences and Humanities	4.3%	3.8%
	TPT	Transport (including Aeronautics)	4.1%	5.0%
	SEC	Security	3.5%	2.9%
	SP1-JTI	Joint Technology Initiatives (Annex IV-SP1)	2.4%	2.8%
CAPACITIES	INFRA	Research Infrastructures	2.1%	1.7%
COOPERATION	SPA	Space	1.5%	1.3%
CAPACITIES	SiS	Science in Society	1.5%	1.3%
FP7 Total			**9,658**	**656,159**

Source: Technopolis, eCorda

Similarly, the following table shows the distribution of Norwegian **applications in H2020 proposals across sub-programmes** (again, only those with more than 1% of applications are shown). Nearly half (49%) were accounted for by just four areas: MSCA, ICT, Energy and Health programmes. The other fourteen programmes shown account for another 47%.

The final column shows the distribution of all applications for comparison, with shading (in the NO column) to indicate where Norway has an above-average concentration of applications. This includes particularly high concentrations (compared to the average) in the Food, InnosupSME and Energy programmes. By comparison, Norway has a particularly below-average concentration of applications in the FET, AdvManu and NMP programmes.

Table 0.5 Applications within H2020 Proposals – by sub-programme

H2020			NO	All Countries
Excellent Sc.	MSCA	Marie-Sklodowska-Curie Actions	23%	24%
Ind. Leadership	LEIT-ICT	Information and Communication Technologies	10%	12%
Societal Challenges	ENERGY	Secure, clean and efficient energy	8%	6%
	HEALTH	Health, demographic change and wellbeing	8%	8%
	FOOD	Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy	8%	6%
	ENV	Climate action, environment, resource efficiency and raw materials	6%	5%
	TPT	Smart, green and integrated transport	5%	5%
Excellent Sc.	ERC	European Research Council (ERC)	5%	5%
Ind. Leadership	INNOSUPSME	Innovation in SMEs	4.1%	3.1%
Societal Challenges	SOCIETY	Europe in a changing world - inclusive, innovative and reflective Societies	4.0%	4.4%
	SECURITY	Secure societies - Protecting freedom and security of Europe and its citizens	3.4%	3.3%
Excellent Sc.	FET	Future and Emerging Technologies (FET)	2.9%	4.4%
Ind. Leadership	LEIT-ADVMAT	Advanced materials	1.9%	1.6%
	LEIT-ADVMANU	Advanced manufacturing and processing	1.8%	2.3%
Excellent Sc.	INFRA	Research Infrastructures	1.7%	1.4%
EC	CROSST	Cross-theme	1.6%	1.6%
Ind. Leadership	LEIT-NMP	Nanotechnologies	1.3%	1.8%
	LEIT-SPACE	Space	1.0%	1.4%

Source: Technopolis, eCorda
Note: Excludes sub-programmes accounting for <1% of Norwegian applications

The following table shows the distribution of Norwegian **applications in proposals by different organisation types**, first for FP7 and then for H2020. The distribution for each comparator country and for all applications is also shown, for comparison. This shows that amongst the six countries, and across both FPs, Norway's applications tend to be under-represented by HES and PRC organisations and over-represented by REC and PUB organisations.

Table 0.6 Applications within FP7 and H2020 Proposals – by organisation type

FP7	NO	SE	DK	FI	AT	NL	All Countries
HES	31%	54%	52%	42%	40%	44%	40%
REC	32%	11%	10%	25%	20%	17%	20%
PRC	25%	25%	26%	24%	29%	30%	28%
PUB	4%	4%	5%	4%	4%	3%	4%
OTH	8%	6%	7%	6%	8%	6%	8%
H2020	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**	**All Countries**
HES	35%	50%	50%	40%	34%	42%	36%
REC	23%	8%	7%	17%	20%	13%	17%
PRC	37%	36%	36%	38%	39%	38%	40%
PUB	3%	4%	5%	3%	2%	3%	3%
OTH	2%	2%	3%	2%	4%	4%	4%

Source: Technopolis, eCorda

A Norwegian organisation was the **coordinator** for 1,190 FP7 proposals (only multi-partner (MP) proposals are included). The number of MP proposals coordinated by Norway during H2020 is already slightly higher (1,221). All of the comparator countries have more MP proposal coordinators during both periods.

The proportion of all MP proposal coordinators that are from Norwegian organisation was 1.7% in FP7 and 1.9% in H2020. In both cases this is also below all of the comparator countries.

However, as a proportion of the MP proposals that they are involved in, Norway's rate of coordination is highest amongst the six countries (14% of FP7 MP proposals and 20% of H2020 MP proposals).

When weighted for the size of the R&D populations, the number of Norwegian proposal coordinators is also above most comparator countries.

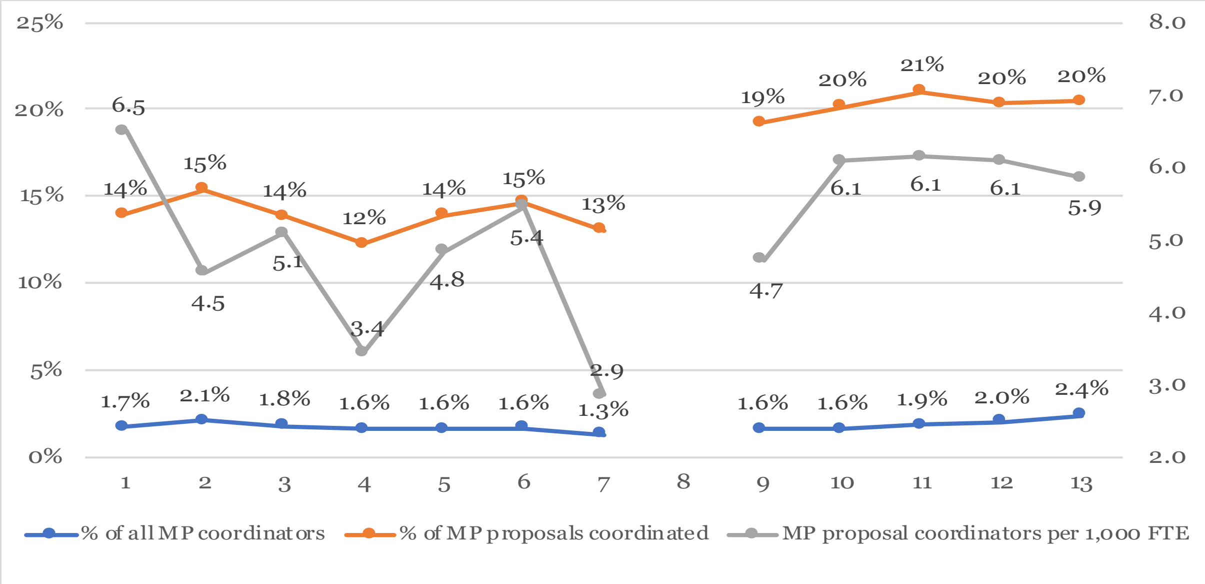
Table 0.7 Coordinators of FP7 and H2020 multi-partner proposals

	NO	SE	DK	FI	AT	NL	All Coun-tries
FP7 MP proposal coordinators	1,190	2,143	1,256	1,389	1,923	3,483	70,763
H2020 MP proposal coordinators	1,221	1,461	1,544	1,456	1,639	3,624	65,732
% of all FP7 MP proposal coordinators	1.7%	3.0%	1.8%	2.0%	2.7%	4.9%	100%
% of all H2020 MP coordinators	1.9%	2.2%	2.3%	2.2%	2.5%	5.5%	100%
% of FP7 MP proposals as coordinator	14%	12%	12%	12%	13%	12%	100%
% of H2020 MP proposals as coordinator	20%	14%	19%	20%	16%	19%	100%
FP7 MP proposal coordinators per 1,000 FTE	33	27	22	25	32	33	
H2020 MP proposal coordinators per 1,000 FTE	29	17	26	29	23	28	

Source: Technopolis, eCorda

The following figure shows that the weighted number of Norwegian coordinators (grey line) has varied year on year, with no obvious trend. The proportion of all coordinators accounted for by Norway (blue line) and the proportion of Norwegian proposals that Norway coordinated (orange line) have both been more stable, tending to fall slightly during the course of FP7 and then increase slightly during H2020.

Figure 0.3 Norwegian coordinators of FP7 and H2020 multi-partner proposals – per year



Source: Technopolis, eCorda

Norwegian involvement in FP7 and H2020 projects

Turning now to grants awarded (projects), Norway participated in 1,485 **projects** during FP7 (6% of the total). The figure so far in H2020 is slightly lower at 1,277 (5% of the total). All of the five comparator countries considered have been involved in higher numbers (and proportions) of FP7 and H2020 projects. However, it is worth noting that most of these countries have seen a more significant decrease in their share of all projects (FP7 to H2020) than Norway.

The final rows in the table show the weighted number of projects (per 1,000 R&D personnel) that each country has been involved in during FP7 and H2020. On this measure, Norway compares more favourably, ranking second (for FP7) and third (for H2020) amongst the six countries considered.

Table 0.8 Involvement in FP7 and H2020 Projects

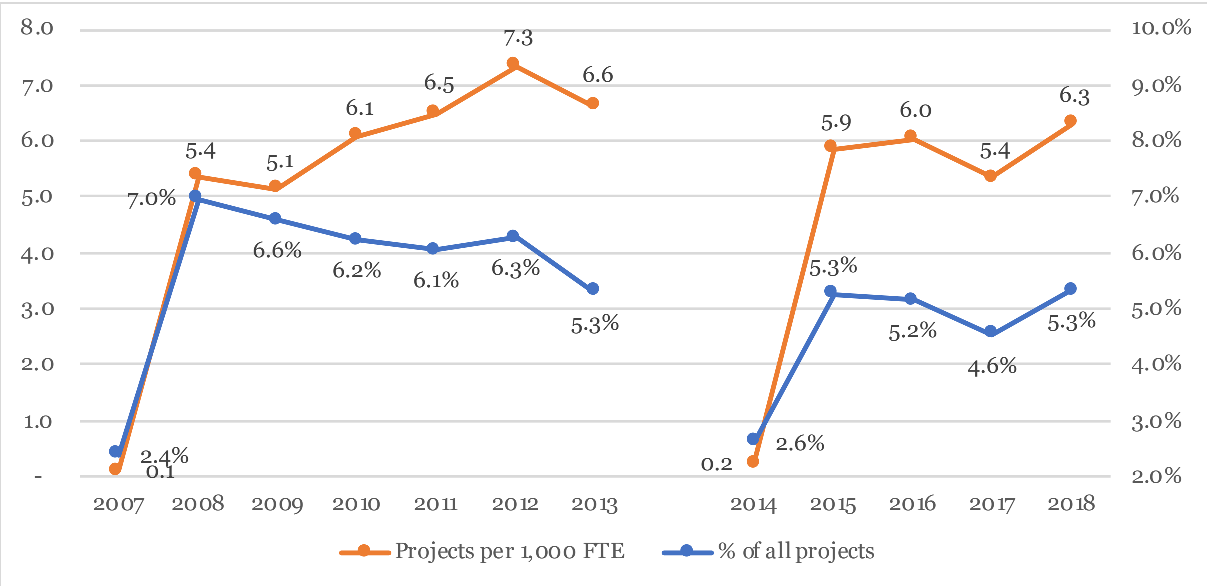
	NO	SE	DK	FI	AT	NL	All
Projects FP7	1,485	3,080	2,011	1,779	2,436	5,024	25,238
Projects H2020	1,277	2,268	1,921	1,469	2,118	4,096	24,172
% of all Projects FP7	5.9%	12.2%	8.0%	7.0%	9.7%	19.9%	5.9%
% of all Projects H2020	5.3%	9.4%	7.9%	6.1%	8.8%	16.9%	5.3%

FP7 Projects per 1,000 FTE	41	39	36	32	41	48	
H2020 Projects per 1,000 FTE	30	26	32	29	30	32	

Source: Technopolis, eCorda

The following figure shows a more detailed breakdown of Norwegian project involvement each year (based on project start years). This shows (orange line) an upward tendency in the number of projects each year during FP7, but a downward tendency in the proportion of all projects that this accounts for. The trend during H2020 on both metrics is less clear, with the number and proportion of projects accounted for by Norway staying relatively stable during the 2015 to 2018 period.

Figure 0.4 FP7 and H2020 Projects with Norwegian involvement – per year



Source: Technopolis, eCorda

The number of individual Norwegian **participations in projects** was 2,185 during FP7 (1.6% of all project participations). Nearly as many project participations have been reached in H2020 (2,003 so far, or 1.7% of the total). There has been a slight increase in the share of all participations accounted for by Norway between FP7 and H2020. Only Denmark and Austria (amongst the comparators) have seen bigger increases, while the proportions accounted for by Sweden and Finland have actually fallen slightly between the two programmes.

All of the five comparator countries have higher numbers (and proportions) of participations in FP7 and H2020 projects. However, when these figures are weighted by the respective R&D populations, Norway compares better. There were 60 Norwegian participations per 1,000 FTE during FP7 and 47 per 1,000 FTE during H2020 (second highest amongst the six countries in both cases).

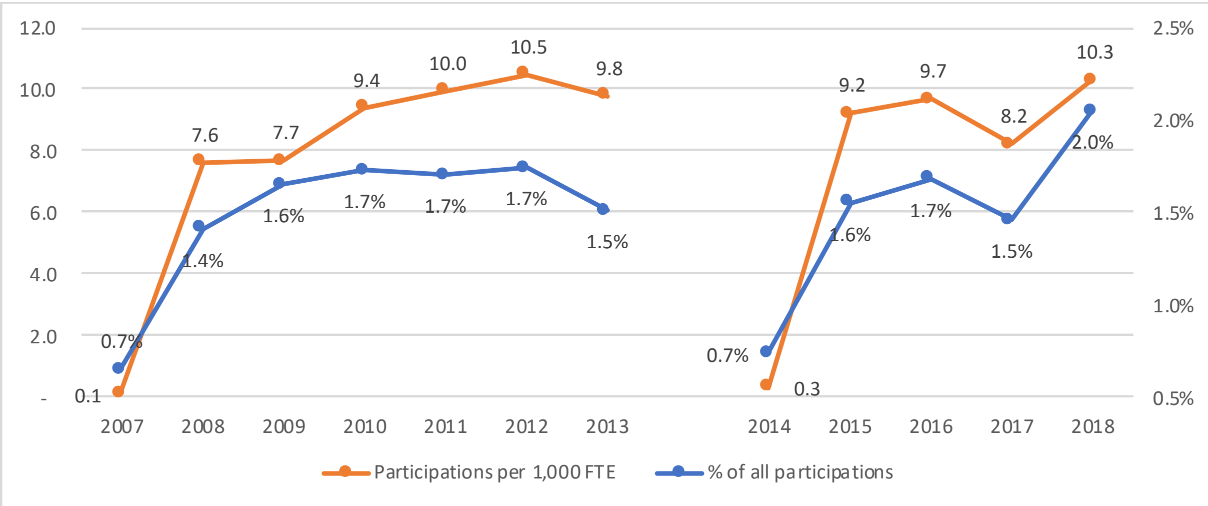
Table 0.9 Participations within FP7 and H2020 Projects

	NO	SE	DK	FI	AT	NL	All
FP7 participations	2,185	4,506	2,754	2,650	3,516	8,151	133,615
H2020 participations	2,003	3,414	2,615	2,253	3,272	7,118	115,956
% of all participations FP7	1.6%	3.4%	2.1%	2.0%	2.6%	6.1%	100%
% of all participations H2020	1.7%	2.9%	2.3%	1.9%	2.8%	6.1%	100%
FP7 participations per 1,000 FTE	60	57	49	48	59	77	
H2020 participations per 1,000 FTE	47	40	44	45	46	55	

Source: Technopolis, eCorda

The following figure shows a more detailed breakdown of Norwegian participations each year (based on project start year). This shows (orange line) an upward tendency in the number of Norwegian participations per 1,000 FTE during both FP7 and H2020 (with a slight dip in 2017). The proportion of all project participations accounted for by Norway (blue line) rose and then fell during FP7, but has then increased across much of the H2020 period (again, with a dip in 2017), reaching a new high of 2.0% in 2018.

Figure 0.5 Norwegian participations in FP7 and H2020 Projects – per year



Source: Technopolis, eCorda

The following table shows the distribution of Norwegian **participations in FP7 projects across the sub-programmes** (only those with more than 1% of participations are shown). Over half (52%) were accounted for by just five areas: ICT, research for the benefit of SMEs, Marie Curie actions, Environment and the KBBE programme. The other twelve programmes shown account for another 46%.

The final column shows the distribution of all participations (i.e. all countries) for comparison. Where Norway has an above-average concentration of participations in a sub-programme, this is shaded in the Norwegian column. This includes particularly high concentrations (compared to the average) in the SME, ENV and Energy programmes. By comparison, Norway has a particularly below-average concentration of participations in the ICT, Marie Curie and Health programmes.

Table 0.10 Participations within FP7 Projects – by sub-programme

			NO	All
CAPACITIES	SME	Research for the benefit of SMEs	14.9%	6.8%
COOPERATION	ICT	Information and Communication Technologies	11.0%	16.8%
	ENV	Environment (including Climate Change)	9.6%	5.3%
PEOPLE	PEOPLE	Marie-Curie Actions	8.9%	14.6%
COOPERATION	KBBE	Food, Agriculture, and Biotechnology	7.8%	5.9%
	ENERGY	Energy	6.3%	3.2%
	NMP	Nanosciences, Nanotechnologies, Materials and new Production Technologies	6.0%	7.7%
	HEALTH	Health	5.4%	8.5%
CAPACITIES	INFRA	Research Infrastructures	5.3%	3.9%
COOPERATION	TPT	Transport (including Aeronautics)	4.7%	6.8%
	SP1-JTI	Joint Technology Initiatives (Annex IV-SP1)	4.5%	4.3%
	SEC	Security	4.0%	2.9%
	SPA	Space	2.7%	2.0%
	SSH	Socio-economic sciences and Humanities	2.5%	2.1%
IDEAS	ERC	European Research Council	2.3%	4.0%
CAPACITIES	SiS	Science in Society	1.8%	1.4%
Euratom	Fission	Nuclear Fission and Radiation Protection	1.0%	1.5%
			2,185	**133,615**

Source: Technopolis, eCorda
Note: Excludes sub-programmes accounting for <1% of Norwegian participations

Similarly, the following table shows the distribution of Norwegian **participations in H2020 projects across sub-programmes** (only those with more than 1% of participations are shown). Nearly half (48%)

were accounted for by just four areas: MSCA, ICT, Energy and Food programmes. The other fifteen programmes shown account for another 51%.

The final column shows the distribution of all participations (i.e. all countries) for comparison. Where Norway has an above-average concentration of participations in a sub-programme, this is shaded in the Norwegian column. This includes particularly high concentrations (compared to the average) in the Energy, Food, Environment and Research Infrastructures programmes. By comparison, Norway has a particularly below-average concentration of participations in the MSCA, Health and FET programmes.

Table 0.11 Participations within H2020 Projects – by sub-programme

H2020			**NO**	**All**
Excellent Sci.	MSCA	Marie-Sklodowska-Curie Actions	13.8%	20.2%
Industrial Leadership	LEIT-ICT	Information and Communication Technologies	11.5%	11.5%
Societal Challenges	ENERGY	Secure, clean and efficient energy	11.5%	7.9%
	FOOD	Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy	11.0%	6.7%
	TPT	Smart, green and integrated transport	7.9%	8.4%
	ENV	Climate action, environment, resource efficiency and raw materials	7.6%	5.4%
Excellent Science	INFRA	Research Infrastructures	6.7%	4.5%
Societal Challenges	HEALTH	Health, demographic change and wellbeing	5.3%	7.3%
	SECURITY	Secure societies - Protecting freedom and security of Europe and its citizens	3.7%	3.0%
Excellent Science	ERC	European Research Council (ERC)	3.2%	5.0%
Industrial Leadership	INNOSUPSME	Innovation in SMEs	2.9%	3.1%
	LEIT-ADVMAT	Advanced materials	2.4%	1.7%
Societal Challenges	SOCIETY	Europe in a changing world - inclusive, innovative and reflective Societies	2.3%	2.3%
Industrial Leadership	LEIT-ADVMANU	Advanced manufacturing and processing	2.0%	2.5%
	LEIT-SPACE	Space	1.9%	1.9%
Science with / for Society	RESACCESS	Develop the accessibility and the use of the results of publicly-funded research	1.6%	0.0%
Industrial Leadership	LEIT-NMP	Nanotechnologies	1.3%	1.2%
Excellent Science	FET	Future and Emerging Technologies (FET)	1.1%	2.8%
Industrial Leadership	LEIT-BIOTECH	Biotechnology	1.0%	0.7%
			2,003	**115,956**

Source: Technopolis, eCorda,
Note: Excludes sub-programmes accounting for <1% of Norwegian participations

The following table shows the distribution of Norwegian **participations in projects by different organisation types**, first for FP7 and then for H2020. The distribution for each comparator country and for all applications is also shown, for comparison. This shows that amongst the six countries, and across both FPs, Norway's participations tend to be under-represented by HES and PRC organisations and over-represented by REC and PUB organisations.

Table 0.12 Participations within FP7 Projects – by organisation type

FP7	NO	SE	DK	FI	AT	NL	All
HES	26%	52%	49%	35%	37%	43%	37%
REC	37%	12%	12%	31%	23%	22%	25%
PRC	29%	28%	29%	26%	34%	29%	30%
PUB	7%	7%	7%	6%	5%	3%	5%
OTH	1%	1%	2%	3%	2%	2%	3%
H2020	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**	**All**
HES	29%	45%	49%	30%	28%	38%	33%
REC	31%	10%	8%	27%	23%	18%	21%
PRC	29%	34%	31%	33%	38%	35%	35%
PUB	7%	9%	7%	5%	5%	4%	6%
OTH	3%	3%	5%	4%	6%	5%	6%

Source: Technopolis,eCorda,
Note:Excludes sub-programmes accounting for <1% of Norwegian participations

EC contributions to Norwegian participations in FP7 totalled €754m (1.7% of the total), which was below that of all comparators. Norway has already achieved a higher absolute return from H2020 (€960m in EC contributions so far, 2.2% of the total), but this is still slightly below other comparators.

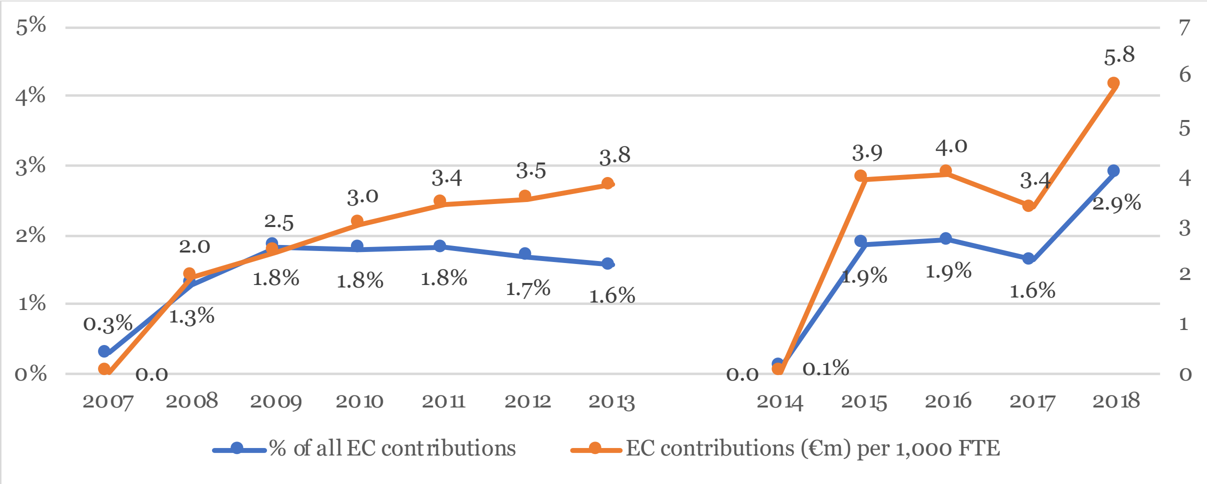
When weighted for the size of the R&D population, EC contributions to Norway compare slightly more favourably, placing the country second (FP7) and third (H2020) highest amongst the comparators.

Table 0.13 EC contributions to participations in FP7 and H2020 projects

	NO	SE	DK	FI	AT	NL
EC contributions to FP7 participations (€m)	754	1,708	1,061	876	1,184	3,330
EC contributions to H2020 participations (€m)	960	1,486	1,094	965	1,236	3,412
% of all EC contributions to FP7 participations	1.7%	3.8%	2.4%	2.0%	2.6%	7.4%
% of all EC contributions to H2020 participations	2.2%	3.4%	2.5%	2.2%	2.8%	7.9%
EC contributions to FP7 participations (€m) per 1,000 FTE	21	22	19	16	20	32
EC contributions (€m) to H2020 participations per 1,000 FTE	23	17	18	19	17	26

Source: Technopolis, eCorda,

Figure 0.6 EC contributions to Norwegian participations in FP7 and H2020 projects – per year



Source: Technopolis, eCorda,

A Norwegian organisation was the **coordinator** for 238 FP7 projects (only multi-partner projects are included). The number of MP projects coordinated by Norway during H2020 is so far a little lower (187). Three of the comparator countries have more MP project coordinators during both periods.

The proportion of all MP project coordinators that are from Norwegian organisations was 2.0% in FP7 (fourth amongst comparator countries) and 1.9% in H2020 (lowest). However, as a proportion of the MP projects that they are involved in, Norway's rate of coordination is third highest in FP7 (17%), increasing to second highest (18%) in H2020.

When weighted for the size of the R&D populations, the number of Norwegian project coordinators compares even better, being second highest in both FP7 and H2020 periods.

Table 0.14 Coordinators of FP7 and H2020 multi-partner projects

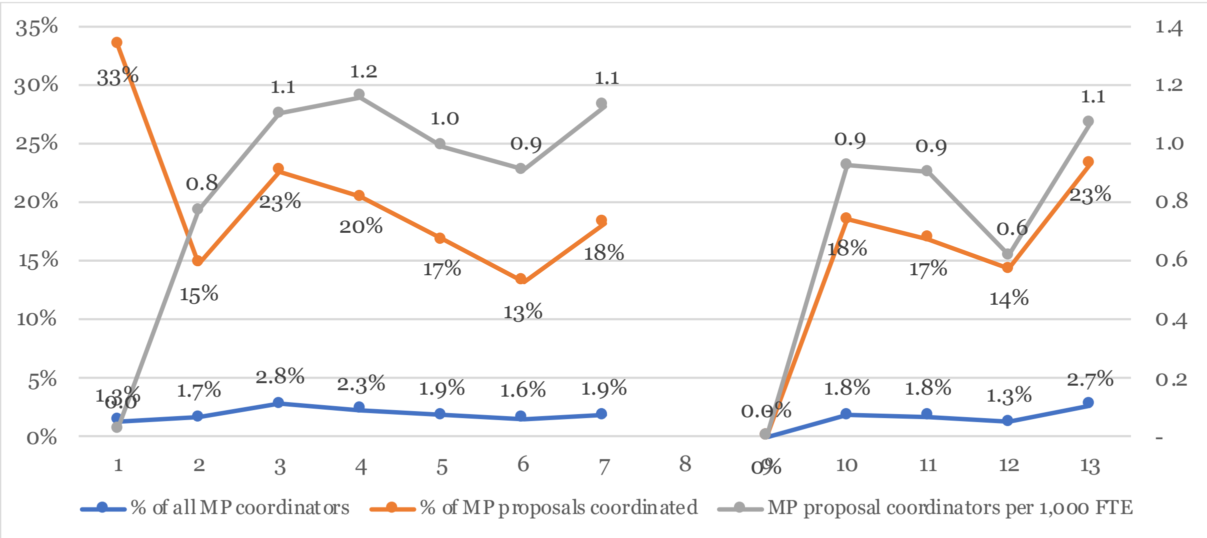
	NO	SE	DK	FI	AT	NL	All
FP7 MP project coordinators	**238**	**353**	**225**	**220**	**383**	**832**	**12055**
H2020 MP project coordinators	187	212	208	203	280	656	9619
% of all FP7 MP project coordinators	2.0%	2.9%	1.9%	1.8%	3.2%	6.9%	100.0%
% of all H2020 MP coordinators	1.9%	2.2%	2.2%	2.1%	2.9%	6.8%	100.0%

% of FP7 MP projects as coordinator	17%	13%	13%	13%	18%	20%	100%
% of H2020 MP projects as coordinator	18%	12%	16%	17%	16%	21%	100%
FP7 MP project coordinators per 1,000 FTE	6.5	4.5	4.0	4.0	6.4	7.9	
H2020 MP project coordinators per 1,000 FTE	4.4	2.5	3.5	4.1	3.9	5.1	

Source: Technopolis, eCorda,
Note: Excludes sub-programmes accounting for <1% of Norwegian participations

The following figure shows that the weighted number of Norwegian coordinators (grey line) has varied year on year, with no obvious trend across the two FPs. The proportion of all coordinators accounted for by Norway (blue line) and the proportion of Norwegian projects that Norway coordinated (orange line) have similarly moved higher and lower, with no clear trend over time.

Figure 0.7 Norwegian coordinators of FP7 and H2020 multi-partner projects – per year



Source: Technopolis, eCorda,

Increasing the quality and international success of Norwegian R&I

Introduction

The analyses below explore **indications of the evolving quality of Norwegian R&I** through assessment of scores awarded to FP proposals led by or involving Norway. This includes a particular focus on the scores for excellence. The analyses also consider the subsequent classification of proposals, focusing on those that have been ‘mainlisted’ or ‘reserved’, i.e. those evaluated as being of sufficient quality to fund (regardless of budget availability or levels of demand). These analyses look over time, compare with other countries and differentiate between stakeholder types and different programmes. They provide indications of the **changing absolute and relative quality of Norwegian R&I.**

The analyses presented at the end of the section also looks at success rates (based on funding awards) of Norwegian proposals, again looking over time, at different stakeholders and sub-programmes, and comparing with other countries. This provides indications of changes in the **ability of Norwegian R&I to compete and succeed in (evolving) international competition.**

Scores awarded to Norwegian proposals

Project proposals are evaluated according to the three evaluation criteria: Excellence (relevance to the topic of the call); Impact; and Quality and efficiency of the implementation. For each criterion experts score the proposal between 0 and 5, where 3 is the threshold. An average is then taken across the scores given. Table 0.15 provides an overview of the interpretation of scores awarded.

These scores are only available for H2020 proposals and so comparisons are not possible with FP7.

Table 0.15 H2020 - Interpretation of the proposal scoring

Score	Interpretation of the score
0	The proposal fails to address the criterion, or cannot be assessed due to missing or incomplete information.
1	Poor. The criterion is inadequately addressed, or there are serious inherent weaknesses.
2	Fair. The proposal broadly addresses the criterion, but there are significant weaknesses.
3	Good. The proposal addresses the criterion very well, but a number of shortcomings are present.
4	Very Good. The proposal addresses the criterion very well, but a small number of shortcomings are present.
5	Excellent. The proposal successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

Note: Source: European Commission: General Briefing for the evaluators, available online at: http://ec.europa.eu/information_society/news-room/cf/dae/document.cfm?action=display&doc_id=5235

H2020 **proposals** with Norwegian involvement have so far scored on average 3.68 for excellence, 3.69 for impact and 3.69 for implementation. This places the country in the bottom half of the group of six countries considered (fourth for each of the three criteria).

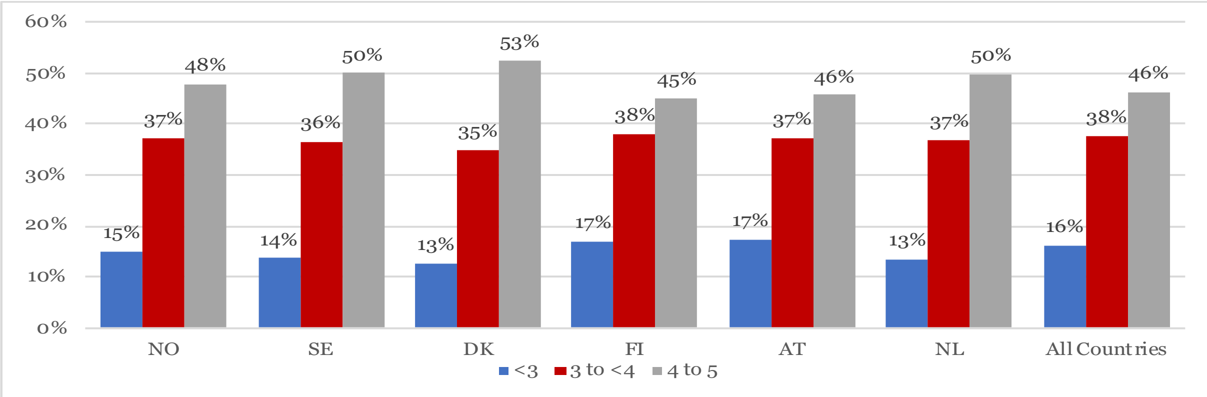
Table 0.16 Average scores for H2020 proposals involving each country

Proposals involving…	NO	SE	DK	FI	AT	NL	All
Average score for excellence	3.68	3.73	3.78	3.63	3.62	3.73	3.68
Average score for impact	3.69	3.72	3.78	3.63	3.61	3.70	3.70
Average score for implementation	3.69	3.70	3.75	3.64	3.65	3.69	3.70

Source: Technopolis, eCorda,

The following figure provides a more detailed breakdown of the spread of excellence scores for Norwegian proposals. It shows that 15% of Norwegian proposals scored less than 3 on this criterion, with only Finland and Austria having a higher proportion. 37% of Norwegian proposals were then scored between 3 and 4, while 48% scored more than 4. Sweden (50%), Denmark (53%) and the Netherlands (50%) each saw higher proportions of their proposals in the top-scoring (4+) category.

Figure 0.8 Distribution of excellence scores for H2020 proposals involving country



' Source: Technopolis, eCorda,

If we consider only **Norwegian-led proposals**, these score higher, on average, across each of the three criteria than do the other proposals that Norway is involved in. However, this is also true for all of the comparator countries and so Norway maintains fourth position for both excellence and impact scores (and drops to fifth out of the six countries for implementation scores).

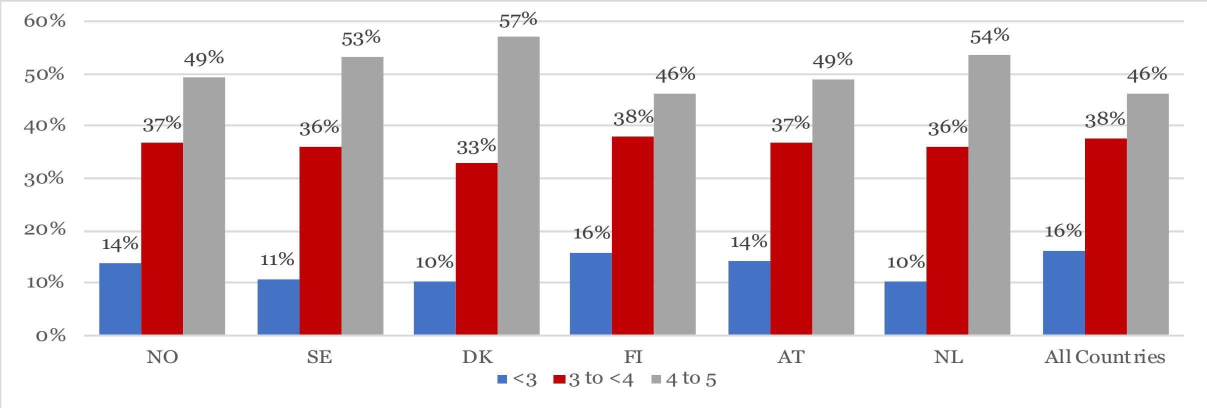
Table 0.17 Average scores for H2020 proposals led by each country

Proposals led by…	NO	SE	DK	FI	AT	NL	All
Average score for excellence	3.74	3.83	3.89	3.68	3.73	3.84	3.68
Average score for impact	3.77	3.83	3.95	3.70	3.73	3.81	3.70
Average score for implementation	3.76	3.80	3.89	3.71	3.78	3.78	3.70

Source: Technopolis, eCorda,

The following figure provides a more detailed breakdown of the spread of excellence scores for Norwegian-led proposals. It shows that 14% of Norwegian-led proposals scored less than 3 on this criteria. This is a slightly smaller proportion than for proposals with any form of Norwegian involvement, but is still third highest amongst the comparator countries (one place higher than for all Norwegian proposals). Nearly half (49%) of Norwegian-led H2020 proposals achieve a score 4 or above for excellence, which is the fourth highest average amongst the six countries shown.

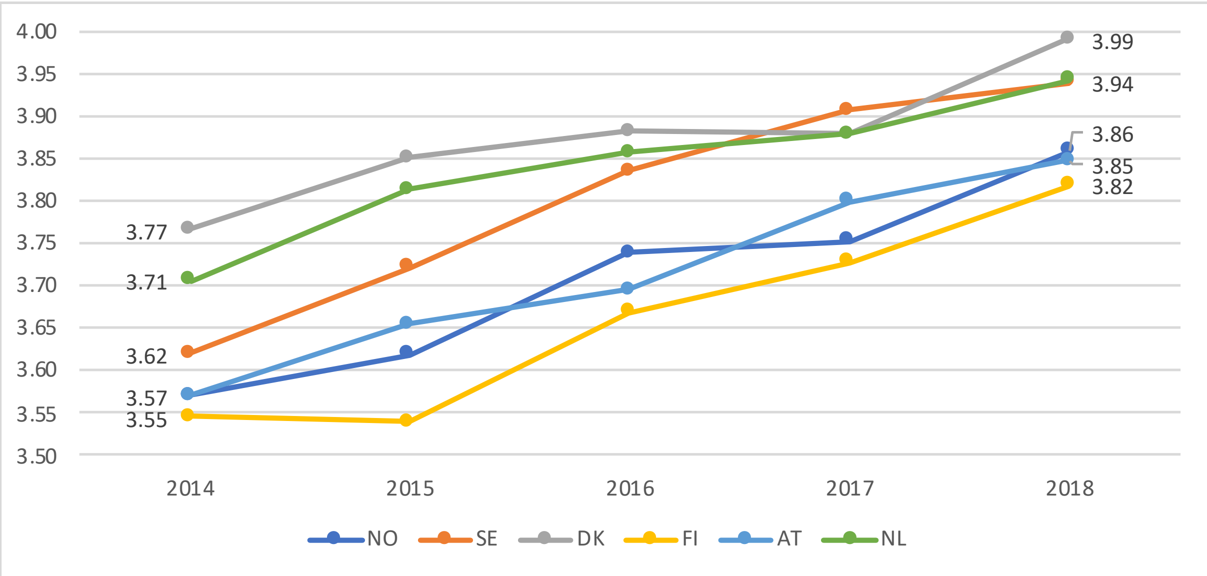
Figure 0.9 Distribution of excellence scores for H2020 proposals led by country



Source: Technopolis, eCorda,

The figure below shows how the average excellence scores for proposals led by each country have changed during the first five years of H2020. In all cases the trend is upwards, with a year-on-year increase throughout the period in nearly all cases. For Norway, its average excellence scores have increased from 3.57 for proposals submitted in the first year of H2020 to 3.86 in 2018. The other five comparator countries have seen similar increases.

Figure 0.10 Excellence scores for H2020 proposals led by country – by year of submission



Source: Technopolis, eCorda,

The following table shows the average excellence scores for different **sub-programmes** of H2020. Areas with less than 10 Norwegian proposals have been excluded. There are four sub-programmes where excellence scores are above average for Norway. These are InnosupSME, NMP, MSCA and Space. In two of these areas (NMP and Space), Norway also outperforms all of the comparator countries as well. Other areas where Norway outperforms all comparator countries, but where Norwegian-led proposals don't score as highly as the abovementioned programmes, are security and advanced materials. By comparison, in the three programmes at the bottom of the table (health, environment and energy), Norwegian-led proposals score less than they do in other sub-programmes, while these scores are also below most, if not all of the comparator countries in these areas as well.

Table 0.18 Average excellence scores for H2020 proposals led by each country – by sub-programme

Average Score	NO	SE	DK	FI	AT	NL
INNOSUPSME	4.02	4.03	4.04	3.91	4.13	3.97
LEIT-NMP	3.95	3.86	3.88	3.69	3.79	3.84
MSCA	3.94	3.98	4.04	3.88	3.92	4.09
LEIT-SPACE	3.82	3.64	3.57	3.60	3.57	3.83
LEIT-BIOTECH	3.72	4.01	4.03	3.87	3.89	3.83
FET	3.71	3.77	3.83	3.71	3.75	3.94
CROSST	3.70	3.63	3.96	3.58	3.62	3.85
SECURITY	3.69	3.54	4.07	3.61	3.55	3.65
INFRA	3.62	3.91	4.06	4.07	3.88	3.81
LEIT-ADVMAT	3.59	3.30	3.28	3.24	3.31	3.36
TPT	3.58	3.71	3.67	3.56	3.63	3.52
LEIT-ICT	3.58	3.70	3.57	3.60	3.64	3.54
FOOD	3.57	3.47	3.58	3.46	3.48	3.60
SOCIETY	3.55	3.54	3.67	3.47	3.47	3.63
LEIT-ADVMANU	3.52	3.63	3.29	3.34	3.56	3.46
HEALTH	3.51	3.65	3.64	3.56	3.50	3.68
ENV	3.50	3.73	3.64	3.58	3.50	3.61
ENERGY	3.43	3.47	3.60	3.45	3.36	3.37
H2020	**3.74**	**3.83**	**3.89**	**3.68**	**3.73**	**3.84**

Source: Technopolis, eCorda,
Note: Sub-programmes where Norway has led 10 or fewer proposals have been excluded

Norwegian-led proposals have tended to score more highly for excellence when led by HES (university) or PRC (industry) **organisation types**. However, this is also true of the comparator countries, and Norway ranks in the bottom half of this group of six countries for the average scores of these types of organisation.

Proposals led by Norwegian PUB (public) and OTH (other) organisations score slightly less, but better than all of the other countries shown. The lowest excellence scores for Norway are achieved by REC (research) organisations. Their average score is also lower than in four of the comparators (all except Sweden).

Table 0.19 Average excellence scores for H2020 proposals led by each country – by organisation type

	NO	SE	DK	FI	AT	NL
HES	3.78	3.82	3.94	3.61	3.77	3.94
PRC	3.78	3.88	3.86	3.77	3.76	3.74
PUB	3.66	3.62	3.55	3.61	3.57	3.58
OTH	3.63	3.62	3.12	3.47	3.44	3.52
REC	3.52	3.46	3.58	3.52	3.61	3.79
All	**3.74**	**3.83**	**3.89**	**3.68**	**3.73**	**3.84**

Source: Technopolis, eCorda,
Note: Sub-programmes where Norway has led 10 or fewer proposals have been excluded

Classification of Norwegian proposals

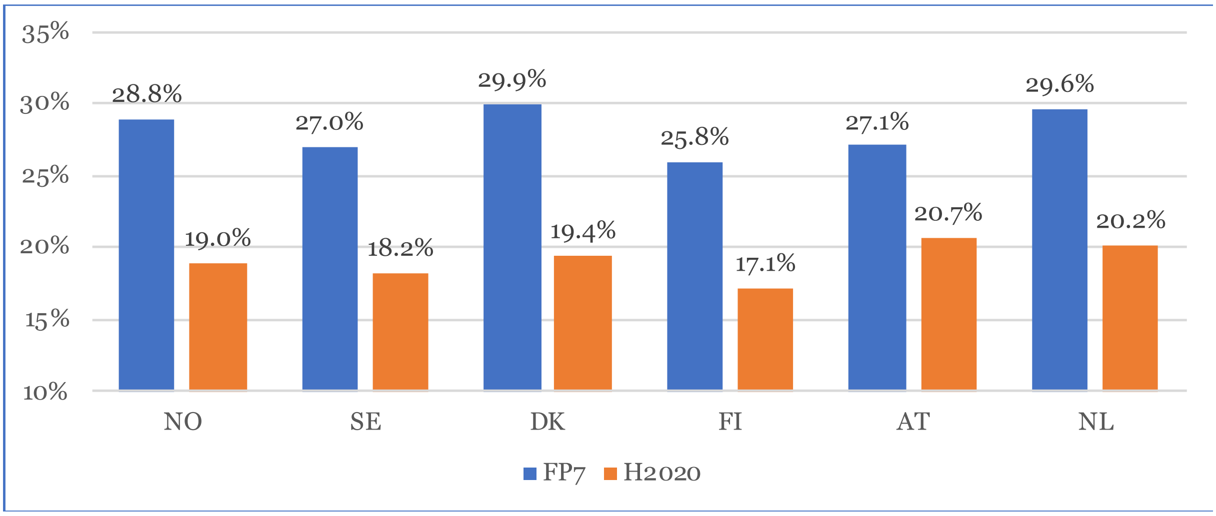
eCorda data also indicates the **evaluation classification** for each proposal, which provides a broad indication of relative quality between proposals. The main categories are:

- Mainlist – to be funded, subject to contract
- Reserve list – will fund if money becomes available (i.e. if mainlist proposals are withdrawn or additional budget becomes available)
- No money [used H2020 only] – All other proposals above threshold score, but not included above
- Rejected – ineligible proposals, proposals below threshold and [for FP7 only] other proposals above threshold but not included above

We have focused the analyses in this section on the proportion of proposals that fall within the first two categories, mainlist and reserve (i.e. those that are evaluated as being of sufficient quality to be funded, regardless of whether they eventually are). Data for both FP7 and H2020 proposals is available.

FP7 **proposals involving** Norway were classified as mainlist / reserve in 29% of cases. This is one of the highest rates amongst comparator countries, only exceeded by Denmark and the Netherlands (both 30%). H2020 proposals involving Norway were classified as mainlist/reserve in only 19% of cases. The rate has dropped similarly for all countries between the programmes, but Norway's proportion now also sits below that of Austria, in addition to Denmark and the Netherlands.

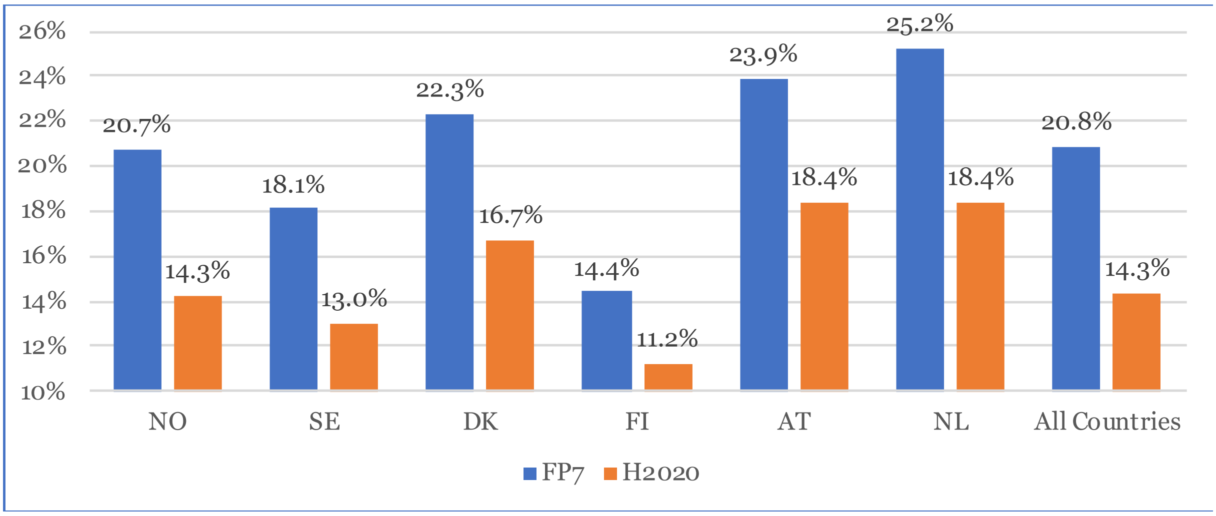
Figure 0.11 Proportion of FP7 and H2020 proposals involved in that are classified as mainlist / reserve



Source: Technopolis, eCorda,

FP7 **proposals led** by Norway were classified as mainlist / reserve in 21% of cases. This is below that of all comparator countries, except Sweden and Finland. H2020 proposals have been much less likely to be classified as mainlist/reserve (both in Norway and generally). 14% of Norwegian-led H2020 proposals have been classified in this way. Again this is below that of all comparator countries, except Sweden and Finland.

Figure 0.12 Proportion of FP7 and H2020 proposals led that are classified as mainlist / reserve



Source: Technopolis, eCorda,

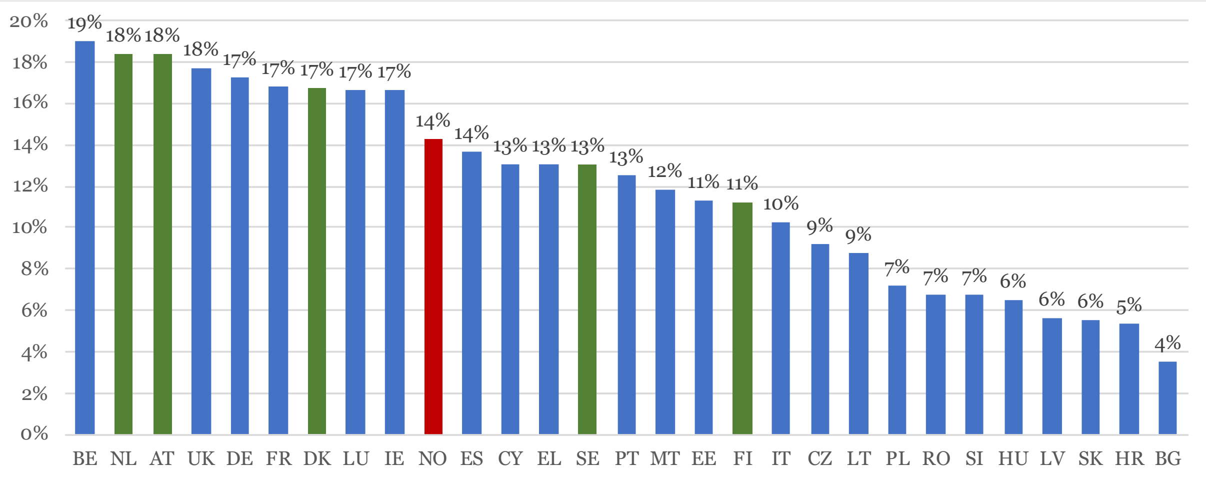
A comparison of the previous two figures might suggest that Norway (and indeed all of the comparator countries) do not perform as well when they coordinate a proposal, compared to when they are just partners. For example, these plots show that 19 per cent of the H2020 proposals that Norway was involved in were mainlisted / reserved, while this is true for only 14 per cent of those that were led by Norway. However, the two figures are not directly comparable, and such conclusions should not be drawn.

Mainlist / reserve rates tend to be higher (on average) for proposals with more partners[80]. This is likely to mainly reflect differences between the programme themes in both: (i) allowable / suitable consortia sizes; and (ii) levels of competition (i.e. success rates). For example, ERC and INNOSUPSME proposals are nearly always single-applicant and these two programmes are also amongst the most competitive areas of H2020 (i.e. with some of the lowest mainlist/reserve rates).

In the first figure above the larger proposals (those that are also, on average, more often mainlisted / reserved) are being counted multiple times, once for each country involved – while in the second figure they will only be counted once, for just one country. Therefore, the larger (and, on average, more successful) proposals are given greater weight in the calculation of overall rates in the first figure (proposals involved in) than they are in the second (proposals led). As a result, the mainlist / reserve rates for all countries falls when one moves from the first way of looking at the data to the second.

As the following figure shows, the mainlist / reserve rate for Norwegian-led proposals actually compares quite favourably against the majority of EU28 countries.

Figure 0.13 Proportion of H2020 proposals led that are classified as mainlist / reserve, by country

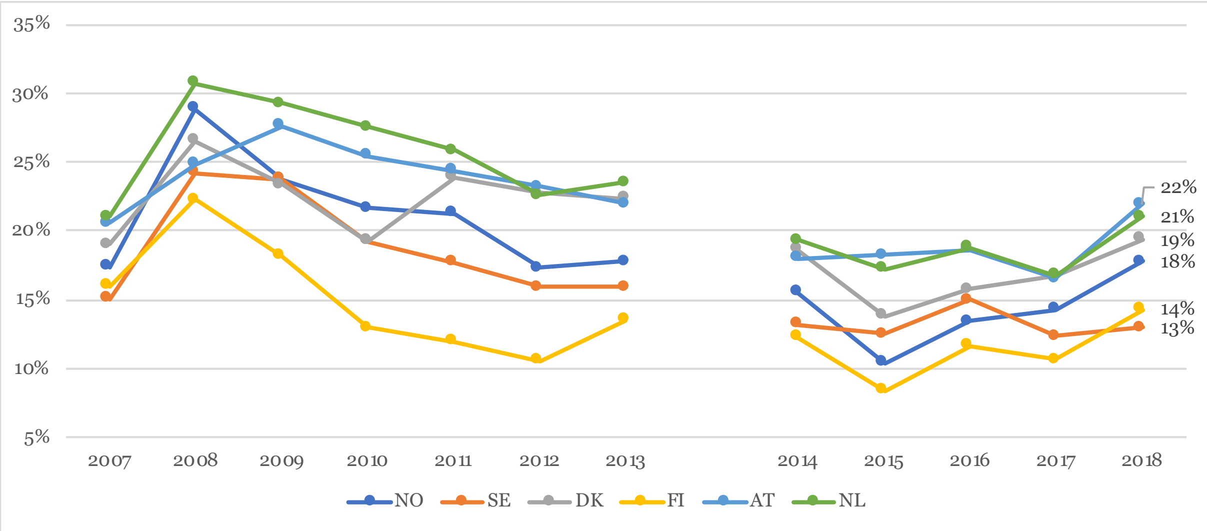


Source: Technopolis, eCorda,

[80] The average mainlist/reserve rate for different H2020 proposals: 1 partner (12%), 1-5 partners (13%), 6-10 partners (17%), 11-15 partners (19%), 16-20 partners (23%), 21-30 partners (31%) and 31+ partners (46%).

The proportion of Norwegian-led proposals classified as mainlist or reserve declined throughout much of FP7, as it did for most comparator countries as well. Since 2005, Norway has seen year-on-year increases however, and in the last couple of years the rate has come close to that of the highest achieving countries (Sweden, Austria and the Netherlands), which themselves have seen less improvement.

Figure 0.14 Proportion of FP7 and H2020 proposals led that are classified as mainlist / reserve – per year



Source: Technopolis, eCorda,

During FP7, Norwegian-led proposals were most frequently mainlisted/reserved in the KBBE, JTI, SiS, SPA and INFRA sub-programmes (at least half of proposals in each case). In SiS in particular, Norway outperformed all of the comparator countries. Other areas of note further down the table, where a much lower proportion of Norwegian-led proposals are mainlisted/reserved, but where Norway still performs well in comparison with other countries, include the SME and Environment sub-programmes.

Norway is amongst the bottom 2 countries (out of six) for its proportion of mainlist/reserve proposals in the areas of People, NMP, Health, SSH and ERC.

Table 0.20 Proportion of FP7 proposals led that are classified as mainlist / reserve – by sub-programme

Theme	NO	SE	DK	FI	AT	NL
KBBE	69%	66%	75%	53%	55%	77%
SP1-JTI	57%	58%	53%	34%	65%	51%
SiS	55%	33%	50%	18%	35%	39%
SPA	50%	41%	33%	43%	56%	43%
INFRA	50%	53%	38%	63%	25%	38%
TPT	41%	32%	45%	50%	40%	36%
ENERGY	31%	34%	36%	30%	23%	34%
SME	28%	13%	25%	11%	19%	21%

ENV	27%	17%	21%	13%	20%	31%
SEC	23%	26%	11%	20%	31%	24%
PEOPLE	21%	22%	25%	18%	27%	28%
ICT	19%	14%	15%	14%	21%	20%
NMP	16%	14%	22%	16%	23%	21%
HEALTH	14%	20%	17%	17%	20%	23%
SSH	10%	10%	19%	16%	20%	24%
ERC	9%	10%	11%	6%	13%	16%
FP7	**21%**	**18%**	**22%**	**14%**	**24%**	**25%**

Source: Technopolis, eCorda,
Note: Sub-programmes where Norway has led 10 or fewer proposals have been excluded

In H2020, Norwegian-led proposals were most frequently mainlisted/reserved in the INFRA, SPACE and ADVMANU sub-programmes (30%+ of proposals in each case). In the last two cases in particular, Norway outperformed all of the comparator countries. Other areas of note further down the table, where a lower proportion of Norwegian-led proposals are mainlisted/reserved, but where Norway still performs well in comparison with other countries (i.e. one of the top two), include the FOOD, ADVMAT, ENERGY, NMP and INNOSUPSME sub-programmes. Norway is amongst the bottom 2 countries for its proportion of mainlist/reserve proposals in INFRA, TPT, ERC, BIOTECH, HEALTH and FET.

Table 0.21 Proportion of H2020 proposals led that are classified as mainlist / reserve – by sub-programme

Theme	NO	SE	DK	FI	AT	NL
INFRA	38%	39%	22%	50%	42%	42%
LEIT-SPACE	38%	16%	18%	14%	27%	23%
LEIT-ADVMANU	31%	21%	10%	22%	19%	22%
FOOD	25%	14%	21%	23%	19%	25%
LEIT-ADVMAT	22%	9%	10%	17%	21%	9%
ENERGY	21%	13%	20%	17%	25%	17%
TPT	17%	24%	21%	14%	36%	30%
MSCA	16%	16%	22%	14%	18%	21%
ENV	16%	9%	18%	13%	16%	16%
LEIT-NMP	14%	5%	12%	4%	17%	8%
SECURITY	13.3%	10.5%	13.0%	7.0%	17.3%	14.0%
INNOSUPSME	12.3%	8.5%	11.7%	9.0%	15.4%	11.6%
LEIT-ICT	12.1%	10.9%	10.2%	10.4%	19.0%	13.0%
SOCIETY	11.7%	14.3%	8.8%	8.0%	10.2%	17.9%
ERC	9.5%	12.8%	13.3%	9.4%	18.2%	19.2%
CROSST	8.8%	0.0%	7.4%	2.4%	4.2%	10.7%
LEIT-BIOTECH	8.1%	9.6%	22.2%	10.0%	13.6%	14.9%
HEALTH	7.2%	11.4%	8.2%	4.8%	9.0%	14.2%
FET	3.7%	11.8%	8.1%	6.9%	11.6%	11.2%
H2020	**14%**	**13%**	**17%**	**11%**	**18%**	**18%**

Source: Technopolis, eCorda,
Note: Sub-programmes where Norway has led 10 or fewer proposals have been excluded

Norwegian-led FP7 proposals that are coordinated by PUB organisations are most likely to be classified as mainlist/reserve. Indeed, Norway's rate here (58%) far outperforms the other comparator countries. REC and PRC-led Norwegian proposals do slightly less well, while the mainlist/reserve rate for Norwegian HES (20%) is below that of all comparator countries except Finland.

Table 0.22 Proportion of FP7 proposals led that are classified as mainlist / reserve – by organisation type

Org Type	NO	SE	DK	FI	AT	NL
PUB	58%	46%	27%	42%	45%	40%
REC	30%	29%	25%	28%	29%	37%
PRC	27%	24%	31%	24%	28%	29%
OTH	24%	19%	28%	21%	28%	29%
HES	20%	21%	26%	16%	25%	27%
FP7	**21%**	**18%**	**22%**	**14%**	**24%**	**25%**

Source: Technopolis, eCorda,

In H2020 Norwegian PUB-led proposals continue to do well (overall and in comparison, with other countries), but PRC rates are among the lowest.

Table 0.23 Proportion of H2020 proposals led that are classified as mainlist / reserve – by organisation type

Org Type	NO	SE	DK	FI	AT	NL
OTH	30%	21%	17%	32%	35%	29%
PUB	26%	25%	22%	19%	54%	24%
REC	23%	16%	20%	23%	22%	29%
HES	15%	15%	19%	11%	17%	20%
PRC	10%	10%	11%	8%	17%	12%
H2020	**14%**	**13%**	**17%**	**11%**	**18%**	**18%**

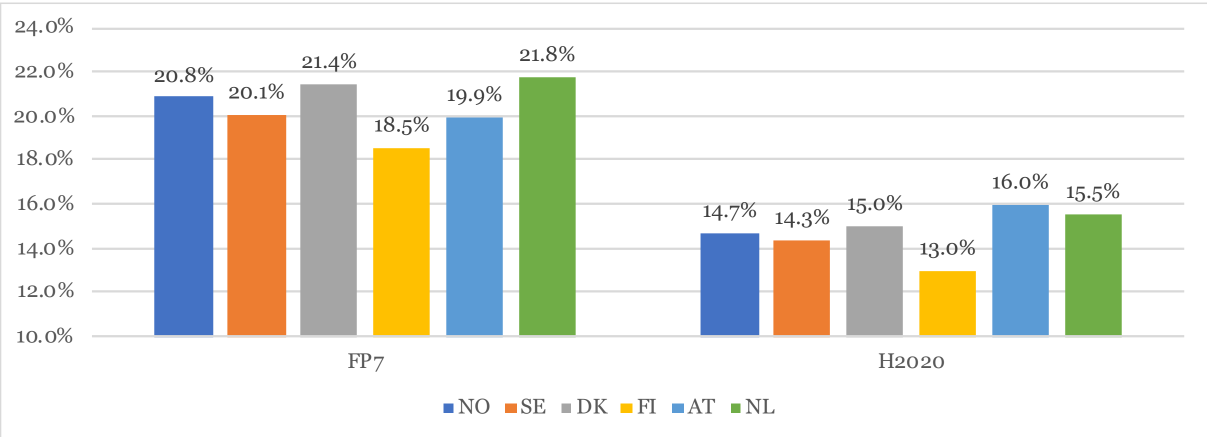
Source: Technopolis, eCorda,

Success rates of Norwegian proposals

The final part of this section looks at success rates (based on funding awards), which provide an indication of the ability of Norwegian R&I to compete and succeed in evolving international competition.

The following figure shows the proportion of **proposals** that a country was **involved in** that have gone on to be awarded grants. During FP7, 21% of proposals with Norwegian involvement went on to be awarded funding. This is slightly below the rates seen in the Netherlands (22%) and Denmark (21%), but above the three other comparator countries. During H2020 so far, 15% of proposals with Norwegian involvement have been awarded funding. This places the country fourth out of the six shown, only above Sweden and Finland.

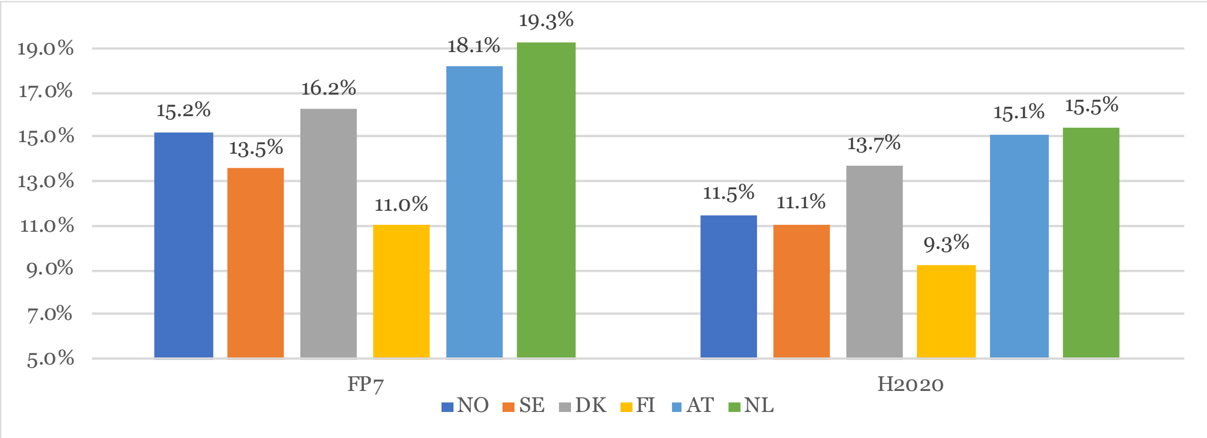
Figure 0.15 Proportion of FP7 and H2020 proposals involved in that have been awarded grants



Source: Technopolis, eCorda,

Amongst FP7 proposals that were led by Norway, 15% were awarded funding. This is below three of the comparator countries, but higher than Sweden and Finland. The same pattern has occurred in H2020 so far, with 12% of Norwegian-led proposals being funded, placing it fourth out of the six countries shown.

Figure 0.16 Proportion of FP7 and H2020 proposals led that have been awarded grants

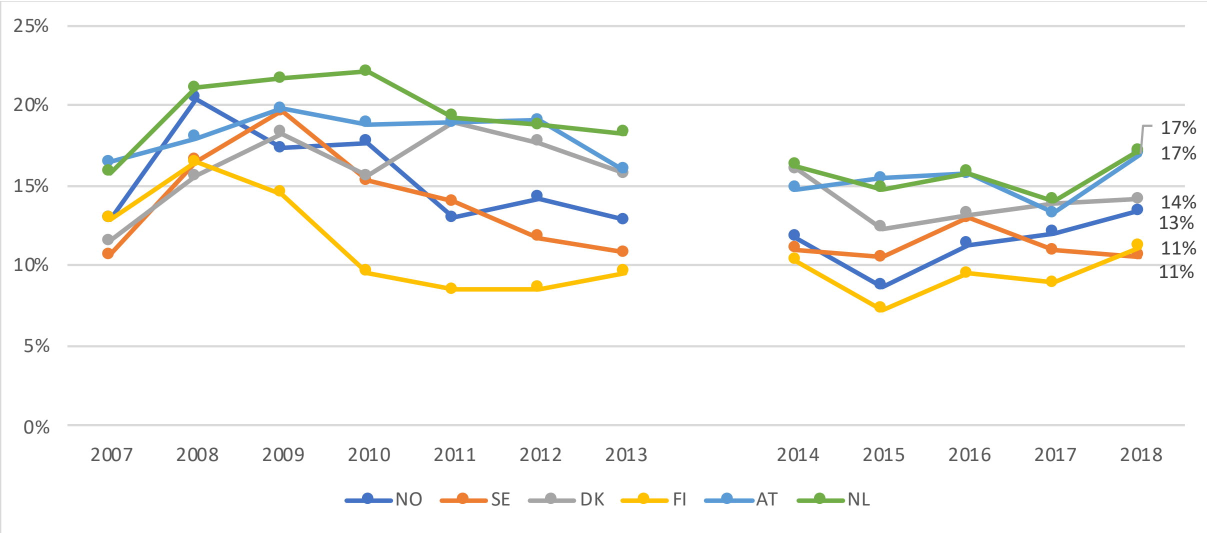


Source: Technopolis, eCorda,

Again, for the same reasons given previously, the two figures above (proposals involved in and proposals led) are not comparable. The lower award rate for proposals led (compared to proposals involved in) for all six countries does not mean that these countries perform badly when acting as the coordinator.

The following figure charts the annual movements in these figures (i.e. the proportion of proposals submitted each year, led by the country, which have then been funded). It shows a general downward trend in Norway's performance during FP7 – a pattern that was matched by several of the comparator countries. The trend has reversed during H2020, with an increasing proportion of Norwegian-led proposals being successful each year between 2015 and 2018. While several of the comparator countries have also seen an upward trend, Norway's appears to be more significant.

Figure 0.17 Proportion of FP7 and H2020 proposals led that have been awarded grants – per submission year



Source: Technopolis, eCorda,

Now looking within the results for FP7, we see that Norway's highest rates of success were in the SiS, INFRA, SPA and JTI sub-programmes, where 30% or more of proposals led have been successful. Relative to its comparators, Norway has been particularly successful (i.e. one of the top two countries) in SiS, SME, ENERGY and ENV sub-programmes.

Norway's lowest rates of success were in SSH and ERC, where only 6% and 7% (respectively) of the proposals the country led were funded. Relative to its comparators, Norway was particularly unsuccessful (i.e. one of the bottom two countries) in SSH, ERC, HEALTH and NMP.

Table 0.24 Proportion of FP7 proposals led that have been awarded grants – by sub-programme

Theme	NO	SE	DK	FI	AT	NL
SiS	40%	33%	43%	9%	18%	25%
INFRA	33%	53%	38%	63%	25%	38%
SPA	32%	29%	17%	30%	40%	40%
SP1-JTI	30%	41%	30%	20%	35%	29%
SME	25%	12%	22%	11%	17%	17%
TPT	23%	22%	15%	36%	31%	24%
ENERGY	23%	17%	24%	20%	12%	22%
SEC	20%	24%	11%	13%	25%	18%
ENV	19%	16%	14%	11%	15%	28%
KBBE	17%	14%	22%	16%	16%	30%
PEOPLE	17%	16%	19%	14%	21%	22%
ICT	15%	11%	13%	12%	18%	16%
NMP	15%	12%	17%	15%	19%	18%
HEALTH	14%	18%	15%	16%	18%	21%
ERC	7%	9%	9%	5%	12%	14%
SSH	6%	5%	12%	11%	13%	16%
FP7	**15%**	**14%**	**16%**	**11%**	**18%**	**19%**

Source: Technopolis, eCorda,
Sub-programmes where Norway has led 10 or fewer proposals have been excluded

Within the sub-programmes of H2020, Norwegian-led proposals were most often successful within the SPACE and INFRA areas. Relative to comparators, Norway's success rate was high (in the top two) in SPACE, ADVMANU, ADVMAT, FOOD, ENERGY, InnosupSME and ICT programmes.

Norway's lowest rates of success were for proposals led in FET, BIOTECH and HEALTH. Relative to comparators, Norway performed poorly (bottom two) in these three areas, plus ERC, ENV and TPT.

Table 0.25 Proportion of H2020 proposals led that have been awarded grants – by sub-programme

	NO	SE	DK	FI	AT	NL
LEIT-SPACE	33%	9%	0%	8%	23%	19%
INFRA	31%	39%	0%	44%	42%	35%
LEIT-ADVMANU	28%	21%	5%	19%	16%	20%
LEIT-ADVMAT	19%	6%	3%	9%	7%	4%
FOOD	16%	10%	13%	13%	12%	14%
ENERGY	15%	11%	15%	12%	18%	12%
MSCA	13%	13%	17%	11%	15%	18%
INNOSUPSME	12%	8%	12%	8%	14%	11%
TPT	12%	15%	19%	13%	26%	19%
SECURITY	11%	9%	13%	7%	12%	9%
LEIT-NMP	11%	5%	11%	4%	15%	8%
LEIT-ICT	11%	10%	9%	8%	16%	10%
ENV	10%	9%	14%	11%	12%	11%
ERC	9%	12%	13%	9%	17%	18%
CROSST	9%	0%	7%	2%	4%	11%
SOCIETY	8%	8%	7%	7%	8%	11%
HEALTH	6%	10%	8%	4%	7%	12%
LEIT-BIOTECH	5%	10%	13%	7%	5%	13%
FET	4%	11%	8%	6%	11%	10%
H2020	**11%**	**11%**	**14%**	**9%**	**15%**	**15%**

Source: Technopolis, eCorda,
Sub-programmes where Norway has led 10 or fewer proposals have been excluded

Norwegian-led FP7 proposals with a PUB coordinator performed well-above the country average, as well as above that of PUB in all comparator countries. Norwegian proposals led by PRC and REC organisations were also more successful than the Norwegian average, and middle-ranking amongst the comparator countries. HES-led Norwegian proposals were least often successful – however this also tended to be true in other countries as well.

Table 0.26 Proportion of FP7 proposals led that have been awarded grants – by organisation type

Org Type	NO	SE	DK	FI	AT	NL
PUB	54%	37%	25%	36%	37%	34%
OTH	21%	10%	27%	21%	19%	23%
REC	20%	19%	16%	19%	21%	27%
PRC	20%	19%	22%	19%	21%	20%
HES	14%	15%	18%	12%	19%	20%
FP7	**15%**	**14%**	**16%**	**11%**	**18%**	**19%**

Source: Technopolis, eCorda,

In H2020 Norwegian PUB again do well, though not at the rates seen in FP7. Norwegian REC performance is also above average. The PRC and HES success rates are both lower (10% and 11%) respectively – in both cases, putting Norway in the bottom three out of the six countries.

Table 0.27 Proportion of H2020 proposals led that have been awarded grants – by organisation type

Org Type	NO	SE	DK	FI	AT	NL
OTH	22%	18%	17%	29%	25%	23%
PUB	22%	25%	19%	19%	39%	23%
REC	16%	11%	14%	15%	16%	20%
HES	11%	12%	15%	9%	14%	17%
PRC	10%	9%	11%	7%	15%	11%
H2020	**11%**	**11%**	**14%**	**9%**	**15%**	**15%**

Source: Technopolis, eCorda

New patterns of Norwegian cooperation across national borders, sectors and fields

Introduction

The analyses below assess the **changing patterns and extent of Norwegian collaboration** within FP proposals and projects**.** This considers both internal cooperation (e.g. Norwegian institutes partnering with Norwegian companies), as well as external (i.e. cross-border) collaboration with other countries. It looks over time, across FP sub-programmes and includes comparison with other countries. A specific analysis of mobility through MSCA is also included, focusing on participants originating from or residing in Norway through these actions and comparing this with other nations.

These analyses provide insight into the extent and configuration of Norwegian R&I collaboration and mobility that has been funded through the FP, as well as evidence of evolving patterns of cooperation – across borders and sectors - that have emerged over time.

Internal Norwegian cooperation

During **FP7**, more than one-quarter (29%) of multi-partner (MP) **proposals** involving Norway had more than one Norwegian applicant involved (see table below). This is the second highest rate amongst the comparator countries, only behind the Netherlands (35%). In fact, the average number of Norwegian organisations involved in a Norwegian MP proposal was 1.43 during FP7.

If we consider only those FP7 MP proposals that were led by Norway, then the proportion involving more than one Norwegian applicant increases significantly (to 61%), with 2.08 Norwegian participants involved (on average) in each Norwegian-led multi-partner FP7 proposal.

Table 0.28 MP FP7 proposals involving multiple applicants from the same country

Proportion of MP proposals involved in that have…	NO	SE	DK	FI	AT	NL
1 applicant from country	71%	72%	75%	72%	73%	65%
2 or more applicants from country	29%	28%	25%	28%	27%	35%
Total MP proposals	5,959	12,066	7,429	7,837	10,308	18,060
Average number of applicants from country	1.43	1.45	1.37	1.47	1.41	1.56

Source: Technopolis, eCorda

The following table shows the combinations of internal cooperation that existed within Norway's FP7 MP proposals. For instance, amongst the 1,710 MP proposals involving multiple Norwegian partners (i.e. 29% of the total 5,959 MP proposals involving Norway), there were 332 involving multiple Norwegian PRC organisations, 194 involving multiple Norwegian REC organisations, 128 involving multiple Norwegian HES organisations and 23 involving multiple Norwegian PUB organisations.

There were higher numbers involving combinations of different types of Norwegian organisation. IN particular, 621 proposal involved both a Norwegian REC and a Norwegian PRC, while 349 combined Norwegian HES and PRC organisations and 337 combined Norwegian HES and REC organisations.

Table 0.29 Number of Norwegian FP7 MP proposals (by combination of organisation types from Norway)

	HES	REC	PRC	PUB	OTH
HES	128	337	349	68	63
REC		194	621	92	116
PRC			332	44	120
PUB				23	16
OTH					93

Source: Technopolis, eCorda

Note: Numbers do not sum to the total number of MP proposals involving multiple Norwegian applicants, as e.g. a proposal in the HES-HES box may also appear in the HES-REC box.

In terms of **FP7 MP projects**, a third of those with Norwegian involvement had more than one Norwegian participant (third highest amongst comparator countries). In fact, Norwegian MP projects involved 1.5 Norwegian participants each on average.

If we consider only FP7 MP projects that were led by Norway, then two thirds (64%) involved more than one Norwegian participant, with 2.1 Norwegian organisations involved in MP projects on average.

Table 0.30 MP FP7 Projects involving multiple Participants from the same country

Proportion of MP projects involved in that have…	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
1 participant from country	67%	67%	71%	69%	69%	57%
2 or more participants from country	33%	33%	29%	31%	31%	43%
Total MP projects	1,373	2,711	1,733	1,644	2,144	4,222
Average number of participants from country	1.51	1.52	1.43	1.53	1.50	1.74

Source: Technopolis, eCorda

Amongst the 452 MP projects with more than one Norwegian participant, nearly half involved both REC and PRC organisations (212), while around a quarter each contained combinations of Norwegian HES and REC and Norwegian PRC with PRC.

Table 0.31 Number of Norwegian FP7 MP Projects (by combination of organisation types from Norway)

	HES	REC	PRC	PUB	OTH
HES	44	101	73	18	3
REC		72	212	29	11
PRC			105	18	12
PUB				8	3
OTH					2

Source: Technopolis, eCorda

During **H2020**, nearly one-third (32%) of multi-partner **proposals** involving Norway had more than one Norwegian applicant involved (see table below). This is the third highest rate amongst the comparator countries, behind the Netherlands (42%) and Finland (34%), and above the proportion achieved during FP7 (29%). In fact, the average number of Norwegian organisations involved in a Norwegian MP proposal was 1.55 during H2020 (above the 1.43 achieved during FP7).

If we consider only those H2020 MP proposals that were led by Norway, then the proportion involving more than one Norwegian applicant increases significantly (to 60%), with 2.2 Norwegian participants involved (on average) in each Norwegian-led multi-partner H2020 proposal. This is similar to that achieved for FP7 MP proposals led by Norway.

Table 0.32 MP H2020 proposals involving multiple applicants from the same country

Proportion of MP proposals involved in that have…	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
1 applicant from country	68%	69%	69%	66%	70%	58%
2 or more applicants from country	32%	31%	31%	34%	30%	42%
Total MP proposals	6,024	10,645	8,225	7,426	104,94	18,871
Average number of applicants from country	1.55	1.52	1.51	1.60	1.47	1.76

Source: Technopolis, eCorda

Amongst the 1,947 MP H2020 proposals involving multiple Norwegian partners, there were 696 combining Norwegian REC and PRC organisations, 535 combining Norwegian HES and REC and 519 involving more than one Norwegian PRC.

Table 0.33 Number of Norwegian H2020 MP proposals (by combination of organisation types from Norway)

	HES	REC	PRC	PUB	OTH
HES	220	535	718	99	44
REC		217	696	106	37
PRC			519	110	44
PUB				21	22
OTH					3

Source: Technopolis, eCorda

In terms of **H2020 MP projects**, more than one third (39%) of those with Norwegian involvement had more than one Norwegian participant (second highest amongst comparator countries, and higher than the 39% achieved in FP7). In fact, Norwegian MP H2020 projects involved 1.7 Norwegian participants each on average, slightly above the 1.5 per project average in FP7.

If we consider only H2020 MP projects that were led by Norway, then more than two thirds (70%) involved more than one Norwegian participant (above the 64% seen in FP7), with 2.1 Norwegian organisations involved in MP projects on average.

Table 0.34 MP H2020 Projects involving multiple Participants from the same country

Proportion of MP projects involved in that have…	NO	SE	DK	FI	AT	NL
1 participant from country	61%	65%	70%	65%	65%	53%
2 or more participants from country	39%	35%	30%	35%	35%	47%
Total MP projects	1,030	1,768	1,321	1,192	1,761	3,103
Average number of participants from country	1.7	1.6	1.5	1.7	1.7	2.0

Source: Technopolis, eCorda

Amongst the 400 MP H2020 projects with more than one Norwegian participant, approximately one third involved more than one Norwegian REC organisation (138), another third combined Norwegian REC and PRC (124) and a quarter involved Norwegian HES and REC organisations (105).

Table 0.35 Number of Norwegian H2020 MP Projects (by combination of organisation types from Norway)

	HES	REC	PRC	PUB	OTH
HES	52	105	78	20	14
REC		138	124	31	14
PRC			88	17	9
PUB				8	8
OTH					6

Source: Technopolis, eCorda

External Norwegian cooperation

Looking beyond Norway, 84% of Norway's 7,078 **FP7 proposals** involved one or more other countries. This is higher than all comparator countries, except Austria (85%). In total, these Norwegian proposals involved over 60,000 non-Norwegian applicants (the equivalent to 10 applicants from other countries for every 1 applicant from Norway in these proposals).

Table 0.36 External cooperation in FP7 proposals

FP7 Proposals	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
Proposals involved in	7,078	15,259	9,316	9,667	12,093	23,053
% of proposals with other countries	84%	79%	79%	81%	85%	78%
Proposals with other countries	5,943	11,983	7,401	7,784	10,254	17,951
Applicants from other countries in these proposals	60,888	116,345	74,602	79,153	100,101	168,448
Proposals with other countries, per 1,000 FTE	163	152	132	141	171	170
Applicants from other countries in these proposals, per 1,000 FTE	1,675	1,354	1,256	1,584	1,398	1,308

Source: Technopolis, eCorda

Norway participated in FP7 proposals with 161 other countries in total (77% of all 210 other countries found in any FP7 proposals). The top 10 partner countries are shown in the table below, with the most frequent partners coming from the UK, Germany, Italy, Spain and France.

It is also worth mentioning that there are several other countries where a large proportion (25%+) of their applications are through proposals involving Norway. This includes the Faroe Islands (56%), Greenland (53%), Cape Verde (46%) and Iceland (32%), amongst others (we have excluded from this list those countries with 10 or fewer applications in proposals).

Table 0.37 Top 10 countries participating in FP7 proposals with Norway

Country of participants	Applications in NO proposals	% of country's applications in all proposals
United Kingdom	7,620	10%
Germany	7,247	9%
Italy	5,500	8%
Spain	5,108	8%
France	4,558	9%
Netherlands	3,849	12%
Sweden	2,670	13%
Belgium	2,351	10%
Greece	1,997	8%
Denmark	1,856	15%

Source: Technopolis, eCorda

The great majority (92%) of Norway's 1,485 **FP7 projects** involved one or more other countries. This is higher than all comparator countries. In total, these Norwegian projects involved nearly 19,000 non-Norwegian participants (the equivalent to 14 participants from other countries for every 1 participant from Norway in these projects).

Table 0.38 External cooperation in FP7 projects

FP7 Projects	NO	SE	DK	FI	AT	NL
Projects involved in	1,485	3,080	2,011	1,779	2,436	5,024
% projects with other countries	92%	87%	86%	92%	87%	83%
Projects with other countries	1,372	2,686	1,729	1,634	2,125	4,157
Participations from other countries in these projects	18,846	34,857	22,731	22,198	27,101	49,071
Projects with other countries, per 1,000 FTE	38	34	31	30	35	39
Participations from other countries in these projects, per 1,000 FTE	518	443	406	402	452	465

Source: Technopolis, eCorda

Norway has participated in FP7 projects with 124 other countries in total (71% of all 176 other countries participating). The top 10 partner countries are shown in the table below – they are the same ten as listed above for involvement in Norwegian proposals, and again most frequently these partners are from the UK, Germany, Italy, Spain and France. There are several other countries where a large proportion (25%+) of their participations are through projects involving Norway. This includes the Faroe Islands (59%), Iceland (41%), China (26%), Malta (25%) and Estonia (25%), amongst others.

Table 0.39 Top 10 countries participating in FP7 projects with Norway

Country of participants	Participations in NO projects	% of country's participations in all projects
Germany	2,398	13%
United Kingdom	2,397	14%
France	1,585	13%
Italy	1,504	13%
Spain	1,403	13%
Netherlands	1,350	17%
Sweden	824	18%
Belgium	778	14%
Denmark	619	22%
Greece	548	15%

Source: Technopolis, eCorda

In **H2020** so far, 70% of Norway's 8,531 **proposals** involved one or more other countries, which is below the 84% seen in FP7. This rate is still higher, however, than all comparator countries, except Austria (80%) and the Netherlands (72%). In total, these Norwegian proposals involved over 72,000 non-Norwegian applicants (12 applicants from other countries for every 1 applicant from Norway).

Table 0.40 External cooperation in H2020 proposals

H2020 proposals	NO	SE	DK	FI	AT	NL
Proposals involved in	8,531	15,543	12,610	11,108	13,044	25,956
% of proposals with other countries	70%	68%	65%	66%	80%	72%
Proposals with other countries	5,997	10,583	8,161	7,379	10,430	18,707
Applicants from other countries in these proposals	72,181	119,207	94,049	85,029	116,301	199,362
Proposals with other countries per 1,000 FTE	142	123	137	148	146	145

Applicants from other countries in these proposals, per 1,000 FTE	1,710	1,388	1,583	1,701	1,624	1,548

Source: Technopolis, eCorda

Norway has participated in H2020 proposals with 163 other countries in total (78% of all 210 other countries participating). The top 10 partner countries are shown in the table below. Most frequently Norwegian proposals included participants from Germany, the UK, Spain, Italy and France.

There are several other countries where a large proportion (25%+) of their applications are through proposals involving Norway. This includes Greenland (82%), Malawi (50%), the Faroe Islands (40%), Namibia (26%) and Iceland (25%), amongst others.

Table 0.41 Top 10 countries participating in FP7 proposals with Norway

Country of participants	Applications in NO proposals	% of country's applications in all proposals
DE	8,470	11%
UK	7,758	10%
ES	7,079	9%
IT	6,463	8%
FR	5,395	10%
NL	4,737	12%
BE	3,281	12%
SE	2,838	13%
EL	2,450	10%
DK	2,400	14%

Source: Technopolis, eCorda

The majority (80%) of Norway's 1,277 **H2020 projects** involved one or more other countries. This is lower than in FP7 (92%), and also only third-highest amongst comparator countries in H2020 (Norway had the highest rate in FP7). In total, these Norwegian projects involved over 19,000 non-Norwegian participants (the equivalent to 14 participants from other countries for every 1 participant from Norway in these projects, a similar rate to FP7).

Table 0.42 External cooperation in H2020 projects

H2020 Projects	NO	SE	DK	FI	AT	NL
Projects involved in	1,277	2,268	1,921	1,469	2,118	4,096
% projects with other countries	80%	77%	68%	80%	82%	74%
Projects with other countries	1,021	1,752	1,307	1,178	1,735	3,048
Participations from other countries in these projects	19,910	29,295	22,222	21,158	28,431	43,943
Projects with other countries, per 1,000 FTE	24	20	22	23.6	24	24
Participations from other countries in these projects, per 1,000 FTE	472	341	374	423	397	341

Source: Technopolis, eCorda

Norway has participated in H2020 projects with 126 other countries in total (82% of all 154 other countries participating). The top 10 partner countries are shown in the table below. The same top partners appear as for H2020 proposals.

There are several other countries where a large proportion (25%+) of their participations are through projects involving Norway. This includes the Faroe Islands (71%), Iceland (40%), Vietnam (38%), Latvia (30%), Kenya (27%), China (26%), South Africa (25%), Russia (25%), amongst others.

Table 0.43 Top 10 countries participating in FP7 projects with Norway

Country of participants	Participations in NO projects	% of country's participations in all projects
DE	2,182	16%
FR	1,889	17%
UK	1,788	14%
ES	1,749	15%
IT	1,574	15%
NL	1,224	17%
BE	928	17%
SE	675	20%
EL	575	17%
AT	559	17%

Source: Technopolis, eCorda

Mobility through the MSCA

The **H2020 Marie Sklodowska-Curie actions (MSCA)** encourage transnational, intersectoral and interdisciplinary mobility through the provision of grants for all stages of researchers' careers. They enable research-focused organisations (universities, research centres, and companies) to host talented foreign researchers and to create strategic partnerships with leading institutions worldwide.

There are four main types of H2020 MSCA, which are each introduced below. The equivalent types of FP7 Marie Curie Actions (MCAs) are also noted against each:

- Innovative Training Networks (**ITN**) are for early-stage researchers. They support joint research training and/or doctoral programmes, implemented by partnerships (of universities, research institutions, research infrastructures, businesses and other actors) from different countries. The grants cover the recruitment and training of researchers for up to three years, plus research costs like joint activities and conferences. [The same scheme was in place during FP7]
- Individual Fellowships (**IF**) are for experienced researchers. The grants support mobility between countries (optionally to the non-academic sector), within and beyond Europe, as well as help attract the best foreign researchers to work in the EU. The grant usually covers two years' salary, a mobility allowance, research costs and overheads for the host institution. [During FP7,

fellowships for experienced researchers were addressed through four separate actions: the IEF, IOF, IIF and CIG[81]]

- Research and Innovation Staff Exchanges (**RISE**) that support the short-term mobility of research and innovation staff at all career levels, including administrative and technical staff. The scheme is open to partnership of universities, research institutions, and non-academic organisations, with academia-to-academia exchanges permitted in worldwide partnerships only. The grant supports the secondment of staff for periods of between one month and one year. [During FP7, staff exchanges were addressed through two actions: IAPP and IRSES[82]].
- Co-funding of regional, national and international programmes (**COFUND**), which provides organisations with additional support for their own researcher training and career development programmes. The extra funds are available for new or existing schemes for training researchers abroad and across various sectors. Participating organisations receive a fixed amount for each supported researcher. [The same scheme was in place during FP7].

Although it doesn't concern mobility, the European Researchers' Night (**NIGHT)** – a Europe-wide public event dedicated to popular science and fun learning – is also supported through MSCA grants. It takes place each year in September, with around 300 cities in 30 countries involved. The funding covers expenses linked to the organisation of outreach events. [The same scheme was in place during FP7].

Country factsheets for FP7 and H2020, available on the MSCA website (MSCA in Numbers[83]), provide more detailed and useful information on participation in this aspect of the Framework Programme than is available through eCorda. As such, these have been used as the basis for analysis in this section.[84]

Note that the H2020 factsheets used were correct as of 5th December 2018. Also, country of origin / destination information is only shown in the factsheets as bar charts, and covering the top origin / destination countries only. For FP7 factsheets, the exact figures are not shown on the chart, and so approximate numbers have had to be inferred from the bars to present in the tables presented below.

We begin by looking at FP7 and then look separately at H2020. More detailed timeseries data (i.e. annual data) is not available.

Norwegian involvement in MCAs during FP7

The table below shows the number of **Norwegian participations in MCAs** during the whole of FP7 (n=191). The number of these participations that relate to NIGHT events (n=5) is also shown. The same

[81] Intra-European Fellowships (IEF), International Outgoing Fellowships (IOF), International Incoming Fellowships (IIF) and Career Integration Grants (CIG).
[82] Industry-Academia Partnerships and Pathways (IAPP) and International Research Staff Exchange Scheme (IRSES).
[83] https://ec.europa.eu/research/mariecurieactions/msca-numbers_en
[84] According to RCN, FP7 fact sheets do not include all Norwegian fellows. However, this should apply also to other countries, so comparisons between countries still should be valid.

data is shown for each of the five comparator countries, which were (in absolute terms) each more active than Norway in the MCAs (from 241 participations by Finland to 1,142 in the Netherlands).

The final row in the table normalises the participation numbers by weighting each country's results by the number of R&D personnel in that country (i.e. MCA participations per 1,000 FTE). On this measure, the scale of Norwegian participation in MCAs in FP7 compares slightly better, with a rate just above that of Finland, but still below that of the other four comparator countries.

[Note that for most MCAs the grant is given to the host, coordinating or partner organisation, rather than researchers or staff benefiting from e.g. mobility schemes. The organisation is therefore represented as the participant in the table below].

Table 0.44 Participations in FP7 MCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
Number of participations in MCAs	191	607	446	241	445	1,142
… of which, participating in NIGHT events	*5*	*42*	*4*	*27*	*23*	*10*
Number of participations in MCAs (per 1,000 FTE)	5.3	7.7	8.0	4.4	7.4	10.8

Source: Technopolis, MCA FP7 Factsheets

The table below shows the **funding awarded** through these MCA participations, first in absolute terms and then weighted for the size of each country (€m of EC contributions per 1,000 FTE R&D personnel).

Norway received €65m in EC contributions during FP7, which is above Finland, but below the other comparator countries (and, at the extreme, just 20% of the amount for the Netherlands). When weighted for the size of R&D populations, the value of Norway's MCA awards (€1.8m per 1,000 FTE) compares a little better, but is still slightly below that of all comparator countries except Finland.

Table 0.45 Funding awarded through FP7 MCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
EC funding awarded to organisations (€m)	65	181	154	49	117	311
EC funding awarded to organisations (€m) (per 1,000 FTEs)	1.8	2.3	2.8	0.9	2.0	2.9

Source: Technopolis, MCA FP7 Factsheets

The table below provides information on the **beneficiaries** of the MCA actions in each country (i.e. the researchers and staff involved, rather than the host organisations). For Norway, there were 266 researchers funded, of which the majority (183) were staff involved in exchanges through the IRSES actions, while a smaller number (83) were researchers involved in the various fellowship actions. The overall number of Norwegian researchers and the number of Norwegian fellowships are both lower than in all of the comparator countries. The number of Norwegian exchanged staff compares slightly better, and is above the number from Denmark and Austria.

The bottom half of the table shows the same data, but weighted by the R&D personnel in these countries. On this basis, the number of Norwegian beneficiaries (7.3 per 1,000 FTE) is above that of Denmark, but the number of Norwegian fellowships (2.3 per 1,000 FTE) is still below that of all comparator countries. On this measure, the number of Norwegian exchange staff (5.0 per 1,000 FTE) is higher than that achieved in any of the comparator countries.

Table 0.46 Fellowships and exchange staff supported through FP7 MCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
National researchers funded	266	703	345	468	1,063	1,191
…of which, fellowships	*83*	*435*	*205*	*242*	*883*	*855*
… of which, exchanged staff (IRSES)	*183*	*268*	*140*	*226*	*180*	*336*
National researchers funded (per 1,000 FTE)	7.3	8.9	6.2	8.5	17.7	11.3
…of which, fellowships (per 1,000 FTE)	*2.3*	*5.5*	*3.7*	*4.4*	*14.7*	*8.1*
… of which, exchanged staff (IRSES) (per 1,000 FTE)	*5.0*	*3.4*	*2.5*	*4.1*	*3.0*	*3.2*

Source: Technopolis, MCA FP7 Factsheets

Some of the Norwegian researchers funded through MCA fellowships are in fact hosted within Norway (28 of the 83, or 34%, which is higher than in any of the comparator countries). Therefore only 55 Norwegian fellows are actually **hosted abroad**. This number is much lower than in any of the other comparator countries (ranging from 163 from Denmark to 763 from Austria). Even when weighted by the national R&D populations, the Norwegian results (1.5 fellowships abroad per 1,000 FTE) is well below that of any of the comparator countries (2.9 to 12.7 per 1,000 FTE).

Table 0.47 Cross-border fellowships funded through FP7 MCA – Norway and comparator countries

Fellowships	NO	SE	DK	FI	AT	NL
National researchers funded	83	435	205	242	883	855
Hosted in country	28	140	42	38	120	205
Hosted abroad	55	295	163	204	763	650
Hosted abroad (%)	66%	68%	80%	84%	86%	76%
National researchers hosted abroad (per 1,000 FTE)	1.5	3.8	2.9	3.7	12.7	6.2

Source: Technopolis, MCA FP7 Factsheets

The following table shows the top 10 destinations of Norwegian fellows. Beyond those that stay in Norway (28), the highest numbers go to Sweden (12) and the UK (7).

Table 0.48 Destination of Norwegian fellows (top 10) during FP7

Origin	Fellows		Origin	Fellows
Norway	28		Spain	5
Sweden	12		France	3
United Kingdom	7		Austria	2
Belgium	5		Denmark	2
Germany	5		Iceland	2

Source: Technopolis, Inferred from MCA FP7 Factsheet. Totals include fellows funded through ITN, IF (IOF, IEF and CIG), RISE (IAPP) and CO-FUND

The top destination countries for IRSES staff exchanges are also available. The main destinations of Norwegian staff are China (57), South Africa (48) and Argentina (19).

Table 0.49 Destination of Norwegian exchange staff (top 10) during FP7

Destination	Staff		Destination	Staff
China	57		Australia	11
South Africa	48		Ukraine	7
Argentina	19		Brazil	2
New Zealand	13		Chile	2
United States	12		Mexico	2

Source: Technopolis, Inferred from MCA FP7 Factsheet. Totals include staff funded through IRSES

The following table shows the number of **researchers hosted** in each country through MCAs. The number of researchers hosted by Norwegian organisations (462) is much higher than the number of Norwegian researchers funded (266, table above). This is true of most of the comparator countries as well (except for Austria). Norway hosts a smaller number of researchers than all comparator countries.

The number of fellowships hosted by Norwegian organisations (307) is nearly four times the number of Norwegian fellowships (83, table above). Again, this is true of all comparators except Austria. Norway hosts more fellowships than any of the comparator countries, except Finland.

The number of exchanged staff hosted by Norwegian organisations (155) is only slightly below the number of Norwegian exchanged staff (183, table above). The same pattern holds for all countries, except the Netherlands. Norway hosts more exchanged staff than all countries except Denmark.

When the results are weighted (bottom half of the table), the number of researchers overall and the number of fellowships hosted by Norwegian organisations (per 1,000 R&D personnel) is lower than all countries except Finland. The number of staff hosted by Norway, however, is higher than in all other countries, when weighted in this way.

Table 0.50 Fellowships and exchange staff hosted through FP7 MCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
Researchers hosted in country	462	1039	825	488	930	2254
…of which, fellowships	307	841	730	275	759	1916
… of which, exchanged staff (IRSES)	155	198	95	213	171	338
Researchers hosted in country (per 1,000 FTE)	12.7	13.2	14.7	8.8	15.5	21.4
…of which, fellowships (per 1,000 FTE)	8.4	10.7	13.0	5.0	12.7	18.2
… of which, exchanged staff (IRSES) (per 1,000 FTE)	4.3	2.5	1.7	3.9	2.9	3.2

Source: Technopolis, MCA FP7 Factsheets

As explained previously, some of the fellows hosted by Norwegian organisations are actually Norwegian (28 of the 307, or 9%). This is a lower proportion than in all comparator countries, except Denmark.

As such, 279 **non-Norwegian fellows are hosted** by Norwegian organisations through FP7 MCAs. This is a lower number than in all the comparator countries except for Finland. When weighted to reflect the size of the national research population, the result for Norway (7.7 non-Norwegians hosted per 1,000 FTE) is still below all of the comparator countries except Finland.

Table 0.51 Cross-border fellowships hosted through FP7 MCA – Norway and comparator countries

Fellowships	NO	SE	DK	FI	AT	NL
Researchers hosted in country	307	841	730	275	759	1916
Nationals	28	140	42	38	120	205
Non-nationals	279	701	688	237	639	1711
Non-nationals (%)	91%	83%	94%	86%	84%	89%
Non-nationals hosted in country (per 1,000 FTE)	7.7	8.9	12.3	4.3	10.7	16.2

Source: Technopolis, MCA FP7 Factsheets

The following table shows the top 10 countries of origin of fellows hosted in Norway. The highest number (28) is from Norway itself. Beyond this, the highest numbers come from Germany (26), Spain (25), Italy (20), France (19) and India (19).

Table 0.52 Origin (nationality) of fellows going to Norway (top 10) during FP7

Origin	Fellows		Origin	Fellows
Norway	28		India	19
Germany	26		Netherlands	15
Spain	25		China	11
Italy	20		United Kingdom	11
France	19		Poland	8

Source: Technopolis, Inferred from MCA FP7 Factsheet. Totals include fellows funded through ITN, IF (IIF, IEF and CIG), RISE (IAPP) and CO-FUND

The top origin countries for IRSES staff exchanges hosted by Norwegian organisations include China (70), South Africa (18) and Argentina (12).

Table 0.53 Origin (nationality) of exchange staff hosted in Norway (top 10) during FP7

Origin	Staff		Origin	Staff
China	70		United States	7
South Africa	18		Mexico	6
Argentina	12		India	5
Ukraine	9		Tunisia	5
New Zealand	7		Australia	4

Source: Technopolis, Inferred from MCA FP7 Factsheet. Totals include fellows funded through IRSES

The following tables provide a more detailed breakdown of Norwegian involvement in MCA actions during FP7. Specifically it shows how the participations, EC contributions, projects and researchers (from or hosted by Norway) discussed above are split across the **different types of MCA action**.

The subsequent tables then show the breakdown across each of these parameters using weighted data (note, now per 10,000 FTE). The same data for the comparator countries is also shown.

Table 0.54 Norwegian participation in FP7 MCA – by action

Norway	Participations	EC contribution (€m)	Projects	Researchers from NO	Researchers to NO
ITN	74	33	61	19	146

IF (IEF, IOF, IIF, CIG)	67	14	67	14	67
RISE (IAPP, IRSES)	43	4	35	204	191
COFUND	2	14	2	29	58
NIGHT	5	0.5	5	n/a	n/a
Total	**191**	**65**	**170**	**266**	**462**

Source: Technopolis, MCA FP7 Factsheets

Weighted Norwegian participation is below that of most comparator countries, except for in relation to the COFUND actions.

Table 0.55 Participation in FP7 MCA – by action. Norway and comparator countries, per 10,000 FTE

MCA Type	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	20.4	30.7	31.3	13.8	23.5	46.5
IF (IEF, IOF, IIF, CIG)	18.4	27.9	37.2	12.9	32.0	46.9
RISE (IAPP, IRSES)	11.8	12.5	10.0	12.1	13.8	13.5
COFUND	0.6	0.9	0.5	-	1.0	0.4
NIGHT	1.4	5.3	0.7	4.9	3.8	0.9
Total	52.5	77.2	79.7	43.7	74.2	108.2

Source: Technopolis, MCA FP7 Factsheets. H2020 MSCA action types have been used (with the FP7 equivalent shown in parenthesis)

Weighted EC contributions to Norway are below that of most comparator countries, except for in relation to the COFUND actions.

Table 0.56 EC contributions (€m) for FP7 MCA – by action. Norway and comparator countries, per 10,000 FTE

MCA Type	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	9.0	11.5	14.7	5.3	8.4	18.2
IF (IEF, IOF, IIF, CIG)	3.7	4.7	8.0	2.1	5.4	7.5
RISE (IAPP, IRSES)	1.2	2.0	1.8	1.5	2.7	2.5
COFUND	3.7	4.7	3.1	-	3.1	1.3

NIGHT	0.1	0.2	0.0	0.1	0.1	0.1
Total	17.8	23.1	27.6	9.0	19.6	29.5

Source: Technopolis, MCA FP7 Factsheets

The weighted number of Norwegian projects is below that of most comparator countries, except for in relation to the COFUND actions.

Table 0.57 FP7 MCA projects – by action. Norway and comparator countries, per 10,000 FTE

MCA Type	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	16.8	22.3	23.8	10.5	18.5	29.1
IF (IEF, IOF, IIF, CIG)	18.4	27.9	37.2	12.7	31.4	46.2
RISE (IAPP, IRSES)	9.6	10.8	9.3	9.4	10.8	11.2
COFUND	0.6	0.9	0.5	-	1.0	0.4
NIGHT	1.4	0.9	0.5	1.3	1.0	0.9
Total	46.8	62.7	71.3	33.9	62.7	87.8

Source: Technopolis, MCA FP7 Factsheets

The weighted number of Norwegian researchers involved is below that of most comparator countries, except for in relation to the RISE and COFUND actions.

Table 0.58 FP7 MCA researchers from country – by action. Norway and comparator countries, per 10,000 FTE

MCA Type	**NO**	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	5.2	12.6	11.1	12.5	26.5	22.1
IF (IEF, IOF, IIF, CIG)	3.9	13.9	10.2	11.8	23.5	25.8
RISE (IAPP, IRSES)	56.1	47.6	36.1	53.8	61.9	49.4
COFUND	8.0	15.4	4.3	6.7	65.4	15.6
NIGHT	n/a	n/a	n/a	n/a	n/a	n/a
Total	73.2	89.4	61.7	84.8	177.4	112.9

Source: Technopolis, MCA FP7 Factsheets

The weighted number of researchers hosted by Norway is below that of most comparator countries, except for in relation to the RISE and COFUND actions.

Table 0.59 FP7 MCA researchers to country – by action. Norway and comparator countries, per 10,000 FTE

MCA Type	NO	SE	DK	FI	AT	NL
ITN	40.2	43.8	60.8	25.9	47.2	99.0
IF (IEF, IOF, IIF, CIG)	18.4	27.9	37.2	12.7	31.4	46.2
RISE (IAPP, IRSES)	52.5	36.9	37.7	49.5	64.6	65.2
COFUND	16.0	23.7	11.8	0.4	12.0	3.3
NIGHT	n/a	n/a	n/a	n/a	n/a	n/a
Total	127.1	132.2	147.5	88.4	155.2	213.7

Source: Technopolis, MCA FP7 Factsheets

Moving on to H2020 MSCA, we present broadly similar information as for FP7 – although the structure and content of the factsheets used as the data source are slightly different between the two programmes.

The table below shows the **number of participations in MSCA applications** during H2020 so far (i.e. to December 2018). FP7 figures are not available for comparison. The number of Norwegian participations in applications (2,765) is lower than most comparator countries, but higher than Finland. Weighted by the number of R&D personnel, the number of Norwegian participations in applications (66 per 1,000 FTE) is higher than in all countries except the Netherlands and Denmark.

Table 0.60 Participation in H2020 MSCA applications – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
Participations in applications	2,765	5,518	5,556	2,570	3,566	11,288
Participations in applications (per 1,000 FTE)	66	64	94	51	50	88

Source: Technopolis, MSCA H2020 Factsheets

The next table shows the **number of participations** in awarded H2020 MSCAs. Norway has had 247 participations so far (as at December 2018), which is fewer than all comparator countries. When weighted by national research personnel, Norway's participation (5.9 per 1,000 R&D personnel) is still below that of most comparators, except Finland (5.6 per 1,000). Nevertheless, the absolute and the weighted number of Norwegian participations in H2020 MSCAs already both exceed the FP7 MCA overall totals.

Table 0.61 Participation in H2020 MSCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
Number of participations in MSCAs	247	592	617	280	445	1,401
Number of participations in MSCAs (per 1,000 FTE)	5.9	6.9	10.4	5.6	6.2	10.9

Source: Technopolis, MSCA H2020 Factsheets

The H2020 factsheets provide a breakdown of participations between **academic and non-academic organisations**. They also show the proportion of participations that are accounted for by private for profit organisations and the proportion accounted for by SMEs. The rates across the comparator countries are also shown below for comparison. Norway has a slightly higher proportion of participations from academic institutions (77%) than any of the other countries. The proportions accounted for by non-academic organisations (23%), private for profit organisations (21%) and SMEs (6%) in Norway are each below the rates seen in all comparator countries.

Table 0.62 Participation in H2020 MSCA – by organisation type, Norway and comparator countries

	NO	SE	DK	FI	AT	NL
% academic	77%	71%	74%	69%	67%	67%
% non-academic	23%	29%	26%	31%	33%	33%
% private for profit	21%	26%	22%	29%	31%	29%
% SMEs	6%	10%	7%	12%	15%	12%

Source: Technopolis, MSCA H2020 Factsheets

The table below shows the **funding awarded** through these MSCA participations, as well as the weighted total for each country (€m of EC contributions per 1,000 FTE R&D personnel). Norway has received €65m in EC contributions during the first period of H2020. This is lower than all comparator countries except Finland. However, it already the same amount as was achieved by Norway during the whole of FP7. Only Finland and the Netherlands amongst the comparator countries have surpassed their FP7 total already. When weighted for the size of R&D personnel, the value of Norway's MSCA awards so far (€1.5m per 1,000 FTE) is still below that of all comparator countries except Finland and Austria. It is also not yet as high as the overall FP7 weighted figure for Norway.

Table 0.63 Funding awarded through H2020 MSCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
EU budget awarded to country (€m)	65	135	175	57	92	316
EU budget awarded to country (€m) (per 1,000 FTE)	1.5	1.6	2.9	1.1	1.3	2.5

Source: Technopolis, MSCA H2020 Factsheets

The table below provides information on the **beneficiaries** of the MSCA actions (i.e. the researchers and staff involved, rather than the host organisations). For Norway, there have been 66 researchers funded, which is much lower than all of the comparator countries, and only a quarter of the total achieved by Norway in the whole of FP7. The second row shows the weighted total. On this basis, the number of Norwegian researchers (1.6 per 1,000 FTE) is also below that of all comparator countries, and well below the figure for the whole of FP7.

Table 0.64 National researchers funded through H2020 MSCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
National researchers funded	66	166	122	193	249	484
National researchers funded (per 1,000 FTE)	1.6	1.9	2.1	3.9	3.5	3.8

Source: Technopolis, MSCA H2020 Factsheets

The following two table shows the top destinations of Norwegian fellows and exchanged staff respectively. As was the case in FP7, the highest numbers of fellows are going to the UK and Sweden.

Table 0.65 Destination of Norwegian fellows (top 10) during H2020

Destination	**Fellows**		**Destination**	**Fellows**
United Kingdom	8		Austria	2
Sweden	6		Norway	2
Denmark	5		<unknown>	
Germany	3		<unknown>	
Switzerland	3		<unknown>	

Source: Technopolis, Inferred from MSCA H2020 Factsheet. Totals include ITN, IF and COFUND

Table 0.66 Destination of Norwegian exchanged staff (top 10) during H2020

Destination	Staff		Destination	Staff
United Kingdom	8		Iceland	1
Vietnam	4		Portugal	1
New Zealand	3		Sweden	1
Australia	2		South Africa	1
Italy	1			

Source: Technopolis, Inferred from MSCA H2020 Factsheet. Totals include RISE

The number of **researchers hosted by Norwegian organisations** so far in H2020 is 210. This is lower than all comparator countries, and so far below the 279 non-Norwegians hosted by Norway during FP7. When weighted to reflect the size of the national research population, the result for Norway (5.0 non-Norwegians hosted per 1,000 FTE) is still below that of all comparator countries.

Table 0.67 Researchers hosted through H2020 MSCA – Norway and comparator countries

	NO	SE	DK	FI	AT	NL
Researchers hosted in country	210	578	649	284	565	1,336
Researchers hosted in country (per 1,000 FTE)	5.0	6.7	10.9	5.7	7.9	10.4

Source: Technopolis, MSCA H2020 Factsheets

The following two tables shows the top origin countries of fellows and exchanged staff hosted by Norwegian organisations respectively.

Table 0.68 Origin (nationality) of fellows going to Norway (top 10) during H2020

Origin	Fellows		Origin	Fellows
Germany	23		Spain	9
Italy	14		United Kingdom	7
India	15		United States	7
Netherlands	11		Poland	6

Portugal	9		Denmark	5

Source: Technopolis, Inferred from MSCA H2020 Factsheet. Totals include ITN, IF and COFUND

Table 0.69 Origin (nationality) of exchanged staff going to Norway (top 10) during H2020

Origin	**Staff**		**Origin**	**Staff**
Denmark	4		Netherlands	2
Portugal	4		Vietnam	2
United Kingdom	4		Columbia	1
Finland	3		Canada	1
Japan	2		Spain	1

Source: Technopolis, Inferred from MSCA H2020 Factsheet. Totals include RISE

The H2020 factsheet calculates that the **top collaborative links** with Norway, based on the total number of collaborations[85], are with the United Kingdom (305), Germany (296), the Netherlands (219), France (196) and Spain (138).

The following tables provide a more detailed breakdown of Norwegian involvement in MSCA actions during H2020. Specifically it shows how the participations, EC contributions, projects and researchers (from or hosted by Norway) discussed above are split across the **different types of MSCA actions**.

The subsequent tables then show the breakdown across each of these parameters using weighted data (note, now per 10,000 FTE). The same data for the comparator countries is also shown.

Table 0.70 Norwegian participation in H2020 MSCA – by action

MCA Type	**Participations**	**EC Contribution (€m)**	**Projects**	**Researchers from NO**	**Researchers to NO**
ITN	138	39	83	18	108
IF	64	13	63	14	63

[85] A collaborative link is assumed to exist between each pair of participants in each contract. When there are 'a' participants from one country and 'b' participants from another in a project, the number of collaborative links is assumed to be 'a x b'.

RISE	39	3	28	31	30
COFUND	6	9	6	3	-
NIGHT	-	-	-	-	-
Total	**247**	**65**	**180**	**66**	**201**

Source: Technopolis, MSCA H2020 Factsheets

Weighted Norwegian participation in the different MSCA actions is below that of most comparator countries, except for the IF and RISE actions.

Table 0.71 Participation in H2020 MSCA – by action. Norway and comparator countries, per 10,000 FTE

	NO	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	33	42	51	28	36	67
IF	15	15	43	11	14	28
RISE	9.2	8.7	7.4	8.2	9.8	7.8
COFUND	1.4	3.5	2.5	4.8	1.7	5.1
NIGHT	0.0	0.2	0.0	3.6	1.1	0.2
Total	59	69	104	56	62	109

Source: Technopolis, eCorda

Weighted EC contributions to Norway through H2020 are above the majority of comparator countries for COFUND, RISE and IF actions. For ITN actions, the weighted EC contributions to Norway are above that of just Finland and Austria.

Table 0.72 EC contributions (€m) for H2020 MSCA – by action. Norway and comparators, per 10,000 FTE

	NO	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	9	12	17	7	8	17
IF	3	3	9	2	2	5
RISE	0.8	0.7	0.5	1.0	0.9	0.8

COFUND	2.1	0.4	3.0	1.0	1.4	1.7
NIGHT	0	0.04	0	0.11	0.07	0.04
Total	15	16	29	11	13	25

Source: Technopolis, MSCA H2020 Factsheets

The weighted number of Norwegian projects is below that of most comparator countries, except for the IF and RISE actions, where it is only behind Austria.

Table 0.73 H2020 MSCA projects – by action. Norway and comparator countries, per 10,000 FTE

	NO	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	20	25	29	15	20	30
IF	15	15	43	11	13	27
RISE	6.6	6.4	5.4	6.2	7.7	4.9
COFUND	1.4	1.9	2.4	1.4	1.4	2.0
NIGHT	0.0	0.2	0.0	0.4	0.6	0.2
Total	43	48	80	34	43	64

Source: Technopolis, MSCA H2020 Factsheets

The weighted number of Norwegian researchers involved is below that of all comparator countries, except for in relation to the RISE actions, where it is higher than Denmark and slightly higher than Sweden.

Table 0.74 H2020 MSCA researchers from country – by action. Norway and comparator countries, per 10,000 FTE

	NO	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	4	5	7	5	12	15
IF	3	6	6	10	7	12
RISE	7.3	7.3	5.7	21.4	13.7	8.6
COFUND	0.7	0.8	1.2	1.8	2.0	2.5
NIGHT	n/a	n/a	n/a	n/a	n/a	n/a

Total	16	19	21	39	35	38

Source: Technopolis, MSCA H2020 Factsheets

The weighted number of researchers hosted by Norway is below that of all comparator countries for RISE and COFUND, and below most comparator countries for ITN. For IF, the weighted number of researchers hosted by Norway is only lower than that of Denmark and the Netherlands.

Table 0.75 H2020 MSCA researchers to country – by action. Norway and comparator countries, per 10,000 FTE

	NO	**SE**	**DK**	**FI**	**AT**	**NL**
ITN	26	35	49	21	26	51
IF	15	15	43	11	13	27
RISE	7.1	14.1	7.6	17.6	24.6	17.6
COFUND	0.0	3.7	9.4	7.4	14.9	7.2
NIGHT	n/a	n/a	n/a	n/a	n/a	n/a
Total	48	67	109	57	79	104

Source: Technopolis, MSCA H2020 Factsheets

Appendix B Interviewees and Advisory Committee members

Interviewees

• Waqar Ahmed	Norway Health Tech
• Michaela Aschan	The Arctic University of Norway
• Bente Bakos	Research Council of Norway
• William Christensen	Ministry of Petroleum and Energy
• Kristin Danielsen	Research Council of Norway
• Sonia Faaland	Prototech
• Sergio Ferreira	Norway Health Tech
• Bjarne Foss	Norwegian university of science and technology
• Gry Færevik	Ministry of Agriculture and Food
• Inge R. Gran	SINTEF Energi
• Tore-Kristian Grunne	Norwegian Ministry of Petroleum and Energy
• Kirsti Gustad	Norwegian Ministry of Agriculture and Food
• Heidi Østbø Haugen	University of Oslo
• Mathias Aguirre Havgar	Innovation Norway
• Per Magnus Kommandantvold	Research Council of Norway
• Ernst H. Kristiansen	SINTEF
• John Krogstie	Norwegian university of science and technology
• Agnes Landstad	FFA (union of research institutes)
• Kyrre Lekve	Simula Research Laboratory
• Tore Li	The Confederation of Norwegian Enterprise (NHO)
• Dagfinn Myhre	Telenor Research
• Øyvind Nielsen	Norsun
• Anine Norgren-Jahnsen	Norwegian Ministry of Agriculture and Food
• Kari Nygard	NILU
• Petter Olsen	Nofima
• Pierre Sames	DNV GL
• Hjørdis Møller Sandborg	Norwegian Ministry of Health and Care services
• Per Morten Sandset	University of Oslo
• Martin Sending	
•	
• Oslo University Hospital	

- Knut Senneseth — Innovation Norway
- Anne Lyche Solheim — NIVA
- Benedicte Sognefest — Innovation Norge
- Inger Slottet — Norwegian Ministry of Trade, Industry and Fisheries
- Pål Sørgaard — Norwegian Ministry of Education and Research
- Katrine Vinnes — Norwegian Industry Association (Norsk Industri)
- Patrick Waldemar — Telenor Research
- Silje Brit Horrisland Whist — Innovation Norge
- Hanne Yssen — Norwegian Ministry of Agriculture and Food
- Kari B. Øiseth — Norwegian Ministry of Education and Research

Advisory Committee members

- Geir Arnulf — Norwegian Ministry of Education and Research
- Izabela Ewa Buraczewska — Norwegian Ministry of Education and Research
- Ernst H. Kristiansen — SINTEF/FFA (union of research institutes)
- Tore Li — The Confederation of Norwegian Enterprise (NHO)
- Ragnar Lie — UHR (Universities Norway)
- Tom-Espen Møller — Research Council of Norway
- Knut Senneseth — Innovation Norway
- Benedicte Sognefest — Innovation Norway
- Inger Slottet — Norwegian Ministry of Trade, Industry and Fisheries

Appendix C Web surveys

Methodological approach

Selection and categorisation of survey respondents

In late May 2019, we launched four surveys. Two of the surveys were sent to individual project participants of FP7 and/or H2020 and two to individual participants of RCN projects granted in parallel with FP7 and H2020:

- Survey 1 was of individuals in companies participating in FP projects; these were all from companies
- Survey 2 was of individuals in R&D providers or other public-sector organisations participating in FP projects; these were strongly dominated by R&D providers (i.e. HEIs, institutes and hospital trusts/regional health authorities)
- Survey 3 was of individuals in companies participating in RCN projects; these were all representing companies.
- Survey 4 was of individual participants in R&D providers or public-sector organisations participating in RCN projects; these respondents were strongly dominated by R&D providers

Surveys 1 and 2 were largely the same aside from smaller differences in question formulations. Surveys 3 and 4 were somewhat shorter and functioned as controls for survey 1 and 2, respectively.

The data for producing the surveys' mailing lists were provided by RCN. We only kept participants in projects belonging to the main parts of the FPs, namely the three main pillars of H2020 (cf. The organisational structure of H2020 around the challenge areas is geared towards facilitating and fostering these "interlinkages", i.e. multi-disciplinary and multi-sectoral collaboration. Addressing societal challenges, while simultaneously enhancing industrial competitiveness and supporting excellent basic research, is at the core of H2020. The H2020 programme is structured around three main pillars and holds dedicated budget lines also for the programmes "Spreading excellence and widening participation" and "Science with and for society", the European Institute of Innovation and Technology (EIT), the pilot project "Fast track to innovation" and the non-nuclear direct actions of the Joint Research Centre (JRC), see **Figure 2.3.**

Figure 2.3) and the FP7 sub-programmes corresponding to these (ct. Figure 4). We similarly only kept participants in projects in RCN programmes that correspond to the three main pillars of H2020 according to a mapping by RCN. We then excluded participants in projects granted less than €100k in public funding (surveys 1 and 2) and less than NOK1m in public funding (survey 3 and 4). Individuals that had both participated in FP and RCN projects were excluded from the control group (surveys 3 and 4). Furthermore, individuals who had participated in more than one FP or one RCN project, respectively, were only invited to respond to the survey based on their experiences of their oldest project. In total, we invited 5 180 individuals to respond to one of the four surveys (including invalid e-mail addresses), 1 473 of which had participated in at least one FP project.

Survey population

Table 0.76 shows the total survey population by stakeholder category, and Source: Technopolis web surveys

Table 0.77 institute participants distributed on the four main institute groups and an “other” group.

Table 0.76 Survey population by stakeholder category.

	Total population	FP7	H2020	RCN
HEIs	1 929	273	180	1 476
Hospital trusts (HF/RHF)	161	22	13	126
Institutes	1 450	314	170	966
Public sector	120	23	14	83
Companies	1 520	329	135	1 056
Total	5 180	961	512	3 707

Source: Technopolis web surveys

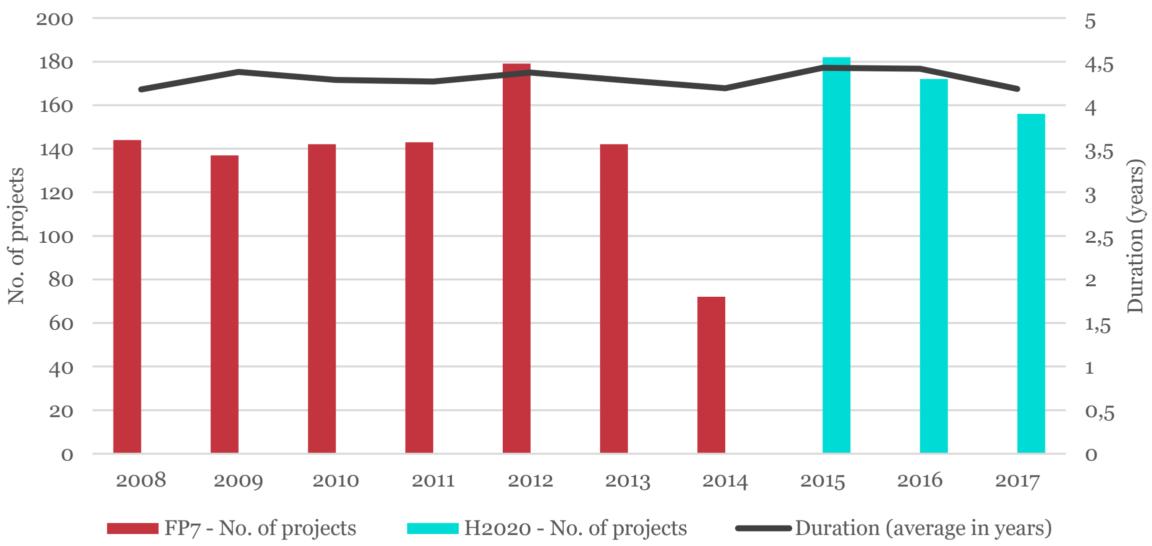
Table 0.77 Survey population in institutes by institute group.

	Subtotal population	FP7	H2020	RCN
Environmental institutes	213	49	23	141
Primary industry institutes	299	46	28	225
Social science institutes	237	31	11	195
Technical-industrial institutes	464	150	80	234
Other institutes	237	38	28	171
Total	1 450	314	170	966

Source: Technopolis web surveys

All individuals invited have participated (participate) in FP projects or RCN projects that started in the period 2007–2017. Figure 0.18 shows the number of FP projects per start year and their average expected duration.[86] The low number of projects started in 2014 is due to the transition from FP7 to H2020.

Figure 0.18 Descriptive statistics of the FP projects the survey population represent.



Source: Technopolis web surveys

Response rates

We sent two reminders to increase response rates. Table 0.78 shows the effective population sizes (less invalid e-mail addresses) and response rates for the four surveys; Source: Technopolis web surveys

Table 0.79 shows population size and response rates by gender.

Table 0.78 Population sizes and response rates.

	Population	Number of responses	Response rate
Survey 1	305	55	18%

[86] 2007 is excluded due to low number of started projects.

Survey 2	825	146	18%
Survey 3	885	120	14%
Survey 4	2 489	460	18%

Source: Technopolis web surveys

Table 0.79 Population sizes by gender; responses rates in parentheses.

	FP7	H2020	RCN
Female	252 (9%)	120 (23%)	1 225 (18%)
Male	708 (15%)	386 (25%)	2 481 (17%)

Source: Technopolis web surveys

Table 0.80–Table 0.83 characterise the respondents in the four surveys.

Table 0.80 Survey respondents by gender.

	Survey 1 (n=55)	Survey 2 (n=146)	Survey 3 (n=120)	Survey 4 (n=460)
Female	7%	25%	21%	38%
Male	93%	75%	79%	62%

Source: Technopolis, eCorda data and RCN data

Table 0.81 Survey population from companies by number of employees.

	Survey 1 (n=55)	Survey 3 (n=120)
0-9 employees	29%	18%
10 – 49 employees	44%	21%
50 – 249 employees	9%	18%
≥250 employees	18%	43%

Source: Technopolis web surveys

Table 0.82 Survey population from companies by age of company.

	Survey 1 (n=55)	Survey 3 (n=119)
0-5 years	7%	2%
5-10 years	18%	13%
10+ years	75%	85%

Source: Technopolis web surveys

Table 0.83 Survey respondents from R&D by stakeholder category.

	Survey 2 (n=146)	Survey 4 (n=460)
HEIs	51%	53%
Hospital trusts (HF/RHF)	2%	3%
Institutes	44%	41%
Public sector	3%	4%

Source: Technopolis, eCorda data and RCN data

On the respondents

For filtering purposes, we asked if the respondent was coordinator of the project. For the same purpose, company respondents were asked if the company is located in- or outside Norway, how many employees it has and the age of the company.

Most survey analyses are presented separately for the two main stakeholder categories; companies and R&D providers, respectively (the latter includes the few responses from public-sector participants). For most of these analyses, responses from FP project participants are compared to the corresponding responses from RCN project participants.

Towards the end of surveys 3 and 4, we asked if the respondent had participated also in FP projects. The respondents who answered "yes" received some additional questions regarding overall impacts and characteristics of FP participation. These responses were merged with corresponding responses from surveys 1 and 2, respectively.

Below is the unabridged questions of survey 1, which includes most of the questions of surveys 2–4.

FP participants – companies (survey 1)

The Norwegian Ministry of Education and Research (MER, *Kunnskapsdepartementet*) has commissioned Samfunnsøkonomisk analyse in collaboration with Technopolis Group to conduct an impact evaluation of Norway's participation in the EU's Framework Programmes (FPs). The evaluation is to be used by Parliament (*Stortinget*) as a foundation for the decision on whether Norway should participate in the next FP, Horizon Europe.

You receive this survey since you have participated in the following FP project:

…

The button below takes you to a web survey that we estimate will take you approximately 20 minutes to complete. We very much appreciate that you take the time to share your experiences of this FP project, including the impacts the project has contributed to.

Background

1. Please characterise your company:

- Company with 0-9 employees in Norway
- Company with 10-49 employees in Norway
- Company with 50-249 employees in Norway
- Company with ≥250 employees in Norway
- Company located outside Norway

- Business federation or employers' organisation
- Other, please specify

2. Please estimate the age of your company

- 0-5 years
- 5-10 years
- 10+ years
- Don't know

The FP project

3. Were you the coordinator of this FP project?

- Yes, I coordinated this multi-partner project
- Yes, but the project only involved my own company (no partners)
- No, my organisation was partner

4. Please assess to what extent the following motives were important for the company's participation in the FP project.

(Not at all, To a small extent, To some extent, To a large extent, To a very large extent, Don't know)

- To solve a specific problem through research and innovation (R&I)
- To build general R&I competence within the company
- To access external R&I competence
- To access external R&I infrastructure (testing/production/prototype equipment, databases, software etc.)
- To establish/strengthen R&I collaboration with university in Norway
- To establish/strengthen R&I collaboration with research institute in Norway
- To establish/strengthen R&I collaboration with hospital trust/regional health authority in Norway
- To establish/strengthen R&I collaboration with company in Norway
- To establish/strengthen R&I collaboration with public organisation in Norway (other than university/research institute/hospital trust/regional health authority)
- To establish/strengthen R&I collaboration with university in another country
- To establish/strengthen R&I collaboration with research institute in another country
- To establish/strengthen R&I collaboration with company in another country
- To find new suppliers
- To find new customers
- To develop a more scientific approach to in-house R&I

- To receive public co-funding for R&I

Voluntary comment:

5. How would you characterise the FP project on the Technology Readiness Level (TRL) scale at the start of the project?

If the project is/was not technological in nature, please try to apply the scale to the project's context.

- TRL1 – Basic principles observed
- TRL2 – Technology concept formulated
- TRL3 – Experimental proof of concept
- TRL4 – Technology validated in lab
- TRL5 – Technology validated in relevant environment
- TRL6 – Technology demonstrated in relevant environment
- TRL7 – System prototype demonstration in operational environment
- TRL8 – System complete and qualified
- TRL9 – Actual system proven in operational environment
- Don't know

Voluntary comment:

6. How would you characterise the FP project on the TRL scale at the end of the project?

If the project is/was not technological in nature, please try to apply the scale to the project's context.

- The project is still on-going so it is too soon to say
- TRL1 – Basic principles observed
- TRL2 – Technology concept formulated
- TRL3 – Experimental proof of concept
- TRL4 – Technology validated in lab
- TRL5 – Technology validated in relevant environment
- TRL6 – Technology demonstrated in relevant environment
- TRL7 – System prototype demonstration in operational environment
- TRL8 – System complete and qualified
- TRL9 – Actual system proven in operational environment
- Don't know

Voluntary comment:

7. Please estimate the total number of hours that you – including colleagues, if applicable – spent on writing/contributing to the FP proposal.

(Open question)

8. Please estimate the total number of hours that you – including colleagues, if applicable – spent on reporting the FP project (all technical and financial reporting, including status, interim and final reports).

(Open question)

Results and impacts for the company

We distinguish between results and impacts. Results refer to the direct outcome of a project, whereas impacts emerge after some time when the results have been further developed, implemented and/or commercialised. We start by asking about results and then continue with impacts.

If the FP project is still on-going and you believe that it is too soon to judge results and impacts you may skip the next three questions – but please do continue answering the survey!

9. Which of the following results has the FP project led to for the company?

(Has already been achieved, Will be achieved in the future, Will not be achieved, Not applicable, Don't know)

- R&I collaboration with university in Norway
- R&I collaboration with research institute in Norway
- R&I collaboration with hospital trust/regional health authority in Norway
- R&I collaboration with company in Norway
- R&I collaboration with public organisation in Norway (other than university/research institute/hospital trust/regional health authority)
- R&I collaboration with university in another country
- R&I collaboration with research institute in another country
- R&I collaboration with company in another country
- R&I collaboration between industry sectors
- Interdisciplinary R&I collaboration
- Knowledge transfer to the company from university in Norway
- Knowledge transfer to the company from research institute in Norway
- Knowledge transfer to the company from hospital trust/regional health authority in Norway
- Knowledge transfer to the company from company in Norway
- Knowledge transfer to the company from public organisation in Norway (other than university/research institute/hospital trust/regional health authority)

- Knowledge transfer to the company from university in another country
- Knowledge transfer to the company from research institute in another country
- Knowledge transfer to the company from company in another country
- Scientific publication with co-author from your company
- Other open publication with co-author from your company

Voluntary comment:

10. Which of the following impacts has the FP project contributed to for the company?

(Has already been achieved, Will be achieved in the future, Will not be achieved, Not applicable, Don't know)

- New R&I project with Norwegian public co-funding
- New R&I project with international/foreign public co-funding
- Self-funded internal R&I project
- Implementation of new construction material/new technology in existing product/service
- Implementation of new method for product/service/process development
- Improvement of existing method for product/service/process development
- Implementation of new manufacturing/production method
- Improvement of existing manufacturing/production method
- Development of demonstrator/prototype
- Development of new/improved product/service
- Commercial introduction of new/improved product/service
- Patent application
- Granted patent
- Recruitment of researcher with PhD degree
- Recruitment of other R&I personnel
- Establishment/maintenance of long-term R&I partnership with university in Norway
- Establishment/maintenance of long-term R&I partnership with research institute in Norway
- Establishment/maintenance of long-term R&I partnership with hospital trust/regional health authority in Norway
- Establishment/maintenance of long-term R&I partnership with company in Norway
- Establishment/maintenance of long-term R&I partnership with public organisation in Norway (other than university/research institute/hospital trust/regional health authority)
- Establishment/maintenance of long-term R&I partnership with university in another country
- Establishment/maintenance of long-term R&I partnership with research institute in another country

- Establishment/maintenance of long-term R&I partnership with company in another country
- More scientific approach to in-house R&I

Voluntary comment:

11. Which of the following commercial impacts has the FP project contributed to for the company?

(Has already been achieved, Will be achieved in the future, Will not be achieved, Not applicable, Don't know)

- Maintained/increased R&I activity in Norway
- Maintained/increased production in Norway
- Maintained/increased employment in Norway
- Increased sales
- Increased exports
- Reduced costs
- New suppliers
- New customers
- New value chain
- New business model
- Increased international competitiveness

Voluntary comment:

12. What would have happened if the project had not been co-funded through the FP? The project probably would have been:

- Implemented with co-funding from the Research Council of Norway
- Implemented with co-funding from Innovation Norway
- Implemented with co-funding through SkatteFUNN
- Implemented with co-funding from other public source, please specify in comment box
- Implemented with 100% own funding
- Not implemented
- Can't assess

Voluntary comment:

The following two questions were not shown if the respondent opted for either "Not implemented" or "Can't assess" on question 12.

If the project likely had been implemented anyway it probably would have been:

- Implemented with the same partnership
- Implemented with only Norwegian partners
- Implemented without partners
- Can't assess

If the project likely had been implemented anyway it probably would have been:

- Implemented within the same time frame
- Implemented later
- Can't assess

Voluntary comment:

Impacts beyond the company

If the FP project is still on-going and you believe that it is too soon to such impacts you may skip the next two questions – but please do continue answering the survey!

13. Which of the following wider impacts do you believe that the FP project has contributed to?

(Has already been achieved, Will be achieved in the future, Will not be achieved, Not applicable, Don't know)

- Improved public services in Norway
- Reduced emissions/pollution in Norway
- Increased energy efficiency in Norway
- Increased international competitiveness for other Norwegian participants (if applicable)
- Technology dissemination between industry sectors, please specify sectors (from-to) in comment box
- Spin-off company, please specify company name in comment box

Voluntary comment:

14. Please assess to what extent you believe that the FP project has contributed to addressing the following societal challenges.

(Not at all, To a small extent, To some extent, To a large extent, To a very large extent, Don't know)

- Health, demographic change and wellbeing
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy
- Secure, clean and efficient energy
- Smart, green and integrated transport

- Climate action, environment, resource efficiency and raw materials
- Europe in a changing world – inclusive, innovative and reflective societies
- Secure societies – protecting freedom and security of Europe and its citizens

Voluntary comment:

15. Please assess to what extent you believe that Norway's overall participation in FP7 and Horizon 2020 has contributed to the following wider impacts.

(Not at all, To a small extent, To some extent, To a large extent, To a very large extent, Don't know)

- Increased quality of Norwegian R&I
- Increased Norwegian innovation capacity
- Increased Norwegian value creation
- More sustainable Norwegian economic development
- Improved social welfare in Norway
- More sustainable Norwegian social development
- Development of Norwegian R&I policies and instruments
- Development of Norwegian R&I sector's collaboration patterns across national borders, sectors and fields

Voluntary comment:

FP projects vs. Norwegian projects

If you have participated in more than one project in FP7 and Horizon 2020, please respond to the questions on this page based on your compound experiences of FP projects.

16. Please assess the following statements on FP proposals/projects when compared to Norwegian proposals/projects (e.g. co-funded by the Research Council of Norway, Innovation Norway or SkatteFUNN).

(Fully disagree, Disagree, Neither disagree nor agree, Agree, Fully agree, Don't know)

- FP proposals take longer time to write
- FP proposal success rates are higher
- FP project administration is more demanding
- FP project reporting requirements are more demanding
- FP projects result in more public funding for the company
- FP projects provide better value for money on the company's own investment
- FP projects provide better opportunities for monitoring the international state of the art
- FP projects provide better opportunities for knowledge/technology import

- FP projects provide better opportunities for finding new R&I partners in other countries
- FP projects provide better opportunities for finding new suppliers in other countries
- FP projects provide better opportunities for finding new customers in other countries
- FP projects provide better opportunities for increasing the company's international competitiveness
- FP projects result in higher quality R&I results
- FP projects result in more useful R&I results
- FP projects are more prestigious
- FP projects provide better marketing opportunities
- FP projects better facilitate understanding other cultures

17. Please elaborate on the advantages and disadvantages of FP proposals/projects.

(Open question)

Appendix D Social network analyses and text mining

Using Social Network Analysis (SNA), the participation data in eCorda allows us to analyse patterns and structures of the Norwegian R&I community's involvement in FP7 and H2020. As described in our proposal, we want to use SNA to answer questions such as:

- Who are the main Norwegian players in the FPs?
- With whom do Norwegian participants collaborate?
- With whom do the Norwegian participants connect internationally?
- Do Norwegian-led projects connect third countries?
- Has there been an evolution between FP7 and H2020? Are new players joining in?

The data bases for the analyses in this appendix are eCorda project data (for network analyses) and published periodic reports available from the EU Open Data Portal[87] (for text mining).

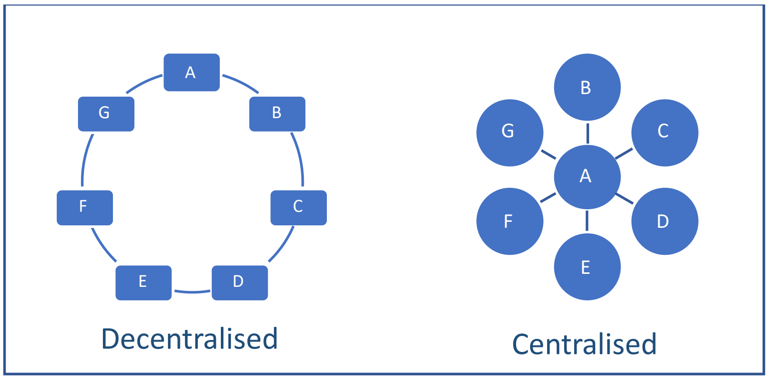
Short introduction to SNA and key terms used

SNA is an approach based on the ideas and tools of sociometry. The underlying idea can be traced back to Emile Durkheim, who argued that human societies were made up of interrelated components. Social patterns were not to be found in the intentions of individuals but in the structure of the social environments in which they were embedded.[88] This thinking – that not the individual person or organisation is the key but its position within the social fabric – is the underlying concept of SNA. This is visualised by using graph theory and applied in numerous contexts, whether personal networks, companies, thematic fields or R&I cooperation patterns. All of these "entities" are called **nodes** and the links connecting them are **ties**, **edges** or **dyads** in SNA terminology.

The structure of a network has effects on the communication flows in terms of speed and accuracy. In this respect, centralised structures such as a star outperform decentralised structures such as a circle, see Figure 0.19, even if mathematically it can be shown that within a circle, there is a shortest minimum solution time. In networks made of humans, there is nevertheless the tendency of more peripheral members to channel information to the most central node.

[87] https://data.europa.eu/euodp/en/data/dataset?q=cordis&ext_boolean=all&sort=views_total+desc
[88] Borgatti, S. et al (2009): Network analysis in the social sciences, Science 323, 892; DOI: 11.1126/science.1165821.

Figure 0.19 Basic network structures



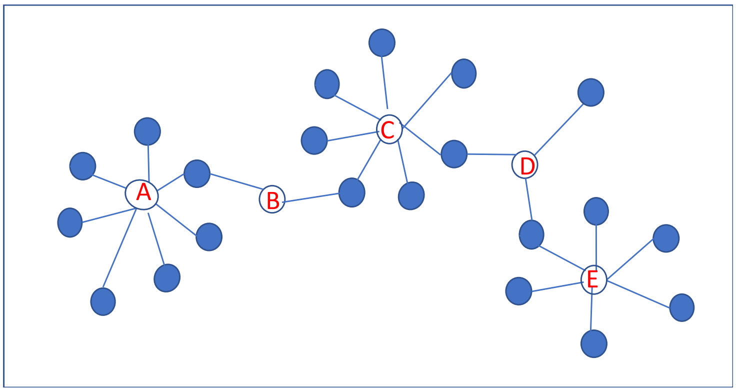
Source: Technopolis

In the decentralised circle form in Figure 0.19, information passes from one node to the other. If A wants to pass information to D, it needs to be passed by B and C or G, F, E. (which is even more cumbersome and risky). In the centralised star form, A can pass information to all others simultaneously and if any peripheral node wants to pass information, it can do so via A, thus having to pass only one node. In network terminology, A has a high local centrality or a high **node degree** in the centralised star structure. The node degree is an important indicator based on the number of relations (ties) of a node and measuring the influence or importance of that node.

In case of R&I networks, speed (i.e. how many nodes information needs to pass through to come to the intended receiver) is one important aspect for participant, but it is at least equally important to have the right partners. For example, networks with the same composition of member skills can perform differently depending on the patterns of relationships among the members. In particular in R&I teams, homogeneity and heterogeneity of networks matter. Social research has shown that networks which tend to be made of nodes with similar features are less innovative and creative. For FP consortia this may mean that a consortium with only one type of participant (e.g. universities), has less exchange of diverse ideas and knowledge than one which is made of different types of partners. Thus, in order to be successful – either in research outcomes such as important publications or innovation outputs such as new processes, products or services, the diversity of the consortium, and thus of the network nodes, matter.

A key feature of SNA is its characterisation through graph-theoretic properties such as structures, positions and dyadic properties. At the node level of analysis, an important concept concerns the centrality measure which relates to the prominence or structural importance of a node. **Betweenness centrality** instruments the extent to which a particular node lies "between" other nodes in the graph; a node of relatively low degree may play an important "intermediary" role and so be very central to the network.[89,90] Nodes A, C, and E in Figure 0.20 have high local centrality, while nodes B and D lie between many pairs of nodes and thus can play the role of a "broker" or **gatekeeper** with a potential for control over others. Node B could therefore be interpreted as an intermediary between the nodes centred around A and C while D might play the same role for the sets of C and E.[91]

Figure 0.20 Local and global centrality.



Source: Technopolis

Thus, in network theory and analysis, the position of a node is fundamental. To a large extent the position determines opportunities and constraints and thus the outcomes of a node. An example in from FP consortia is the position of a project coordinator; it may not only decide on what partners to include, but through its central role in the consortium the coordinator is also key in passing on information to all (or selected) partners. If this coordinator is also involved in other FP projects, he or she could be a broker with the capacity to pass on (or not) information also from other consortia in which it is involved. Centrality is not only linked to power and control; it also has tangible outcomes. It has been shown that the centrality of a company for example predicts its ability to innovate as measured by patents granted.[92]

A potentially negative effect of networks comes with the trust that is built among partners. Again, in a typical FP consortium it can be observed that participants who collaborated successfully tend to

[89] The indicator of 'betweenness centrality' is based on the number of shortest paths from all actors to all others that pass through a given node normalised by the total number of shortest paths in a network. In other words, the higher the number of shortest paths on which a node can be approached, the higher its betweenness centrality in the network. Bonacich (1972) argued that the centrality of a particular point cannot be assessed in isolation from the centrality of all the other points to which it is connected. A point which is connected to central points has its own centrality boosted, and this, in turn, boosts the centrality of the other points to which it is connected. The inherent circularity involved in the calculation of centrality can be avoided through normalisation. Bonacich defined the centrality of i equals the sum of its connections to other points, weighted by the centrality of each of these other points.
[90] Freeman, L, Roeder D, Mulholland R. (1979): Centrality in social networks: experimental results, in: *Social Networks* 2(2), pp 119-141.
[91] Scott, J. (1987): Social network analysis. A handbook. London, Sage.
[92] Powell, W., Koput, K, Smith-Doerr, L. (1996) in: Interorganisational collaboration and the locus of innovation: networks of learning in biotechnology, in: *Administrative Science Quarterly* 41 116.

collaborate again. This can be in terms of pairs of nodes but also larger numbers of nodes. Over time, they form so called "clubs" and it becomes more and more difficult for new entrants to join. Consequently, nodes become homogenous as a result of experiencing and adapting to similar social environments.[93] Homogeneity is however less conducive in R&I, and therefore networks and consortia benefit from integrating new partners. This phenomenon can be linked to and measured with **density**. Density of a network is calculated by dividing the number of all real ties by the number of all potential ties. The calculated number is between 0 and 1. A network density of 0 means that all nodes are unconnected while at 1, all are connected. The indicator is not scale-independent; it is easier to achieve high network density in a small network with few nodes than in a large network where connecting with other nodes becomes more and more difficult as the number of nodes increases.

Norwegian FP participation

A Commission study on SNA of FP7 found that new networks involving new partners lead to greater research integration in the short term and strengthened knowledge transfer in the medium long-term.[94] Previous studies on the long-term impact of the FPs observed that networks formed through FP funding tended to evolve slowly, with new members being tested and admitted only once trust had been established.[95]

As indicated above, network analyses can be performed at different levels, for example at individual node level, i.e. at participant level ("Has the participant's network evolved in terms of number of partners or type of partner?"), at sub-programme level ("Has the participants' network evolved in terms of geography of (new) partners, or in terms of disciplines?"), or at the "umbrella" level as it is done with the final evaluations of the FPs ("Is there a widening or cohesion effect?"). As with any large population, there is by far less inertia at the micro (or individual) level, than at a sectoral or thematic level and at the highest, aggregated, level. Thus, while many characteristics at FP level apply at this highest level, some parts of our analysis focus on Norwegian participants only. The patterns we identify and describe for those may differ from the overall FP picture.

Structural aspects of Norwegian participants: the gatekeepers

Table 0.84 lists the gatekeepers in the FP7 and H2020 networks of Norwegian participants, based on the normalised scores of betweenness centrality.[96] The distribution of the betweenness centrality in the Norwegian FP7 network was obviously quite skewed thus indicating a core-periphery network structure. In such a structure, a few influential actors (i.e. hubs or gatekeepers) located at the centre of the network

[93] Borgatti, op.cit.
[94] European Commission (2015), "Study on Network Analysis of the 7th Framework Programme Participation, Final Report", Directorate General for Research and Innovation.
[95] European Policy Evaluation Consortium (EPEC) (2011). "Understanding the long-term impact of the framework programme", Final Report to the European Commission DG Research, Brussels.
[96] Note that for the initial analyses we kept the individual participants as registered in eCorda. In particular several SINTEF institutes are included as individual participants. In subsequent, more detailed analyses we have merged all SINTEF institutes into one.

establish strong ties between themselves and weaker ties with the periphery where the density of ties – and consequently the flow of knowledge between peripheral players – is lower.

The Norwegian FP7 and H2020 networks both exhibit a core-periphery structure with SINTEF in a unique position in FP7, meaning that in many Norwegian participants were connected through SINTEF. In H2020, SINTEF's importance as gatekeeper is almost matched by NTNU's. From FP7 to H2020 there have been quite a few changes in terms of the relative importance of individual gatekeepers, with only a narrow majority (8 in 15) of the gatekeepers from FP7 still on the top 15 list for H2020.[97] In addition to SINTEF and NTNU, Nofima and IRIS[98] among the institutes and UiO, UiB, UiT and NMBU among the HEIs have been important gatekeepers in both FPs, thus indicating that the structure of the networks for the main participants after all have remained broadly similar over time (although one should bear in mind that H2020 is on-going and positions therefore may change).

[97] Teknologisk Institutt was bought by the Dutch Kiwa in 2015 and has apparently focused much less on the FPs since then; Kiwa Teknologisk Institutt only participates in three projects in H2020. Nor-Tek Teknologisenter was forced to close down in 2017 (and had no projects in H2020).
[98] part of NORCE Norwegian Research Centre AS as of 01.01.2018

Table 0.84 Top 15 Norwegian gatekeepers in FP7/H2020.

Rank	Participant name	Betweenness centrality	Participant name	Betweenness centrality
	FP7		H2020	
1	Stiftelsen SINTEF (SINTEF)	1.000	Stiftelsen SINTEF (SINTEF)	1.000
2	Teknologisk Institutt AS (TI)	0.554	NTNU	0.978
3	UiO	0.483	UiO	0.580
4	Nofima	0.297	UiB	0.369
5	Nor-Tek Teknologisenter AS	0.253	Nofima	0.207
6	NTNU	0.241	UiT	0.199
7	UiB	0.163	SINTEF Ocean	0.159
8	DNV GL AS	0.160	Lyse AS	0.126
9	Polewall AS	0.154	RCN	0.118
10	UiT	0.117	NMBU	0.112
11	IMR	0.113	Meteorologisk Institutt	0.110
12	NILU	0.109	Oslomet	0.108
13	NMBU	0.096	IRIS	0.104
14	Statoil Petroleum ASA	0.088	SINTEF Energi	0.096
15	IRIS	0.088	NIBIO	0.080

Source: Technopolis analysis of eCorda data

The ranking as key gatekeeper is not to be confused with the number of projects. As indicated in Figure 0.20, seemingly unimportant nodes can be gatekeepers if they are in the right position in the network. This is the case for example for Polewall, which participated in only two projects in FP7, but did so with

SINTEF in one project and with TI in another. Since SINTEF and TI did not participate in any common FP7 project, Polewall became a bridge between the two most central organisations in FP7, thus obtaining a prominent betweenness centrality.

Network trends: density

As mentioned above, teams which have built trust tend to collaborate over time and create clubs. This can be analysed through measuring the degree of cohesion in a network over time. In order to understand whether or not H2020 is a mere continuation of FP7 (in network terms), we constructed the network density indicator for both FPs. FP7 participants were thus taken as the basis. For H2020, we then analysed the changes in the number of nodes (new participants) and ties (new links created through projects).

Table 0.85 shows that the total number of Norwegian organisations has decreased somewhat from FP7 to H2020, although one must again bear in mind that for H2020, the data covers only the first five years and that network instruments may change. Similarly, the share of Norwegian participants (grant holders) has decreased marginally. The number of collaboration pairs is (still) smaller in H2020 than in FP7, but the analysis of the Norwegian sub-network shows that there are more pairs that involve a Norwegian organisation in H2020 than in FP7 (0.13% versus 0.11%). Despite the fact that there are fewer Norwegian participants in H2020 and that there are also fewer pairs for the whole network, the increasing number of Norwegian pairs suggests that either new partnerships between Norwegian participants have gained momentum, or that the established participants are included in more projects and in new partnerships. This can be cross-checked with the density indicator of the networks.

Table 0.85 Number of organisations and pairs per FP and sub-Norwegian network of projects involving at least one Norwegian participant

Indicators	FP7 (2007–2013)	H2020 (2014–2018)
Total number of organisations (full network)	30,905	29,486
Number of pairs (full network)	732,358	649,918
Density (full network)	0.15%	0.15%
Share of Norwegian grant holders	1.8%	1.7%
Share of pairs involving at least one Norwegian grant holder	0.11%	0.13%
Density (Norwegian sub-network)	0.55%	0.65%

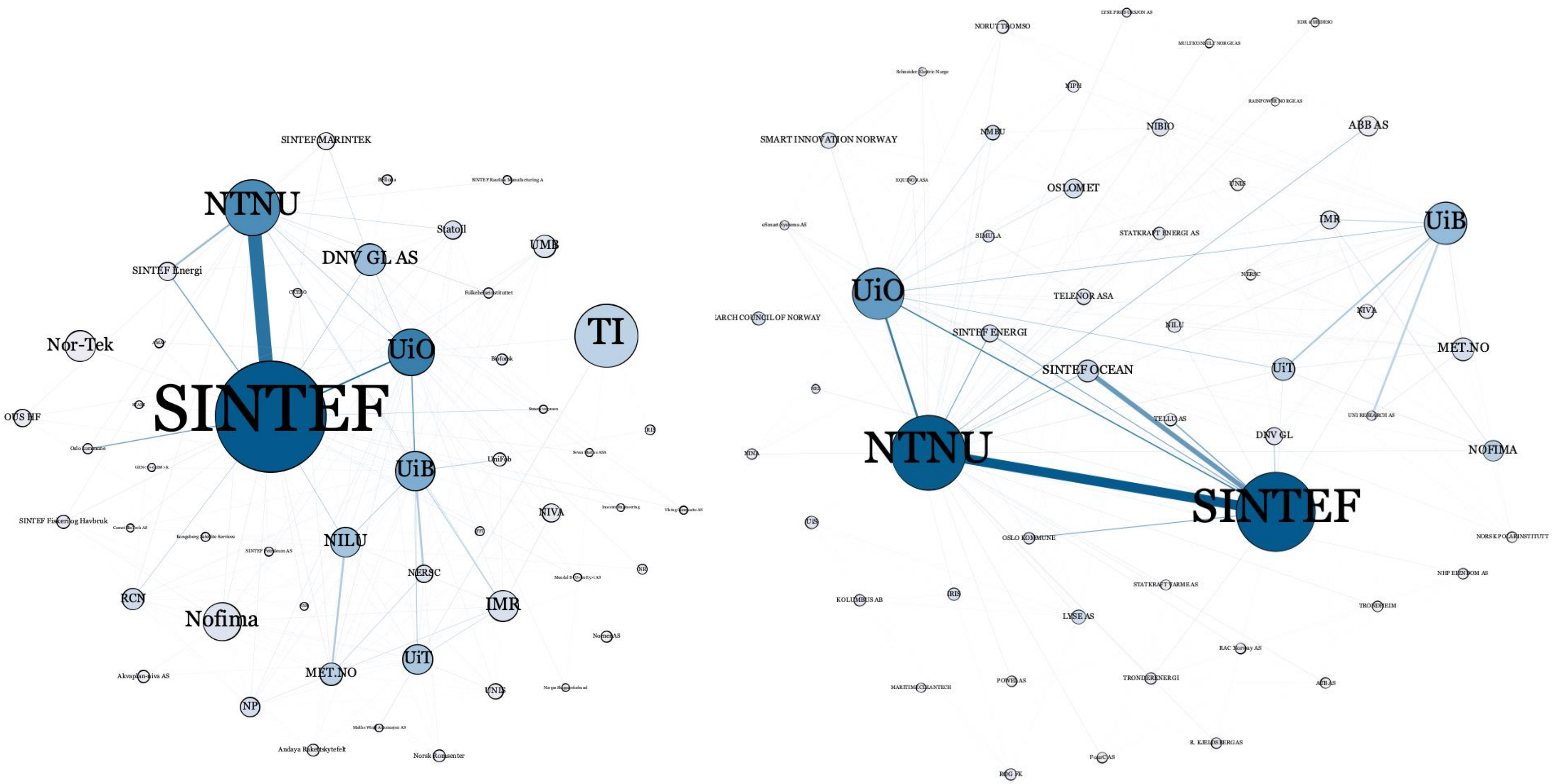
Source: Technopolis analysis of eCorda data

The network density for the two FPs has remained steady at 0.15 per cent (at least so far in H2020). If we look at the Norwegian sub-network, the density overall is higher and has increased from 0.55 per cent in FP7 to 0.65 per cent in H2020. As mentioned earlier, it is easier to connect in small networks than in large ones and thus obtain a higher density. The constant density of the whole network indicates that the number of new collaboration pairs have remained stable for the whole network meaning that they have increased proportional to the number of new participants. At the whole network level, exiting organisations in H2020 have been compensated by new participants and their new collaboration ties. The higher Norwegian densities indicate a higher cohesion level, which indicates that FP7 participants participate again in H2020, but do so more often. Thus, the core Norwegian participants are more successful in the sense that they are involved in more projects and thus have higher numbers and shares in terms of ties. While the core participants have increased their presence, a larger number of new Norwegian participants have joined in H2020, establishing new connections.

Figure 0.21 presents the social network graphs for the main Norwegian participants in FP7 and H2020. The colour intensity of a node represents its importance as gatekeeper, from dark blue indicating a high betweenness centrality to white indicating a low value. The size of the node indicates the weighted degree of node centrality, the measure based on the number of ties for a node.

The Figure shows that in FP7 SINTEF was by far the most important partner for other Norwegian organisations, followed by NTNU, UiO and UiB. TI and Nofima were also quite important as partners, but they were not equally centrally placed in the intra-Norwegian network. By H2020 SINTEF and NTNU have become more equal in terms of importance for other Norwegian organisations; in both FPs the wide ties between NTNU and SINTEF reflect their established close partnership. The Figure shows that in H2020 there are fewer “core” Norwegian participants than in FP7 (fewer “mid-sized and dark nodes), essentially mainly SINTEF and the three big universities.

Figure 0.21 Social networks of main Norwegian participants in FP7 and H2020 projects.



Source: Technopolis analysis of eCorda data

Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Who collaborates with whom? Analysis of pairs

While we know from many empirical studies that organisations of the same types tend to collaborate with each other, network theory suggests that heterogeneity is important for creativity and innovation. In R&I, interdisciplinarity and mixed gender are other forms of heterogeneity. In the following analysis, we have analysed the main stakeholder types, namely the eCorda classifications higher education (HES), research organisations/institutes (REC), the private sector (PRC), the public sector (PUB) and a residual other group (OTH) and compared the number of pairs between different combinations. We analysed these pairs for Norwegian partners only, as well as for all partners.

If we first look only at intra-Norwegian collaboration, Table 0.86 indicates that the by far the most common collaboration between stakeholder types in both FPs is REC–PRC. Although this dominance has decreased somewhat in H2020, all other combinations that do not involve the motley OTH type have increased, with HES–REC collaboration seeing the largest increase.

Including also non-Norwegian partners, the patterns are rather different, but also quite stable between FP7 and H2020. HES–REC, HES–PRC and REC–PRC collaboration dominates in roughly the same proportions, with a slowly decreasing proportion from FP7 to H2020 for HES–REC and REC–PRC and a slowly increasing one for HES–PRC. Although the intra-stakeholder type collaboration preferences in FP projects are not necessarily indicative of the preferences in purely national projects (such as those funded by RCN or IN), these differences nevertheless suggest that FP projects result in notably greater diversity in terms of intra-stakeholder type collaboration.

Table 0.86 Share of heterogenic stakeholder pairs in Norwegian R&I networks.

Pairs		Only Norwegian partners		With all partners	
		FP7	H2020	FP7	H2020
HES	REC	12%	20%	28%	24%
HES	PRC	17%	19%	22%	24%
HES	PUB	0%	4%	5%	5%
REC	PRC	44%	38%	22%	20%
REC	PUB	0%	5%	7%	7%
PRC	PUB	0%	4%	4%	4%
HES	OTH	6%	2%	4%	5%
REC	OTH	10%	2%	3%	5%
PRC	OTH	11%	4%	3%	4%

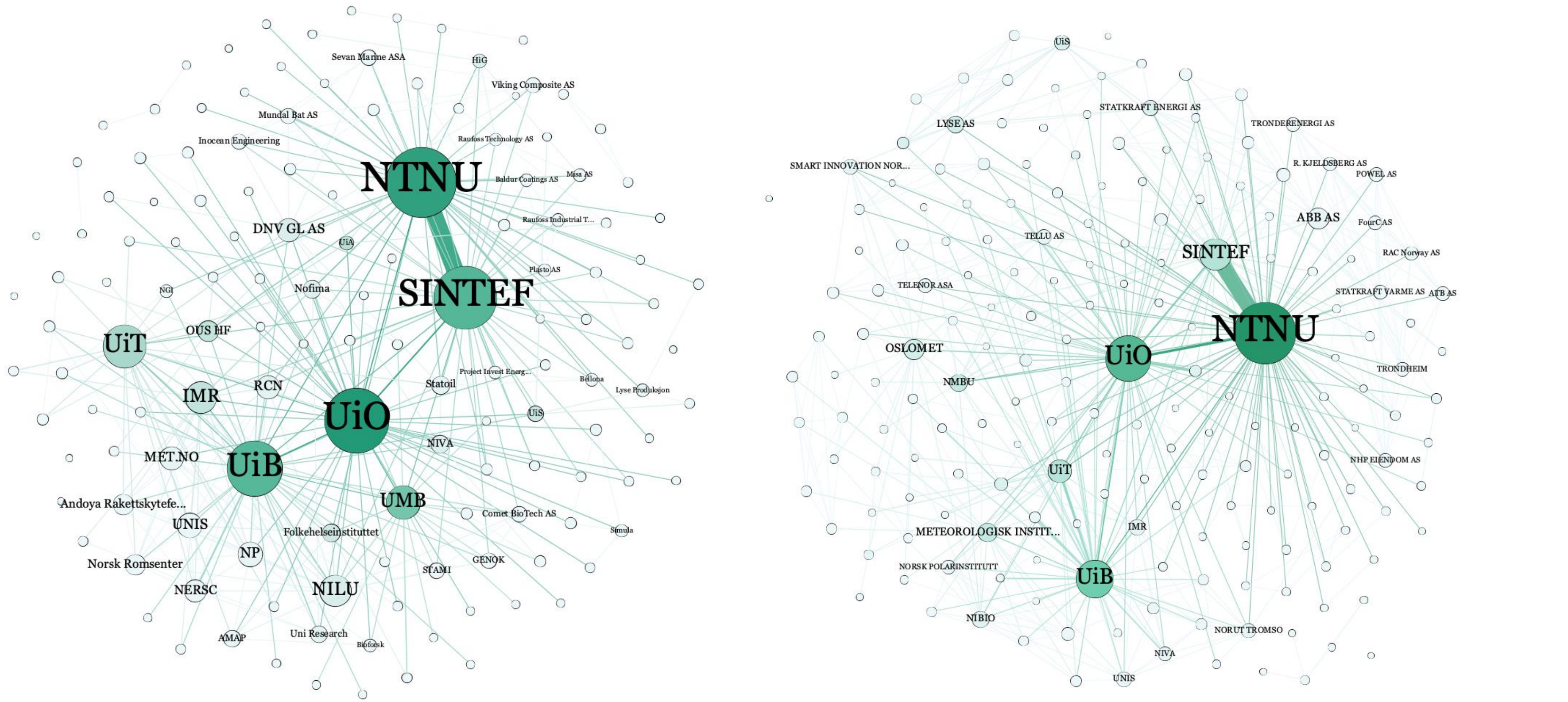
PUB	OTH	0%	1%	1%	2%

Source: Technopolis analysis of eCorda data
Legend: Colours indicate shares: 0–4% are red to orange, >5–10% yellow and >10% light to dark green.

Figure 0.22 visualises the intra-Norwegian collaboration pairs including at least one HEI (HES) and Figure 0.23 the intra-Norwegian collaboration pairs including at least one research institute (REC), thus illustrating the changes from FP7 to H2020 consistent with the “Only Norwegian partners” columns of Table 0.86.

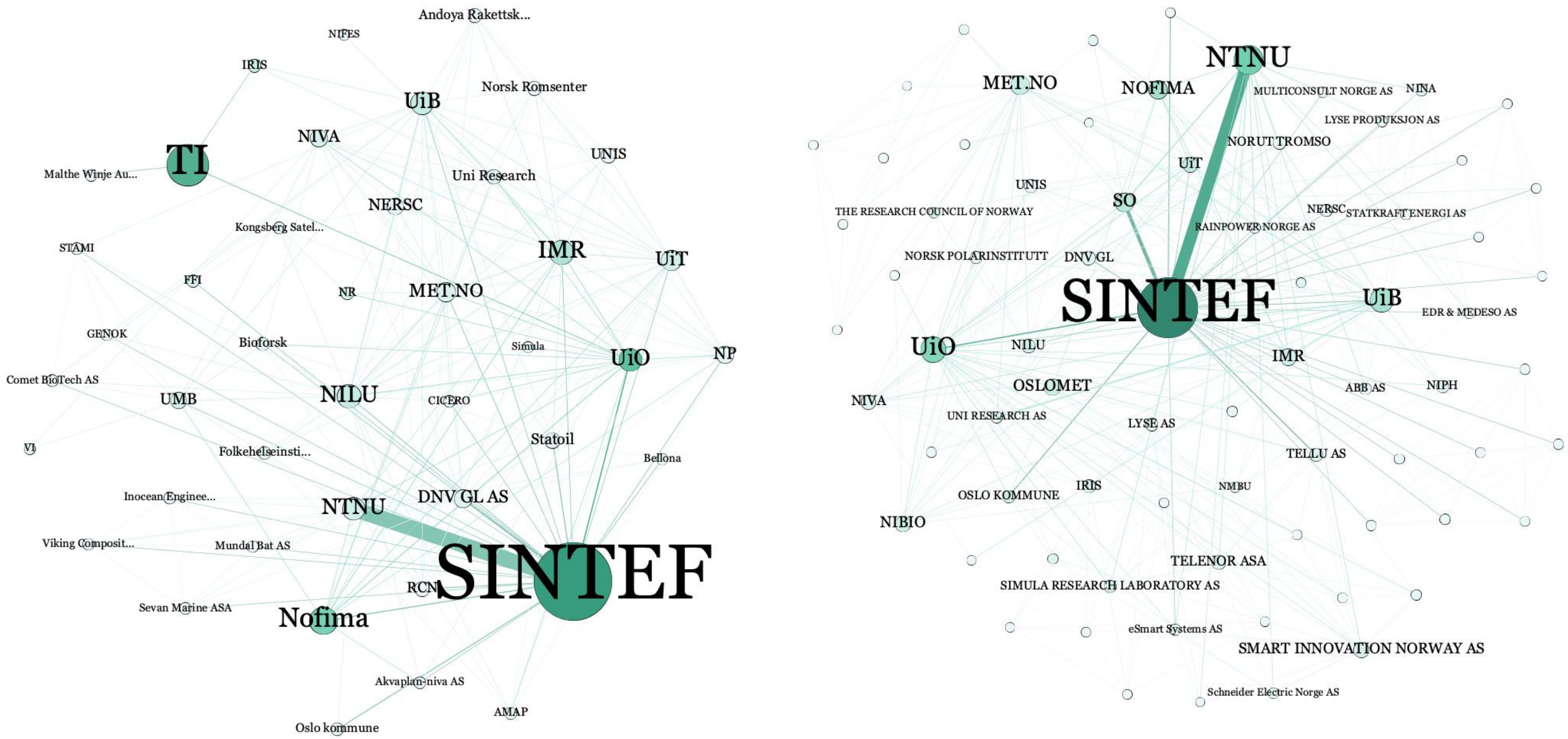
From Figure 0.22 we see that NTNU, UiO and UiB were similarly important as FP partners for other Norwegian organisations in FP7, followed by UiT and UMB (NMBU). In H2020 NTNU has maintained its position as the most important HEI partner in the intra-Norwegian network, whereas all other HEIs have become less important. In H2020 there are not only fewer “core” HEIs than in FP7, there are also more unique organisations that collaborate with Norwegian HEIs.

Figure 0.22 Intra-Norwegian collaboration pairs in FP7 (left) and H2020 (right) including at least one HEI.



Source: Technopolis analysis of eCorda data
Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Figure 0.23 Intra-Norwegian collaboration pairs in FP7 (left) and H2020 (right) including at least one research institute.



Source: Technopolis analysis of eCorda data
Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Figure 0.23 illustrates that SINTEF's complete dominance as institute partner for other Norwegian organisations has become less pronounced in H2020, whereas Nofima maintains its position as the (distant) second most important institute. Recall that TI, which had a central role in FP7, has scaled back its FP participation dramatically following a change in ownership in 2015.

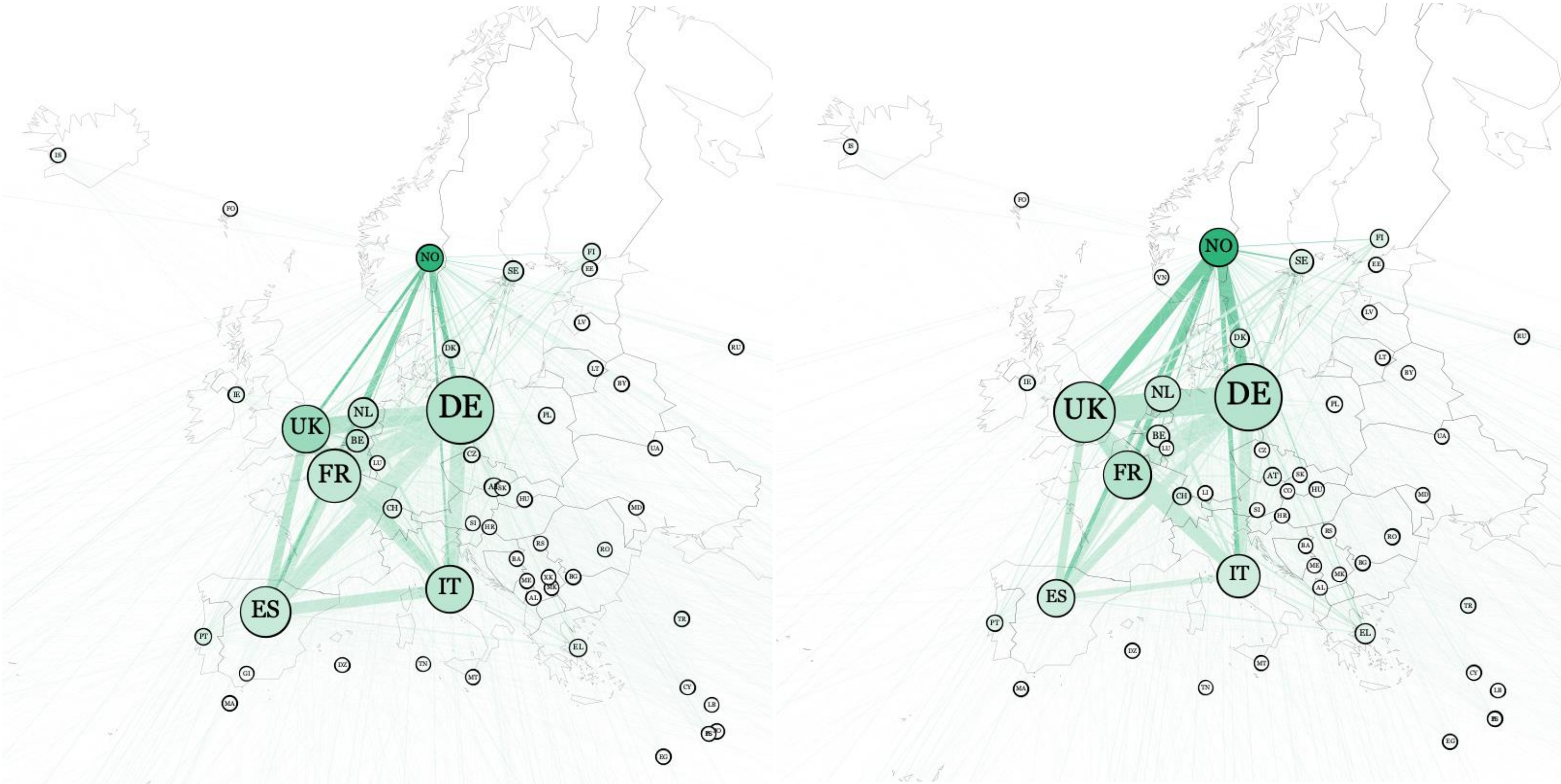
Collaboration with other countries

We the go on to explore the collaboration patterns between Norwegian organisations and their partners in other countries. Figure 0.24 presents the collaboration networks for the two FPs. The betweenness centrality shows which countries are the central knowledge brokers (dark green (high), white (low)) for Norwegian participants. (The most central country in the network is Norway since, by construction, we analyse only projects with at least one Norwegian partner.)

In FP7, the most important country in terms of betweenness centrality was the UK, followed by Germany, Spain, France, Italy and the Netherlands. This means that these countries were the most central in order to ensure collaborations with the rest of the participants. In H2020, not only did the size of the Norwegian node increase, thus indicating an increased number of collaborations (the relevant measure is the increased share of pairs, cf. Table 0.85), but there was also a change in the preferred collaboration partners and gatekeepers. Norwegian participants increased collaboration with the UK, Germany and the Netherlands, and the two former countries are for Norwegian participants also the key gatekeepers. However, in terms of direct links, Germany was the most important country in both FPs.

Figure 0.25 shows the collaboration networks for projects coordinated by a Norwegian organisation. The reasons for this was the hypothesis that Norwegian-led projects may offer a higher chance for other Norwegian players to participate, and that we wanted to see if Norwegian coordinators team up with other non-EU28 – so-called third – countries. The large size of the Norwegian nodes can both be explained by us only analysing Norwegian projects and the fact that Norwegian coordinators tend to include additional Norwegian organisations. In FP7, the UK was the main collaboration country and France the key hub for accessing other countries (indicated by the dark colour of the French node). In H2020, a shift away from the UK and a wider distribution over several other countries can be seen. In H2020, the dominant collaboration partner is Germany, followed by Spain, France and Italy. The key hubs for accessing other countries are Germany and Italy.

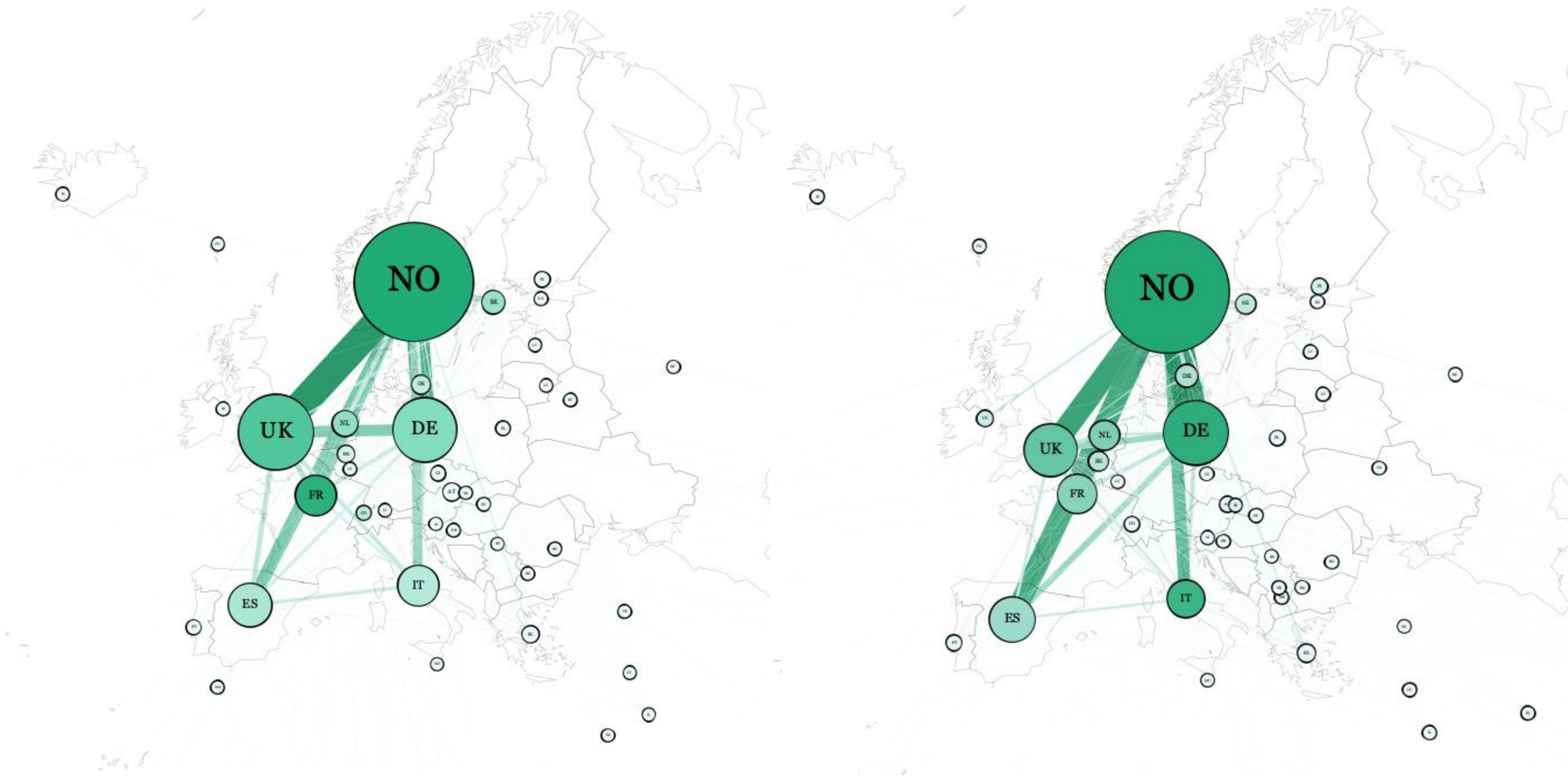
Figure 0.24 Norwegian partners' collaboration networks in FP7 (left) and H2020 (right).



Source: Technopolis analysis of eCorda data

Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Figure 0.25 The network of main countries participating in FP7/H2020 projects with a Norwegian coordinator.



Source: Technopolis analysis of eCorda data
Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

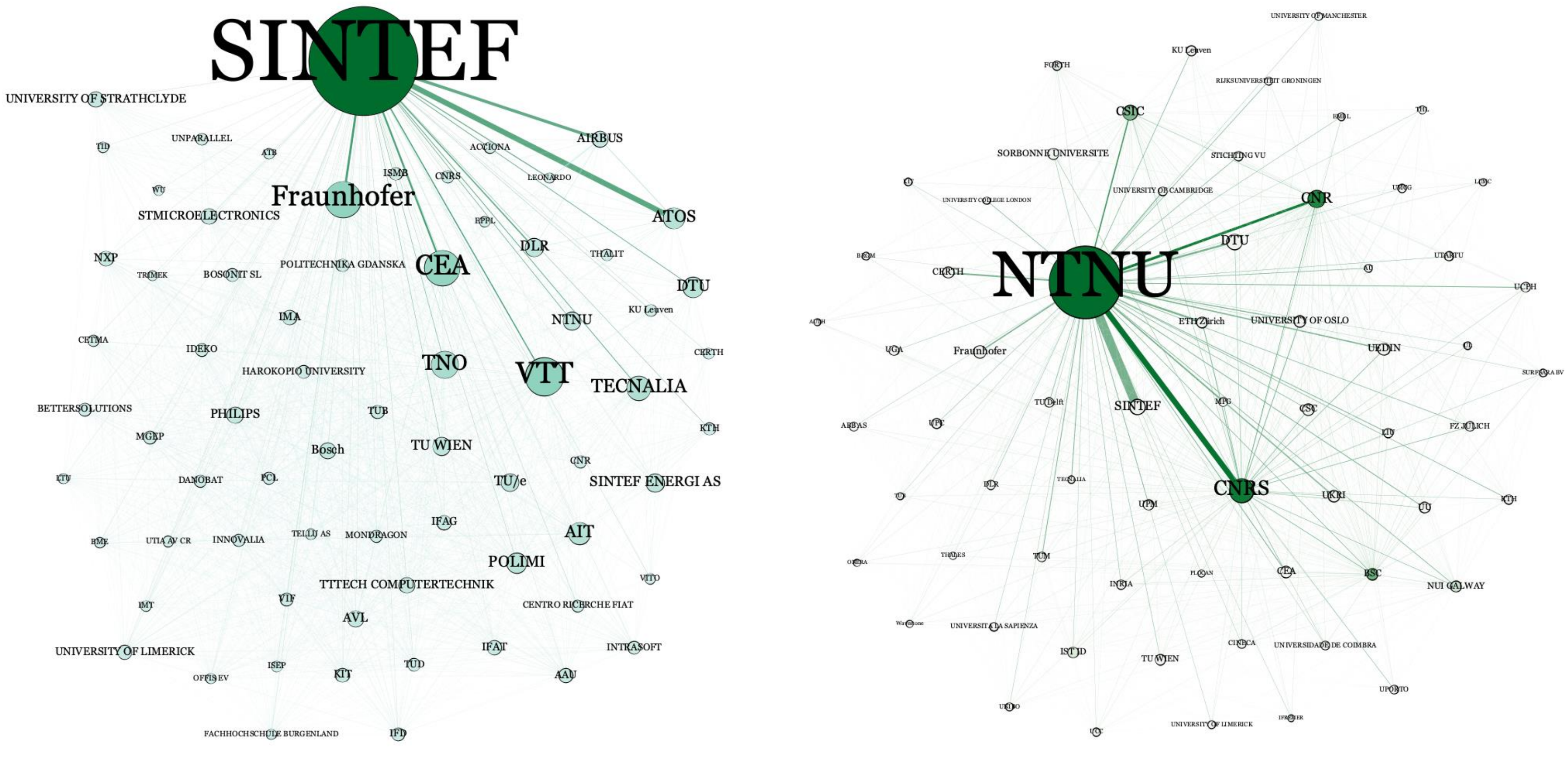
Networks of top Norwegian FP participants

We know from previous figures that SINTEF, NTNU, UiO and UiB are the most frequent Norwegian FP participants. We now take a closer look at their overall collaboration networks in H2020.

Figure 0.26 shows the overall H2020 networks of SINTEF and NTNU. The Figure shows that SINTEF collaborates intensely with VTT, CEA, Fraunhofer, TNO and Tecnalia, which like SINTEF are all (among) the largest technically oriented public research organisation in their respective country. ATOS and Airbus are important partners in the private sector. NTNU has fewer foreign partners than SINTEF. The key ones are the French umbrella research organisation CNRS (which in reality may mean numerous research departments and units), Italian CNR and Spanish CSIC. We can clearly see that SINTEF plays an important role for NTNU, but also that this is not reciprocal; in SINTEFs network, NTNU plays only a minor role. NTNU's strong links to CNRS, CNR and CSIC are probably a result of a university's greater focus on basic research; all three research institutes have strong ties to universities and focus less on applied research than the preferred collaboration partners of SINTEF.

Figure 0.27 shows the overall H2020 networks of UiO and UiB, which in many respects clearly differ from SINTEF's and NTNU's. Obviously, academic partners dominate for both. UiO's network is denser than that of UiB (and NTNU) in the sense that it has many more links and more partners. Among the preferred ones are CNRS and CNR, but also Germany-based EMBL and a number of HEIs, including the universities of Helsinki, Edinburgh, UCL, DTU and KTH. UiB's main partners are CNRS, CSIC, and CNR, and the most important universities are DTU, University of Helsinki, ETH Zurich and Lund University.

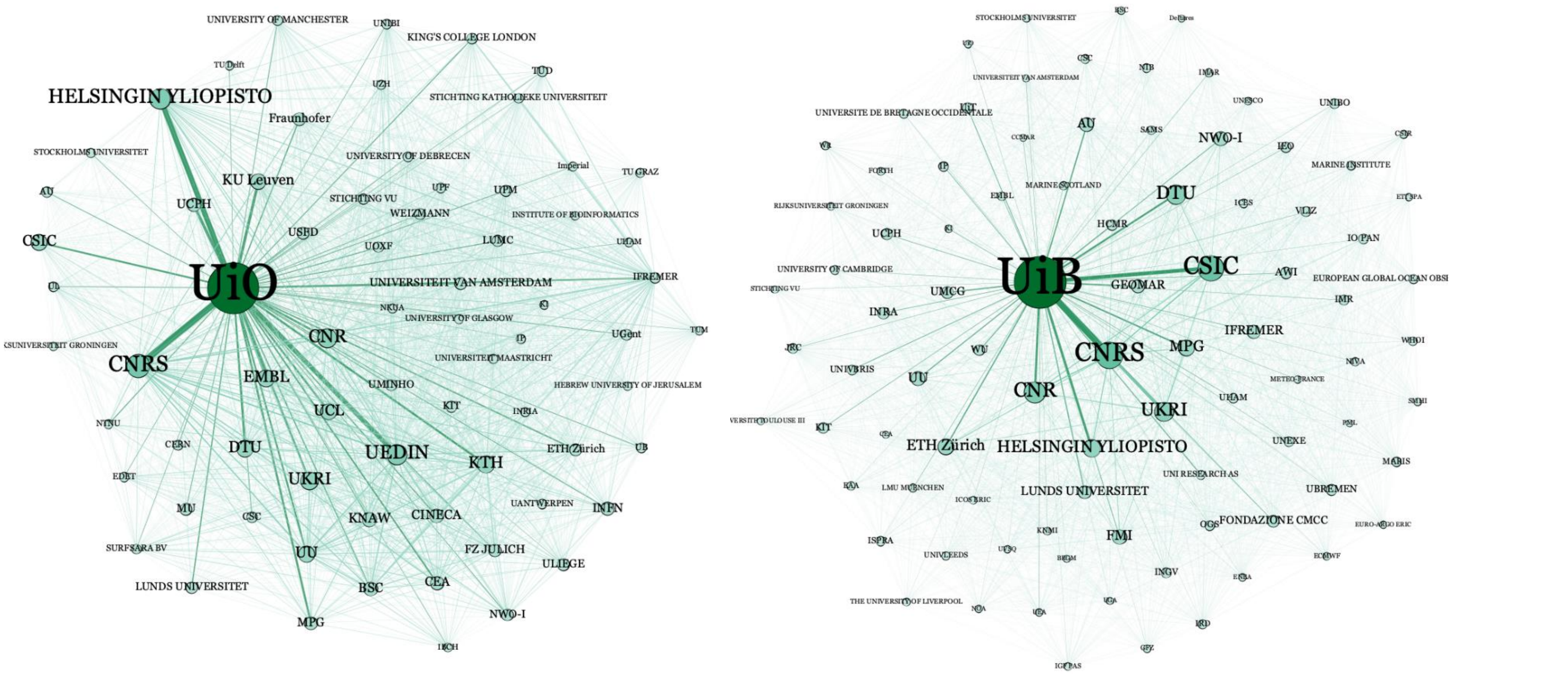
Figure 0.26 H2020 collaboration networks of SINTEF (left) and NTNU (right).



Source: Technopolis analysis of eCorda data

Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Figure 0.27 H2020 collaboration networks of UiO (left) and UiB (right).



Source: Technopolis analysis of eCorda data
Legend: The size of the node represents its centrality, the colour its betweenness centrality (dark is high, light is low).

Networks in selected thematic areas

We then take a closer look at collaboration patterns by H2020 thematic area. We know from Figure 0.24 that Germany is Norway's favoured partner country. Table 0.87 shows that is also the most important partner country in almost all of the main thematic areas, with the exception of Food and bio-economy (FOOD), where France, Spain, the UK and Italy dominate. UK is the favoured country in Marie-Curie projects (MSCA), while France is preferred in Smart, Green and Integrated Transport (TPT).

Table 0.87 Norwegian collaboration in H2020 by partner country and thematic area.

Country	LEIT	INFRA	FOOD	TPT	MSCA	ENV	ENERGY	HEALTH	FET	Other	Grand Total
DE	2.31%	1.43%	0.95%	1.26%	1.35%	0.82%	0.93%	0.94%	0.73%	1.04%	11.77%
FR	1.72%	1.42%	1.22%	1.56%	0.81%	0.80%	0.63%	0.78%	0.41%	0.67%	10.02%
UK	1.23%	1.31%	1.17%	0.85%	1.37%	0.79%	0.65%	0.86%	0.54%	0.86%	9.62%
ES	2.26%	1.02%	1.19%	0.80%	0.63%	0.82%	0.82%	0.60%	0.49%	0.70%	9.33%
IT	1.51%	1.09%	1.13%	0.78%	0.59%	0.65%	0.70%	0.63%	0.54%	0.84%	8.44%
NL	0.94%	0.94%	0.81%	0.66%	0.93%	0.60%	0.49%	0.66%	0.17%	0.54%	6.73%
BE	0.71%	0.44%	0.68%	0.66%	0.33%	0.54%	0.45%	0.45%	0.12%	0.45%	4.82%
SE	0.48%	0.55%	0.35%	0.43%	0.43%	0.26%	0.28%	0.29%	0.16%	0.28%	3.51%
AT	0.62%	0.30%	0.24%	0.35%	0.21%	0.26%	0.27%	0.18%	0.11%	0.43%	2.97%
DK	0.30%	0.26%	0.50%	0.34%	0.40%	0.23%	0.33%	0.29%	0.04%	0.26%	2.95%
EL	0.63%	0.41%	0.43%	0.13%	0.15%	0.23%	0.19%	0.16%	0.11%	0.38%	2.82%
FI	0.50%	0.47%	0.32%	0.10%	0.20%	0.23%	0.18%	0.19%	0.09%	0.33%	2.59%
CH	0.32%	0.35%	0.20%	0.20%	0.29%	0.14%	0.27%	0.26%	0.21%	0.17%	2.42%
PT	0.37%	0.37%	0.35%	0.07%	0.22%	0.25%	0.26%	0.16%	0.04%	0.24%	2.34%
PL	0.23%	0.33%	0.18%	0.25%	0.08%	0.13%	0.21%	0.16%	0.05%	0.26%	1.88%
IE	0.25%	0.23%	0.37%	0.25%	0.09%	0.20%	0.15%	0.08%	0.04%	0.20%	1.84%
CZ	0.21%	0.29%	0.13%	0.19%	0.09%	0.09%	0.09%	0.11%	0.02%	0.15%	1.36%
RO	0.13%	0.12%	0.19%	0.05%	0.08%	0.13%	0.14%	0.04%	0.01%	0.20%	1.09%

Other	1.37%	1.46%	2.06%	1.02%	1.60%	1.39%	1.11%	1.24%	0.23%	2.03%	13.50%
Grand Total	**16.07%**	**12.78%**	**12.47%**	**9.97%**	**9.84%**	**8.58%**	**8.14%**	**8.06%**	**4.10%**	**10.00%**	**100.00%**

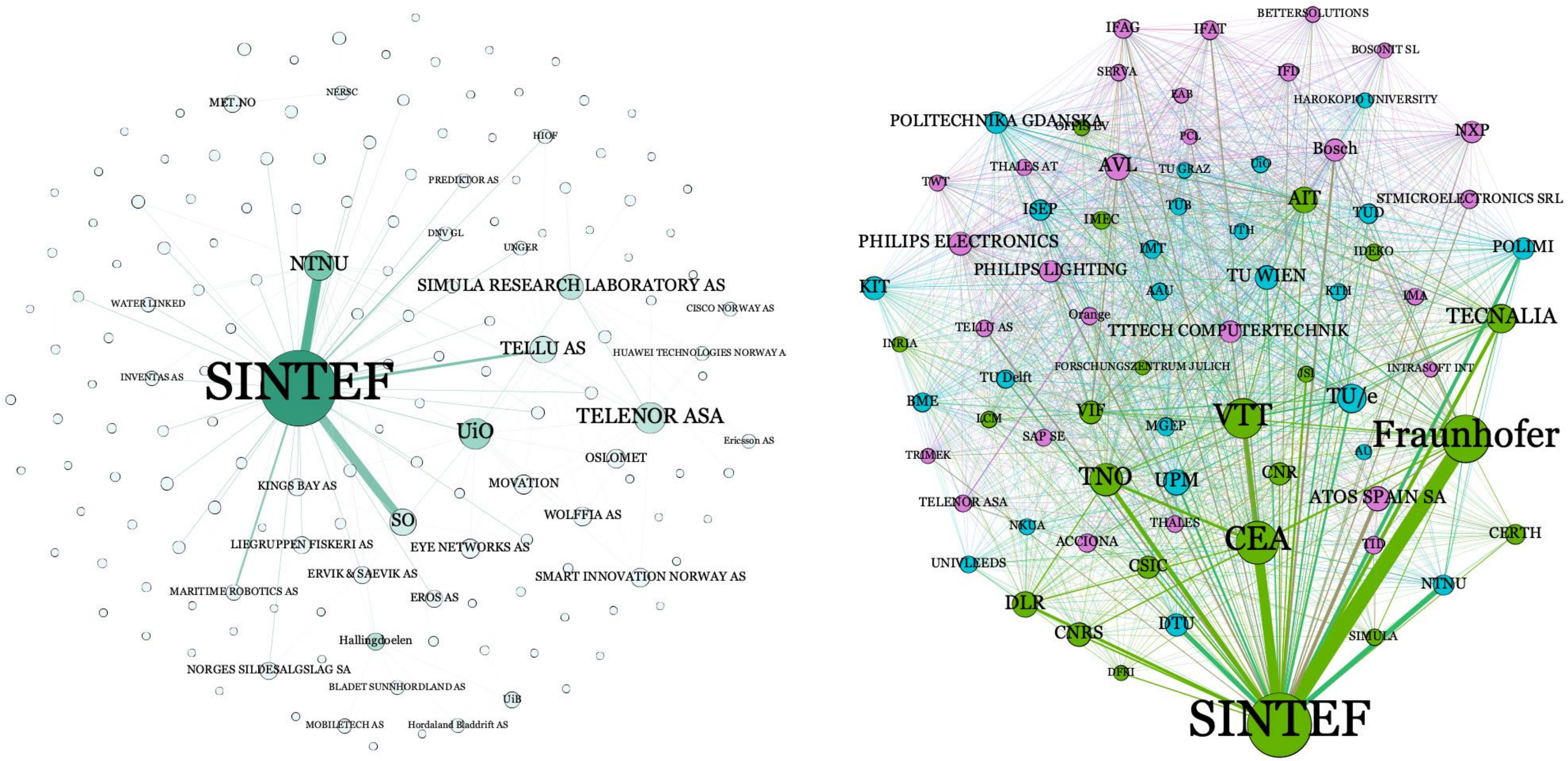
Source: Technopolis analysis of eCorda data
Legend: Darker green indicates stronger preference

In Figure 0.28–Figure 0.33we analyse the Norwegian and overall collaboration networks in the H2020 thematic areas of greatest importance to Norway.

Leadership in Enabling and Industrial Technologies (LEIT)

Figure 0.28 (left) shows that the main Norwegian participants in LEIT are SINTEF, NTNU, UiO and Telenor, with SINTEF as the obvious centre. Figure 0.28 (right) shows that SINTEF maintains very strong collaboration links to German Fraunhofer, French CEA, Finnish VTT and Dutch TNO. The international LEIT network is dominated by REC and HES organisations; while many companies (PRC) are involved, many are not at the core of the network.

Figure 0.28 National (left) and overall (right) collaboration networks in H2020 LEIT thematic area.

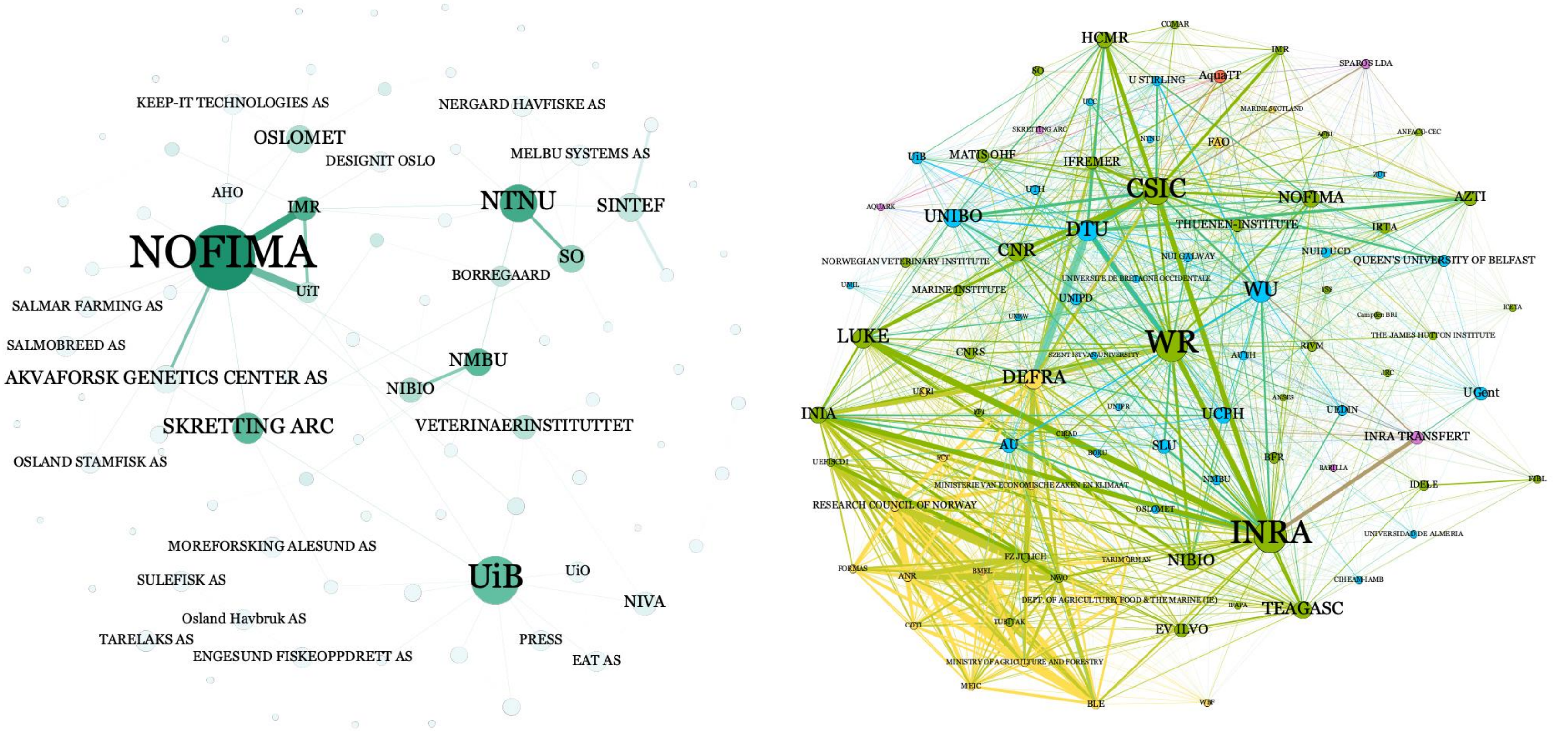


Source: Technopolis analysis of eCorda data
Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy (FOOD)

Figure 0.29 (left) highlights that the Norwegian network in FOOD is quite loosely connected with a slightly more pronounced sub-network around Nofima. In the international FOOD network, Nofima is the only easily discernible noticeable Norwegian participant. Overall, Norwegian participants play a relatively limited role in this thematic area. The international network is dominated by the leading Dutch Wageningen University (WU) and Wageningen Research Foundation (WR), where the latter together with French INRA and the Spanish CSIC constitute the network's core partners. The private sector (PRC) is all but absent.

Figure 0.29 National (left) and overall (right) collaboration networks in H2020 FOOD thematic area.



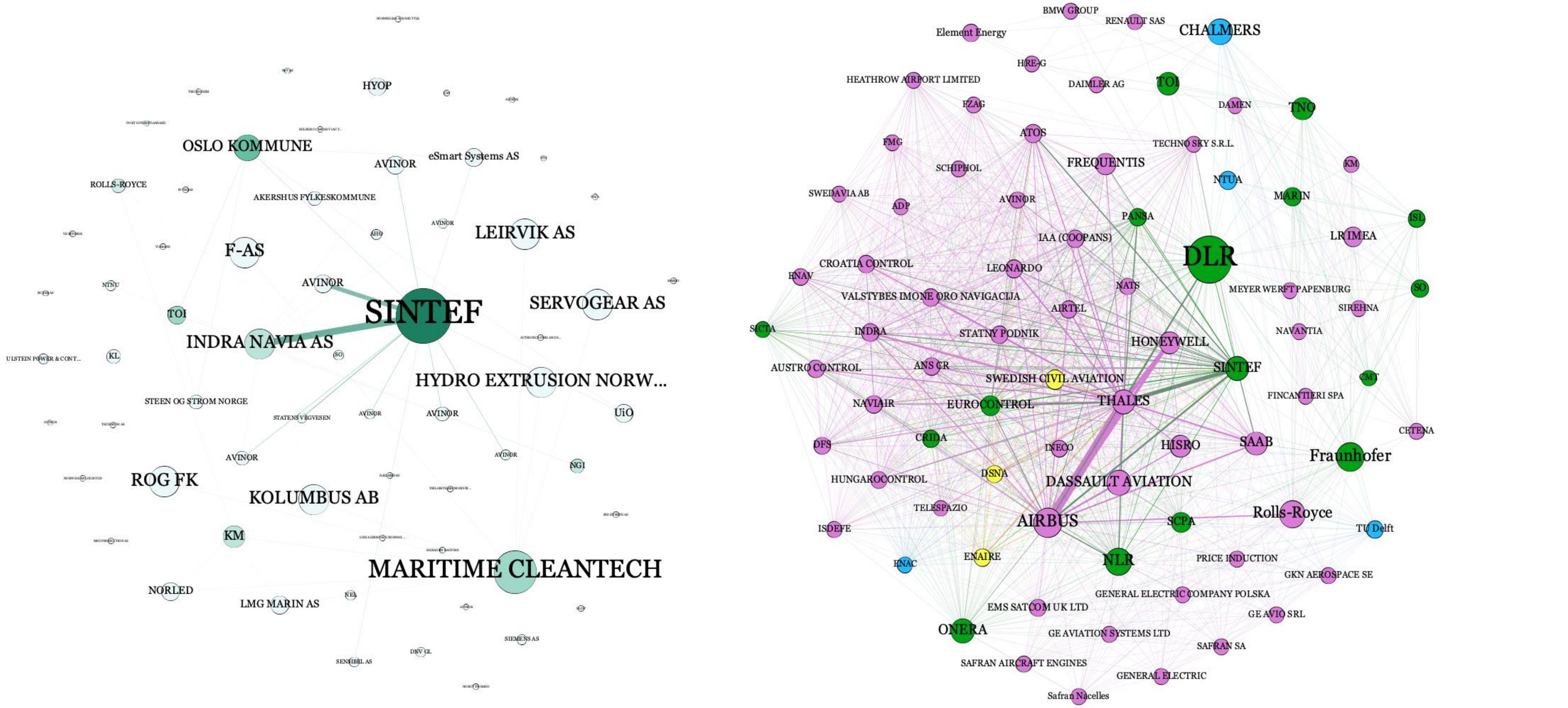
Source: Technopolis analysis of eCorda data

Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

Smart, Green and Integrated Transport (TPT)

Figure 0.30 (left) shows that the Norwegian network in TPT is similar to the one in FOOD, i.e. a loose network without strongly interconnected organisations, although SINTEF is the obvious core. In the international network (right), German DLR, Thales and Airbus are the central organisations, and SINTEF is rather well placed in the network. Overall, universities play a minor role in TPT. Despite being an important participant in the national network, Maritime Cleantech is not even visible in the international one; stronger intra-Norwegian ties would most likely enhance its position in the international network.

Figure 0.30 National (left) and overall (right) collaboration networks in H2020 TPT thematic area.

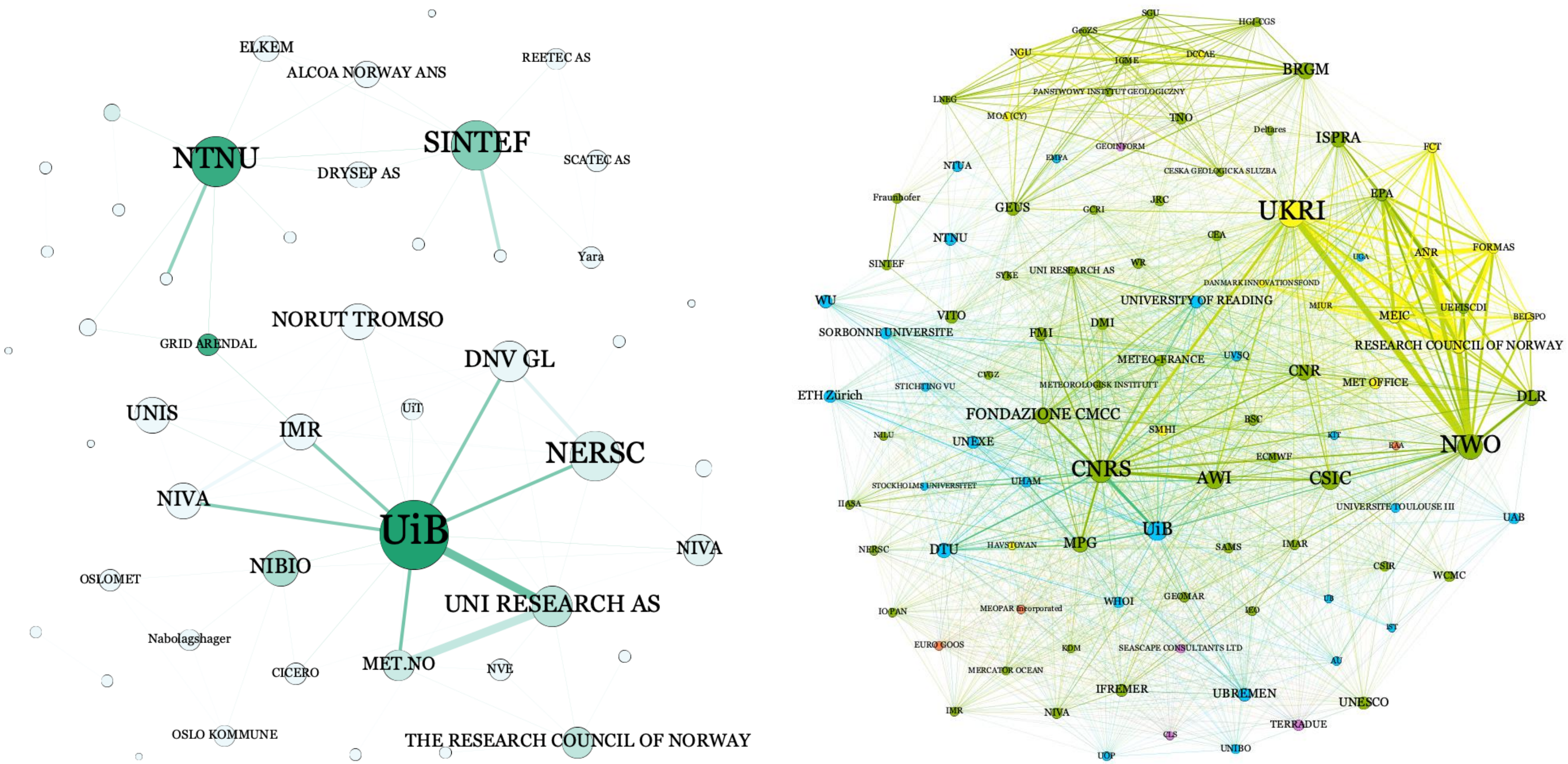


Source: Technopolis analysis of eCorda data
Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

Climate action, environment, resource efficiency and raw materials (ENV)

Figure 0.31 (left) illustrates that the Norwegian H2020 network in environment action consists of three sub-networks, each with its own centre and hardly connected to each other; the sub-network around UiB is obviously the most important. However, UIB's role in the international network (right) is less dominating, but the university is a discernible node at the centre of the network. Key players are Dutch NOW and British UKRI, but UiB is closer connected to some centrally placed institutes, including French CNRS, German AWI, German MPG and Spanish CSIC. The network includes very few companies.

Figure 0.31 National (left) and overall (right) collaboration networks in H2020 ENV thematic area.

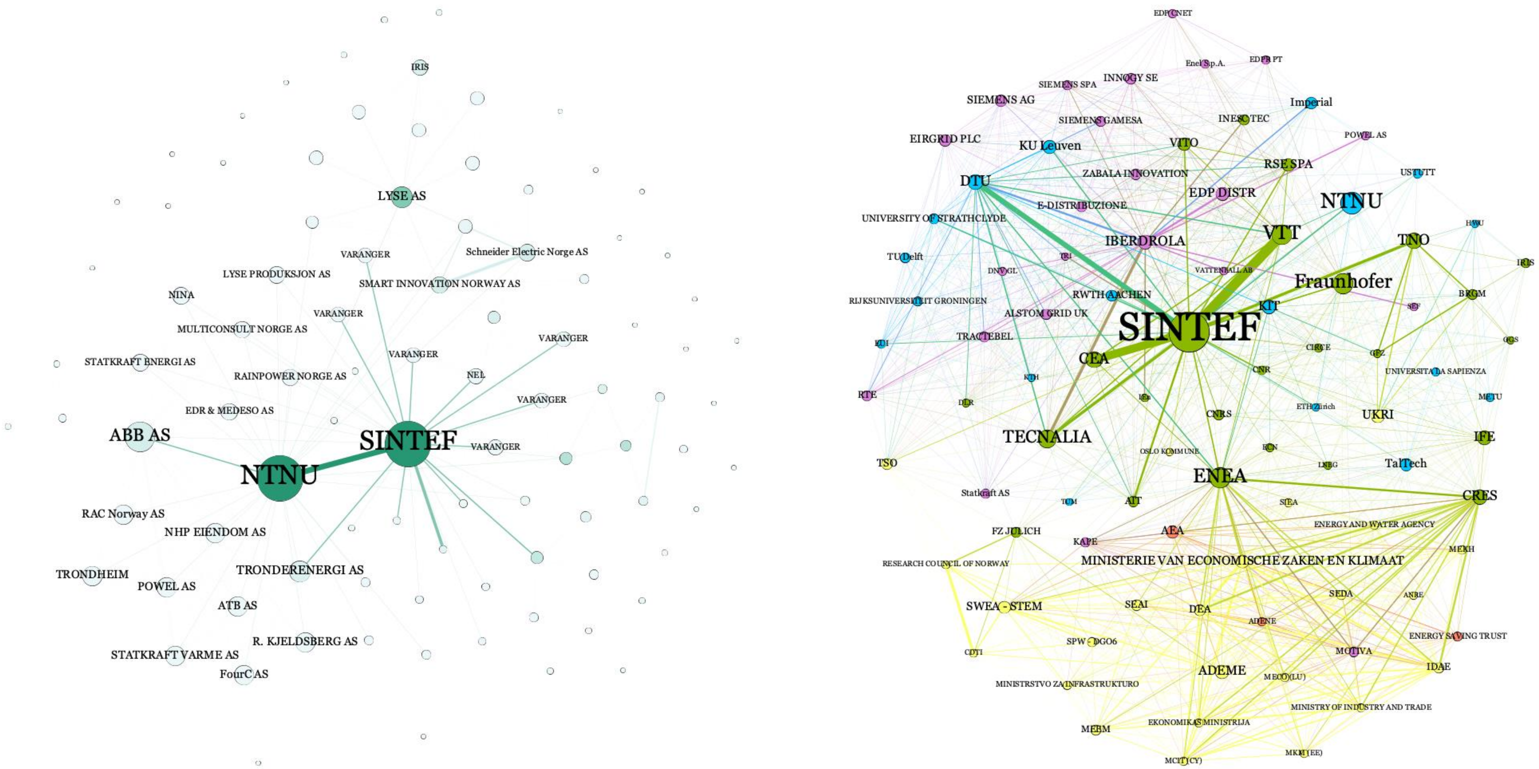


Source: Technopolis analysis of eCorda data
Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

Secure, clean and efficient energy (ENERGY)

Figure 0.32 (left) shows that the national energy network is centred around SINTEF and NTNU. SINTEF is very central also in the international network (right) and maintains close links to in particular with Finnish VTT, French CEA, Spanish Tecnalia and Dutch TNO. The international network shares some traits with the LEIT network, but with a smaller role for German Fraunhofer and Italian ENEA. ENEA links to a distinctive part of the ENERGY network dominated by public organisations.

Figure 0.32 National (left) and overall (right) collaboration networks in H2020 ENERGY thematic area.



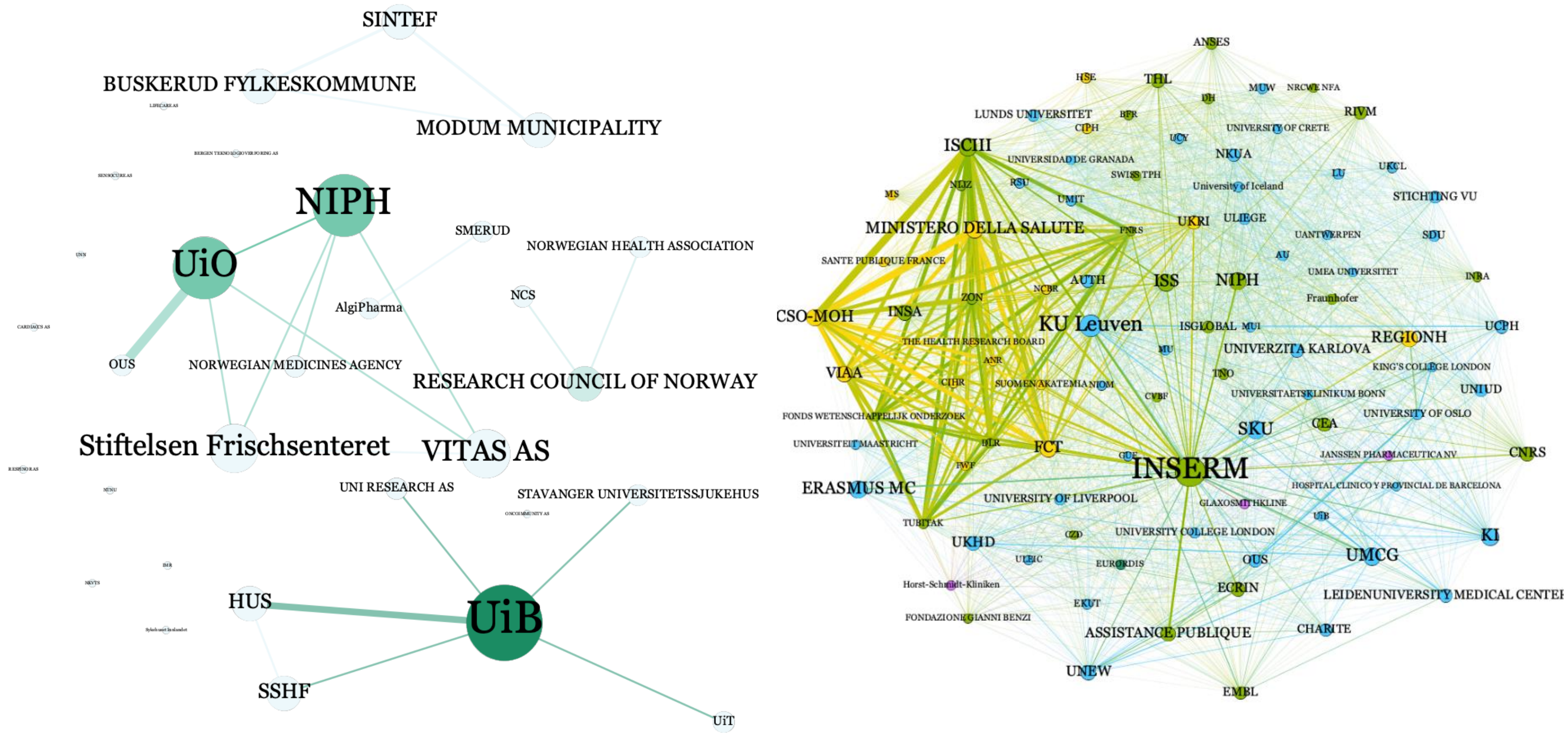
Source: Technopolis analysis of eCorda data

Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

Health, demographic change and wellbeing (HEALTH)

Figure 0.33 (left) illustrates that the Norwegian H2020 health network is quite small with a limited number of participants in two sub-networks, one centred around NIPH and UiO, the other around UiB. The international network is extremely dense, but also includes a sub-network dominated by organisations from the REC and PUB sectors (to the left in the right figure). NIPH is well connected in the overall network, where French INSERM plays an outstanding role while the private sector is almost absent.

Figure 0.33 National (left) and overall (right) collaboration networks in H2020 HEALTH thematic area.



Source: Technopolis analysis of eCorda data
Legend for right figure: Green: REC; pink: PRC; light blue: HES; yellow: PUB; red: OTH

These graphical representations of FP collaboration patters in key thematic areas indicate that for Norwegian actors, international visibility is closely linked to either national champions (such as SINTEF) or broad and well-connected national networks (such as in energy). The Norwegian position in FP networks can be either be developed through strengthening of national champions or by stimulating development of national R&I networks (e.g. through nationally funded projects). A key success factor for being part of the international knowledge exchange as offered through the FPs is to bring something attractive to the party. From the network analyses we can conclude that participation in the FPs provides invaluable assets in the form of access to diverse and outstanding knowledge bases.

Norwegian-led projects a key for third country participants

An analysis of the FPs showed that the participation rate of third countries has decreased in H2020 compared to FP7.[99] We set out to determine if Norway, as an associated third country, is an important hub for other third countries. We analysed the collaboration patterns in terms of weighted degree of centrality and compared Norway to Finland (similar in size, but EU Member State) and Switzerland (associated country) (European Commission, 2017a).

Table 0.88 shows that Norway had partners from 44 third countries in FP7 and so far from 41 third countries in H2020, while the figures for Finland and Switzerland are much lower. Norway's preferred collaboration partners in FP7 among third countries were Switzerland, Iceland and Russia, followed by Turkey, China, Israel, Canada and South Korea. Among the many other third countries were the US, Australia and Japan, but also countries such as India, Singapore, Uganda and Chile, thus many continents. For H2020, a slight shift in preferences can be noted; while the most preferred third country is still Switzerland, China, the US, South Africa and Israel follow. The Table also indicates that in H2020, Norwegian collaboration with third countries has increased substantially as measured by the cumulative weight of the ties with third countries.

Table 0.88 Key information on third country collaboration.

	Norway	**Switzerland**	**Finland**
Number of third country partner countries FP7	44	18	13
Number of third country partner countries H2020	41	6	19

99 European Commission (2017): Interim evaluation of Horizon 2020.

Cumulative weight of collaboration with 3rd countries, FP7[100]	10 721 (9 743)	6 989 (100)	10 721 (10 609)
Cumulative weight of collaboration with 3rd countries, H2020[101]	19 702 (12 646)	7 119 (63)	19 749 (12 321)

Source: Technopolis analysis of eCorda data

For Switzerland the pattern is very different; in terms of number of countries and collaboration with third countries, Switzerland has a much weaker position. Its preferred collaboration country is Norway. Without Norway, the cumulative weight of third country collaboration is down to 100, as indicated in the Table. Finland seems to do pretty well with third countries too, but one needs to bear in mind that for Finland, Norway is a third country and the Finnish–Norwegian collaboration is very strong (10 609 in FP7 and 12 321 in H2020). Without Norway and Switzerland, the Finnish third-country collaboration in FP7 would have been reduced most significantly to 112 and for H2020 to 347. Switzerland plays only a marginal role in the collaboration pattern of Finland in both FPs.

What are the topics of projects?

In order to get a better understanding for the projects' content beyond what they originally set out to do (as described in project abstracts), we analysed the information contained in the projects' periodic reports.[102]

The analyses used WORDij, which is a semantic network tool for capturing relationships between words and assigning word-pair link strengths. This information was used as the basis for more sophisticated analyses, such as word network structure mapping. We used WORDij in order to capture the most frequent single words and pair of words in the texts. While doing that, we also applied a stopword removal process, in order to remove words that are poor descriptors, such as "and", "but", "because", "the", "a", "based" etc.

The data used for the text mining analysis are a subset of the H2020 eCorda database containing available periodic reports summaries of projects involving Norwegian organisations. The distribution of summaries on the thematic areas of the subset is summarised in Table 0.89. The majority of summaries are in the areas of LEIT (25%), ENERGY (10%), TPT (9%) and FOOD (9%).

[100] Figures in brackets for Norway and Switzerland exclude these countries. For Finland, the figure in brackets indicates the Norwegian weight.
[101] Ibid.
[102] Periodic reports are not available for all Norwegian projects but compared to proposal abstracts, summaries are likely to indicate what projects were/are about and not only what they intended to do.

Table 0.89 Distribution of project's periodic reports by thematic area

Thematic area	Share	Number
Leadership in Enabling and Industrial Technologies (LEIT)	25%	104
Secure, clean and efficient energy (ENERGY)	10%	41
Smart, green and integrated transport (TPT)	9%	40
Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy (FOOD)	9%	40
Marie-Sklodowska-Curie Actions (MSCA)	8%	33
Research Infrastructures (INFRA)	8%	33
Climate action, environment, resource efficiency and raw materials (ENV)	7%	30
Health, demographic change and wellbeing (HEALTH)	7%	29
Secure societies - protecting freedom and security of Europe and its citizens (SECURITY)	4%	18
Europe in a changing world - inclusive, innovative and reflective societies (SOCIETY)	4%	16
European Research Council (ERC)	3%	12
Innovation in SMEs (SME)	2%	9
Other	4%	18
Total	**100%**	**423**

Source: Technopolis analysis of eCorda data

Single word frequency

Figure 0.34 shows that the most frequent words in Norwegian H2020 periodic report summaries are “energy”, “development”, “innovation”, “technology”, “management”, “production”, “technologies”, “industry”, “impact” and “sustainable”.[103] These findings suggest a predominance of energy and technological topics which seem to be very much in line with the preferred thematic priorities (cf. Table 0.87).

Figure 0.34 Single word occurrences in Norwegian H2020 periodic report summaries.

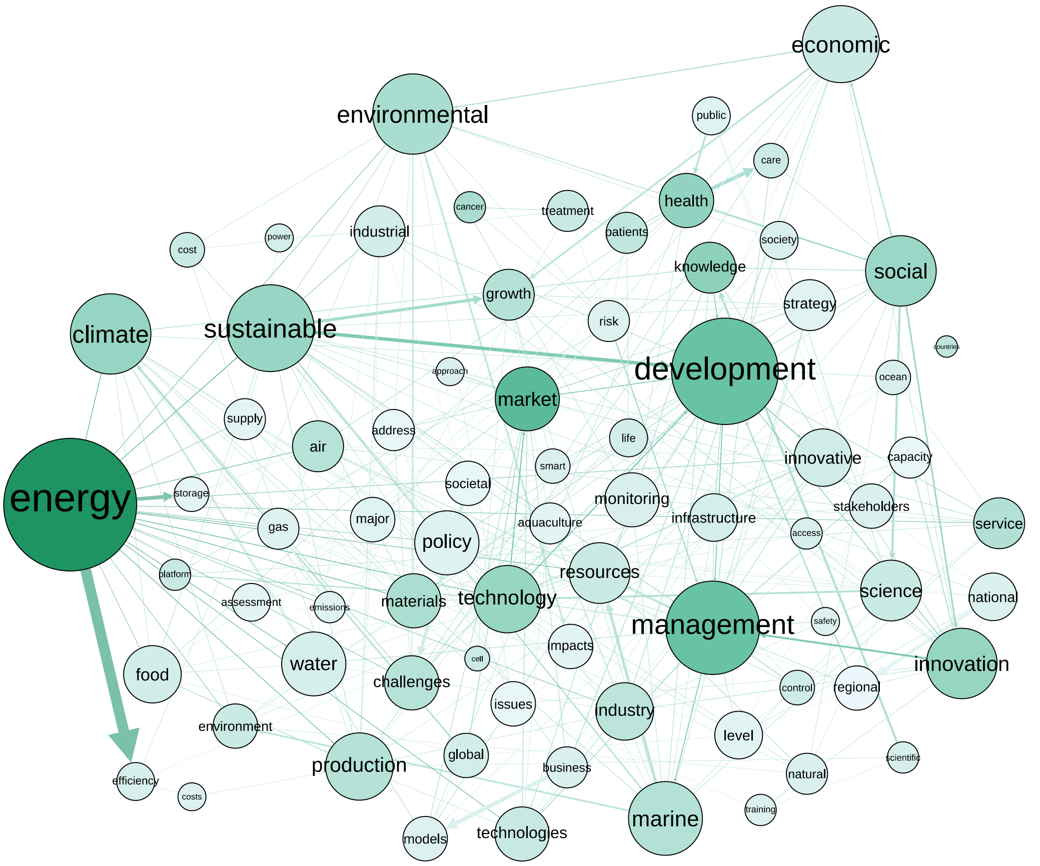
Source: Technopolis analysis of eCorda data

[103] Only words occurring more than 100 times have been included in the Figure.

Relationship between pairs of words

Figure 0.35 shows words appearing together in the periodic report summaries, which helps understanding the context in which the terms are used. The size of nodes (in this case: words) indicates the degree of centrality of the node, thus the number of connections that the node has to other nodes within the network. The link indicates co-occurring terms. For example, “energy” often occurs with “efficiency”, “storage”, “climate”, “environmental”, “sustainable”, “air”, “gas” and “supply”. The word “development” is often mentioned together with “sustainable”, “economic”, “resources”, “market” and “social”. In the Figure, the colour intensity represents the betweenness centrality of each node, thus the hubs linking most of the words. “Energy” is obviously the most central term in the sense that it is the word with the strongest hub position in the network. “Market”, “development” and “management” are also terms with high betweenness centrality. Finally, the arrows appearing in certain ties indicate the order in which the words are connected. For example, “energy” and “efficiency” always appear in the order “energy efficiency”; the same for “sustainable growth”, “business models”, “energy storage” and “health care”.

Figure 0.35 Co-occurring terms in Norwegian H2020 periodic report summaries.

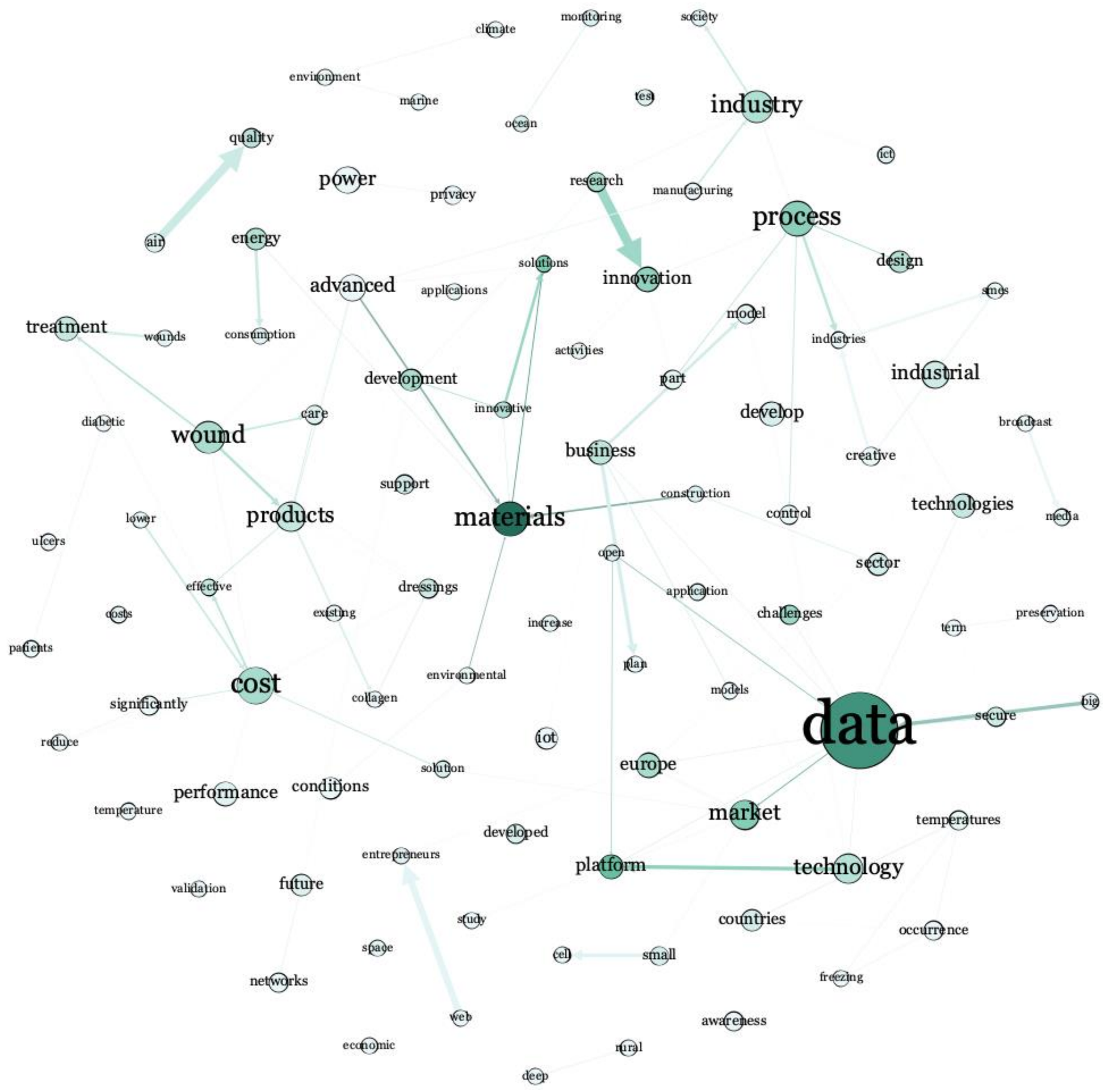


Source: Technopolis analysis of eCorda data

Figure 0.36–Figure 0.39 provide equivalent graphs for the four thematic areas with most available periodic reports.

Figure 0.36 shows that in the LEIT area, the dominating terms are “data”, “materials”, “process”, “products”, “cost” and “industry”. Frequently co-occurring words are “research [and] innovation”, “air quality”, “web entrepreneurs” and “platform technology”.

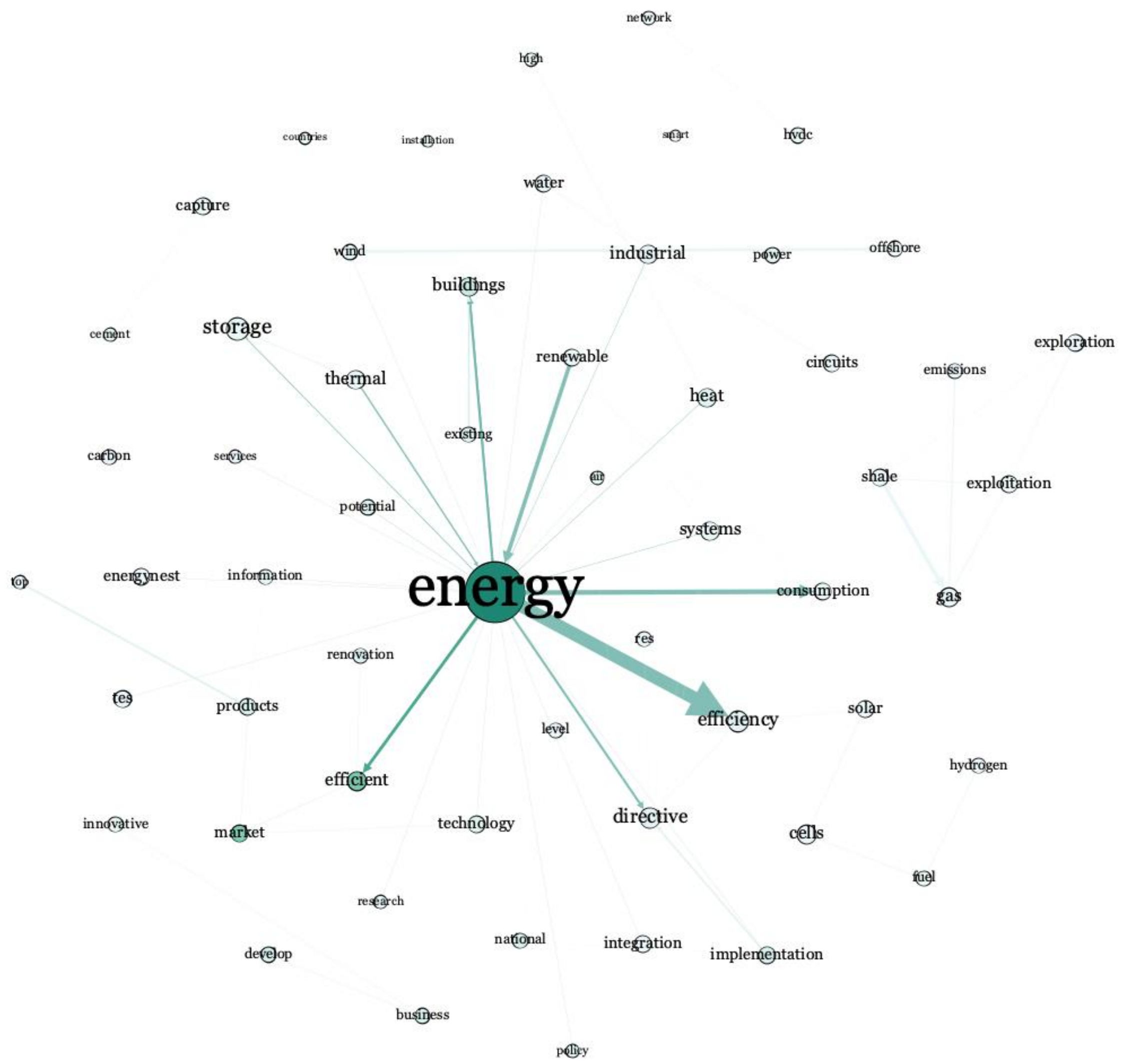
Figure 0.36 Co-occurring terms in Norwegian H2020 periodic report summaries in the LEIT thematic area.



Source: Technopolis analysis of eCorda data

Energy is of course the key term in the ENERGY area, as illustrated by Figure 0.37, often found together with “efficiency”, “efficient” or “renewable”, but also with “consumption”, “buildings” or “directive” – suggesting an important link to the regulatory framework in the field of energy.

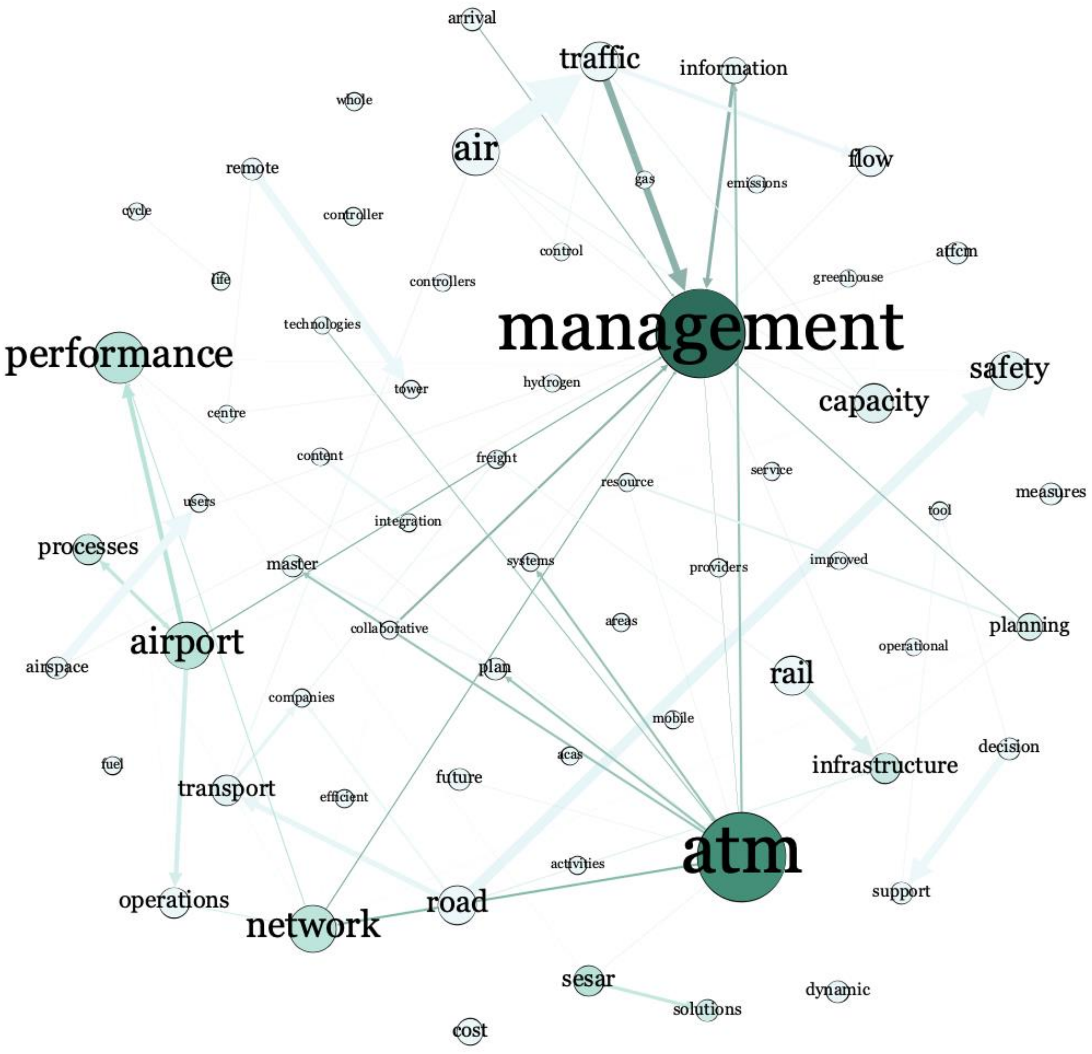
Figure 0.37 Co-occurring terms in Norwegian H2020 periodic report summaries in the ENERGY thematic area.



Source: Technopolis analysis of eCorda data

In the TPT area, “management” and “atm” (air transport management) are the key terms, see Figure 0.38. These terms, as well as ”airport”, “air” and several other aerospace-related terms indicate a strong Norwegian preference for air transport, although “road safety” and “rail infrastructure” are fairly common co-occurring terms.

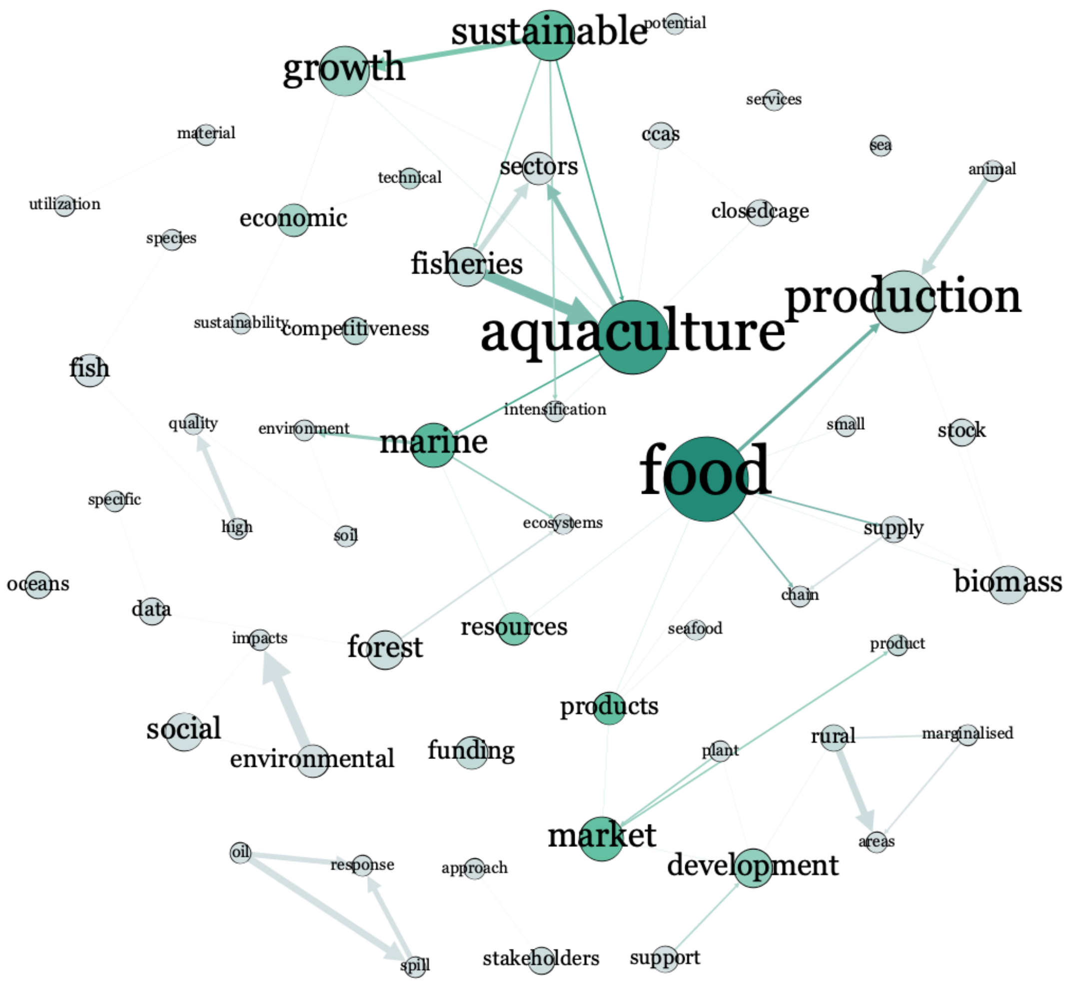
Figure 0.38 Co-occurring terms in Norwegian H2020 periodic report summaries in the TPT thematic area.



Source: Technopolis analysis of eCorda data

As expected, "food" and "aquaculture" are the central terms in the FOOD area, see Figure 0.39. The emphasis on "food production", "sustainable growth", "products", "development" and "market" suggest a strong commercial focus, while the frequency of the terms "stakeholders" and "social" indicates a focus on consumers.

Figure 0.39 Co-occurring terms in Norwegian H2020 periodic report summaries in the FOOD thematic area.



Source: Technopolis analysis of eCorda data

Appendix E Participant characteristics, Econometrics and CIS-data

Participant characteristics

In this section we present the characteristics of the FP7 and H2020 projects participants by linking Samfunnsøkonomisk analyses' database for R&I instruments and national accounting statistics.

Samfunnsøkonomisk analyses' database for R&I instruments covers all project support from Norwegian public funding agencies as well as from the Framework Programme (FP7 and H2020). The database (Samspillsdatabasen) may be used to analyse public policy support to Norwegian organisations. Among other things, the database allows for mapping of how public programmes have been utilised by individual companies, sectors, geographies etc. over time, including funding amounts. Coupling to the company's database of annual accounts of Norwegian companies, a detailed analysis of public funding by company size geography and industry can be made. We can also identify the participants' use of other instruments.

The database covers projects support from Research Council of Norway, Innovation Norway, Enova, Regional research fund, Norwegian Space centre, County funding, GIEK, Export credit, Arts Council of Norway FP7 and H2020 up until 2018 (only 2017 for RCN).

Data on FP participation originate from eCorda data, but we rely on the research sector categorisation of RCN in order to compare the FP project participants with the participants in national instruments.

Research sector distribution

About two thirds of the Norwegian FP funding has benefited universities, university colleges and research institutes, whereas one quarter has gone to companies. Other public sector participants and other organisations have benefitted from the remaining.

The sectoral distribution of FP funding follows a similar pattern to that of RCN funding at large, but the private sector has benefited to a larger extent from the FPs and in particular in H2020. The share of unique participants[104] is generally much higher within the private sector than for the research sector, but higher for the FP funding than for the RCN funding. This indicates that the RCN funding is more concentrated amongst fewer companies. Looking at the share of unique FP participants over the entire assessment period does not alter the pattern.

The national R&I portfolio also covers funding instruments such as SkatteFUNN[105] and instruments supplied by other agencies including Innovation Norway (IN) predominately targeting companies.

[104] *Unique participants* refer to each participant only being counted once independent upon the number of participations

[105] The SkatteFUNN Tax Deduction Scheme is a rights-based tax deduction scheme designed to stimulate research and development (R&D) activities in Norwegian companies.

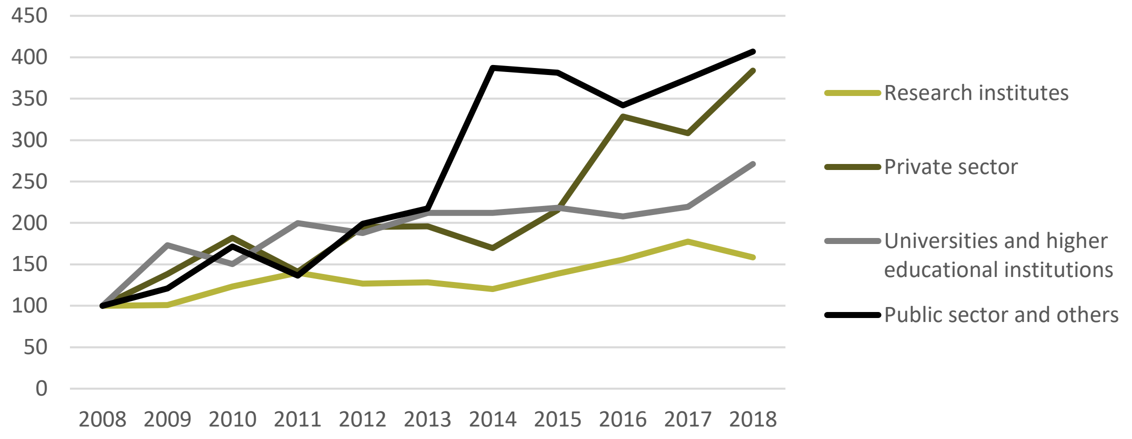
Table 0.90 Sectoral distribution of R&I funding to Norwegian participants. FPs, RCN, IN and Enova. 2007-2018.

	EU FP7		H2020		RCN		SkatteFUNN		IN		Enova	
	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants
Hospital trusts/regional Health authorities	0 %	0 %	2 %	1 %	1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Research institutes	39 %	10 %	31 %	11 %	35 %	2 %	0 %	0 %	0 %	1 %	0 %	0 %
Private sector	20 %	71 %	29 %	71 %	19 %	90 %	98 %	99 %	99 %	98 %	94 %	88 %
Universities and higher educational institutions	37 %	6 %	30 %	4 %	41 %	2 %	0 %	0 %	0 %	0 %	0 %	0 %
Public sector and others	5 %	12 %	8 %	14 %	4 %	6 %	2 %	1 %	0 %	1 %	5 %	11 %
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN's research sector categorisation. Public sector and others include public sector participants and other organisations located in Norway. Participants not categorised is not included. FP funding refer to funding from signed projects and allocated to the year in which the contract was signed. RCN funding does not include basic funding to research institutes, STIM-EU nor PES funding. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. 2017 is the most recently available year for RCN and Enova.

The FP funding to the private sector has grown year by year, see Figure 3.3. There has also been a strong growth in funding to "public sector and others" and the hospital trusts/regional health authorities, although their participation remains at a modest level. Funding to the hospital trusts/regional health authorities remains at a low level and varies greatly from year to year and is therefore not included in the figure. Growth has been modest for research institutes and higher educational institutions. Consequently, these sectors' relative share of Norwegian H2020 funding is lower than it was in FP7 (Figure 0.40).

Figure 0.40 Growth in FP funding to Norwegian participants. Per R&D sector. Funding is indexed at 2008=100.



Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN's research sector categorisation. Public sector and others include public sector participants and other organisations located in Norway. Participants not categorised is not included. Funding refer to funding from awarded projects allocated to the year in which the contract was signed.

Organisations from all parts of the country participate in the FPs, but participation is dominated by organisations in the Oslo region (Oslo and Viken) and Trøndelag, which together receive about 75 per cent of all Norwegian FP funding and account for about 60 per cent of the Norwegian FP participants, see Table 0.91.

Trøndelag receives around 30 per cent of Norwegian FP funding, but only hosts around 10 per cent of Norwegian participants, which reflects the frequent and significant participation of two R&D providers SINTEF and NTNU. Participation from Oslo and Viken is much more diversified. The geographical distribution of FP funding remains relatively stable across the two FPs. Share of funding to participants located in Viken has gone up in H2020 (from 12 per cent in FP7 to 17 per cent in H2020), whereas Oslo and Vestland decline relatively. The increase in FP funding for Viken is largely, but not only, caused by a NOK 230 million project awarded in 2016.

Counties with little FP participation (share of funding) like Agder, Nordland and Møre & Romsdal have seen relative increases in H2020 funding compared to FP7.

Comparing FP funding with funding from RCN reveals similar geographical distribution although FP funding is more concentrated to Trøndelag.

Table 0.91 Geographical distribution of FP participation. FPs and RCN. Share of funding and share of unique participants. All research sectors. 2007-2018.

	EU FP7		H2020		Norges forskningsråd		Innovasjon Norge		SkatteFUNN		Enova	
	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants
VIKEN	12 %	20 %	16 %	19 %	14 %	11 %	10 %	11 %	15 %	16 %	10 %	13 %
OSLO	30 %	29 %	29 %	29 %	30 %	16 %	10 %	5 %	26 %	23 %	31 %	8 %
INNLANDET	1 %	3 %	1 %	3 %	2 %	3 %	9 %	13 %	3 %	4 %	5 %	9 %
VESTFOLD OG TELEMARK	2 %	6 %	2 %	5 %	1 %	3 %	6 %	7 %	6 %	7 %	4 %	5 %
AGDER	1 %	4 %	2 %	4 %	1 %	3 %	6 %	6 %	4 %	5 %	6 %	5 %
ROGALAND	3 %	9 %	3 %	7 %	3 %	6 %	7 %	8 %	11 %	10 %	10 %	9 %
VESTLAND	13 %	9 %	12 %	11 %	15 %	7 %	12 %	12 %	11 %	12 %	10 %	10 %
MØRE OG ROMSDAL	1 %	4 %	1 %	3 %	1 %	4 %	6 %	6 %	6 %	6 %	3 %	14 %
TRØNDELAG	31 %	11 %	29 %	10 %	21 %	8 %	14 %	13 %	11 %	10 %	9 %	12 %
NORDLAND	0 %	3 %	2 %	4 %	1 %	2 %	8 %	6 %	3 %	4 %	4 %	6 %
TROMS OG FINNMARK	5 %	3 %	4 %	4 %	6 %	3 %	10 %	10 %	3 %	3 %	7 %	6 %
SVALBARD, Continental shelf and unreg.	0 %	0 %	0 %	1 %	4 %	34 %	1 %	2 %	0 %	1 %	1 %	3 %
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN's research sector categorisation. Funding is allocated to the participant organisational id number. Public sector and others include public sector participants and other organisations located in Norway. Participants not categorised is not included. Funding refer to funding from awarded projects and allocated to the year in which the contract was signed. RCN funding does not include basic funding to research institutes, STIM-EU or PES. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. 2017 is the most recently available year for RCN and Enova.

R&D providers

When only looking at R&D providers, FP participation is dominated by a few large players - UiO, NTNU and UIB and SINTEF.

Table 0.92 Sectoral distribution of R&I funding to Norwegian participants. Higher educational institutions and research institutions. Total in mill. 2018-NOK 2007-2018.

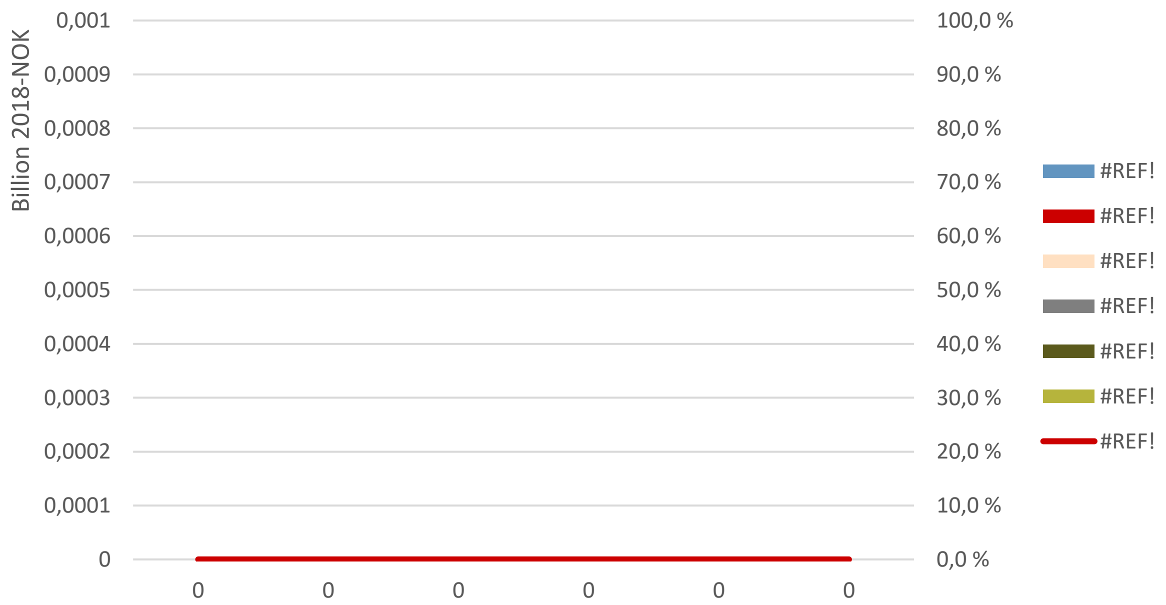
Institutional name (as registered in RCN data)	Funding in mill. 2018-NOK	Share of funding to higher edu. Inst.	Institution (as registered in RCN data)	Funding in mill. 2018-NOK	Share of funding to research institutes
UiO	1 546	32 %	STIFTELSEN SINTEF	1 635	32 %
NTNU	1 235	26 %	SINTEF AS	543	11 %
UiB	991	21 %	SINTEF ENERGI AS	277	6 %
UiT	288	6 %	NILU - STIFTELSEN NORSK INSTITUTT FOR LUFTFORSKNING	196	4 %
NMBU	208	4 %	SINTEF OCEAN AS	179	4 %
Oslo Met	93	2 %	HAVFORSKNINGSINSTITUTTET	172	3 %
UiS	88	2 %	FOLKEHELSEINSTITUTTET	159	3 %
Share of all funding to higher educational institutions		92 %	Share of all funding to research institutes		63 %

Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN's research sector categorisation. FP funding refer to funding from awarded projects and allocated to the year in which the contract was signed.

FP funding represent make up less than 4 per cent of R&I funding in the research institutes and higher educational institutions, albeit with institutional variations.

For the research institute sector, FP funding have remained relatively stable between 3 and 3.5 per cent of total R&I funding during the period of 2007-2017. Share of FP funding is highest amongst technical institutes (5.5 per cent in 2017).

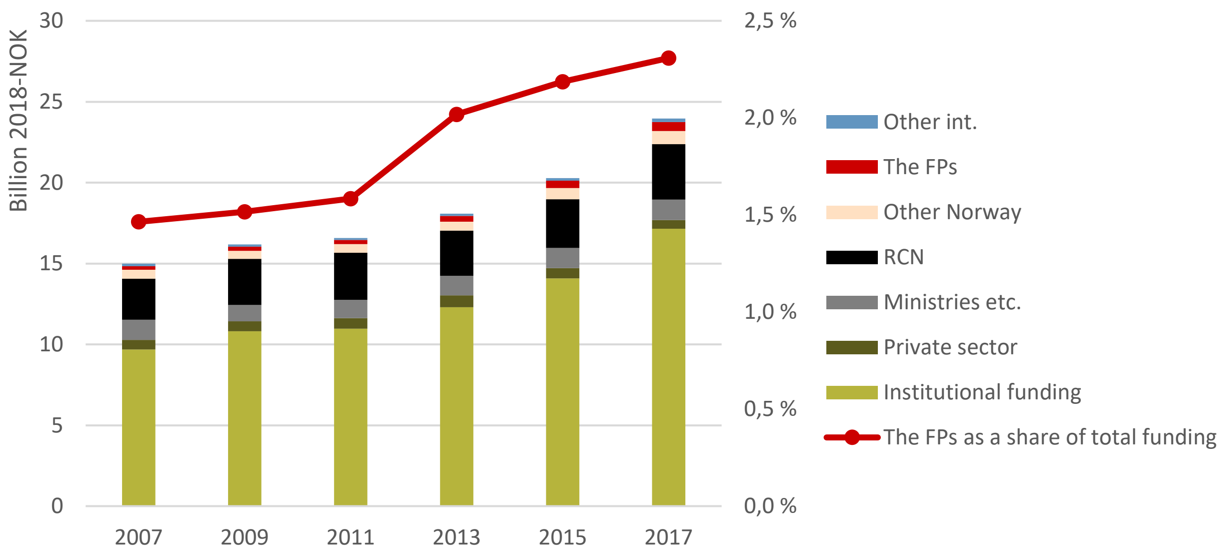
Figure 0.41 R&D funding to research institutes. In billion 2018-NOK. 2007-2017.



Source: Samfunnsøkonomisk analyse AS, RnD statistics bank, SSB

For the higher educational institutions, FP funding represent about 2,3 per cent of total R&I funding in 2017 up from 1.4 per cent in 2007. Institutional funding and RCN are by far the most important sources of R&I funding equivalent to 70 per cent and 14 per cent of total R&I funding in 2017. UiO, NTNU and UiB are the three largest FP participants measured in FP funding and also in FP funding as a share of all R&I funding for which between 3,5-4 per cent of R&I funding came from the FPs in 2017 (RnD statistic bank, 2019).

Figure 0.42 R&D funding to higher educational institutions. In billion 2018-NOK. 2007-2017.

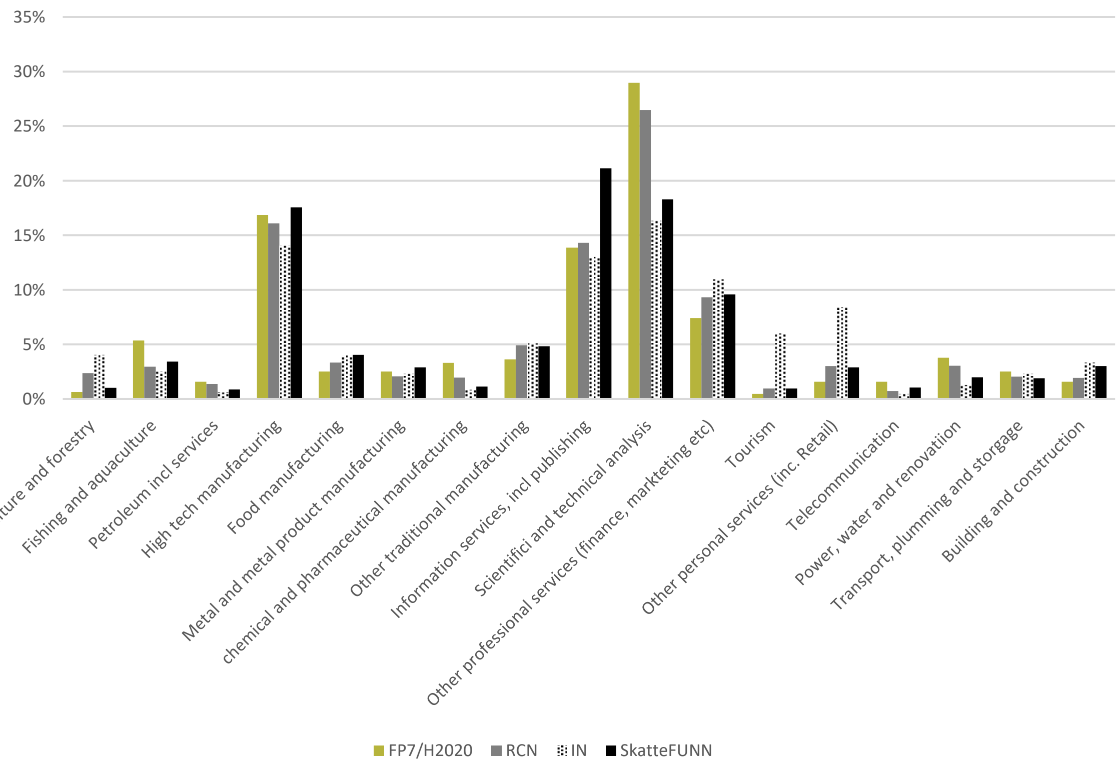


Source: Samfunnsøkonomisk analyse AS, RnD statistics bank, SSB

Private sector participation

In total 654 companies have participated in FP7 and so far into H2020. Companies in all parts of the economy are active in the FPs, but three sectors stand out, namely advanced manufacturing, ICT and professional, scientific and technical activities. These are also among the industries with the highest share of firms performing R&D (Statistics Norway, 2019) and in terms of funding from national instruments. Distribution of FP funding follows the same pattern as RCN and SkatteFUNN, whereas IN fund relatively more R&I activities in agriculture and forestry, other personal services and tourism.

Figure 0.43 Share of FP funding to companies by industry. 2007-2018.



Source: Samfunnsøkonomisk analyse AS based on data from eCorda, accounting statistics and RCN

Note: RCN's research sector categorisation. Funding refer to funding from awarded projects and allocated to the year in which the contract was signed. Samfunnsøkonomisk analyses AS' industry categorisation based on NACE. RCN funding does not include basic funding to research institutes, STIM-EU or PES. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. 2017 is the most recently available year for RCN and Enova.

Table 0.93 Industry categorisation Samfunnsøkonomisk analyse AS industry categorisation

SØA industry category	Industry classification (NACE)
Agriculture and forestry	01,02
Fishing and aquaculture	03
Petroleum incl. services	06,09
Mining	05,07,08
High tech manufacturing	26-31,32,33,45,46
Food manufacturing	10,11
Metal and metal product manufacturing	25,26
Oil refinery	19
Chemical and pharmaceutical manufacturing	20,21
Other traditional manufacturing	13-18, 22, 23
Information services, incl. publishing	58-60,62,63
Scientific and technical analysis	71,72,75
Other professional services (finance, marketing etc)	64-70,73,77,78,81
Tourism	55,56,79
Other personal services incl. Retail	79, 90-96
Telecommunications	61
Power, water and renovation	35-39
Transport, plumbing and storage	49-53
Building and construction	41-43
Health and social industry	87-90

Sources: Samfunnsøkonomisk analyse AS

FP company participation is dominated by companies from Oslo region. Funding distribution resembles that of RCN also when only looking at private sector participation and is for example much more concentrated than IN and SkatteFUNN funding.

Table 0.94 Geographical distribution of FP participation. FPs and RCN. Share of funding and share of unique participants. Only private sector. 2007-2018.

	FP7		H2020		RCN		IN		SkatteFUNN		Enova	
	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants
VIKEN	30 %	22 %	34 %	22 %	21 %	10 %	10 %	11 %	15 %	16 %	10 %	13 %
OSLO	25 %	23 %	27 %	26 %	28 %	13 %	9 %	5 %	26 %	23 %	32 %	8 %
INNLANDET	3 %	2 %	2 %	3 %	4 %	3 %	9 %	13 %	3 %	4 %	6 %	9 %
VESTFOLD OG TELEMARK	8 %	7 %	5 %	5 %	6 %	3 %	6 %	7 %	6 %	7 %	4 %	5 %
AGDER	3 %	4 %	4 %	5 %	4 %	3 %	6 %	6 %	4 %	5 %	7 %	5 %
ROGALAND	8 %	9 %	5 %	8 %	8 %	6 %	8 %	8 %	11 %	10 %	10 %	10 %
VESTLAND	4 %	9 %	5 %	10 %	8 %	6 %	12 %	12 %	11 %	12 %	8 %	10 %
MØRE OG ROMSDAL	4 %	5 %	4 %	3 %	5 %	4 %	6 %	6 %	6 %	6 %	1 %	14 %
TRØNDELAG	9 %	11 %	10 %	11 %	12 %	8 %	14 %	13 %	11 %	10 %	9 %	12 %
NORDLAND	2 %	4 %	3 %	3 %	1 %	2 %	8 %	6 %	3 %	4 %	4 %	6 %
TROMS OG FINNMARK	4 %	2 %	1 %	3 %	3 %	3 %	10 %	9 %	3 %	3 %	8 %	6 %
SVALBARD, Continental shelf and unreg.	0 %	0 %	0 %	1 %	1 %	38 %	1 %	2 %	0 %	1 %	1 %	3 %
	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

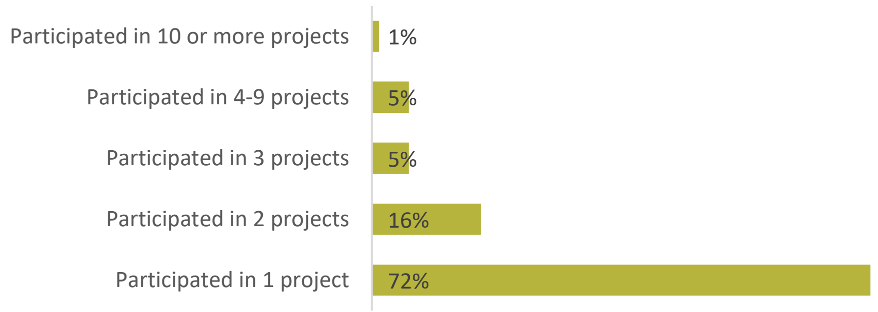
Source: Samfunnsøkonomisk analyse database on R&I instruments, RCN, eCorda.
Note: RCN's research sector categorisation. Funding is allocated to the participant organisational id number. Public sector and others include public sector participants and other organisations located in Norway. Participants not categorised is not included. Funding refer to funding from awarded projects and allocated to the year in which the contract was signed. RCN funding does not include basic funding to research institutes, STIM-EU or PES. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. 2017 is the most recently available year for RCN and Enova.

Close to 40 per cent are small companies (with less than 10 employees), around 40 per cent are companies with 10-250 employees and 20 per cent have more than 250 employees. In Norway, fewer than 1 per cent of all companies have more than 250 employees. Compared to their share in the economy, the share of large companies with FP participation is thus relatively high. Not only are large companies somewhat over-represented amongst FP companies, beneficiaries are in general also longer established than what we see in the economy in general.

Large companies typically participate in more and or larger projects and their involvement has increased in recent years. In FP7 around 8 per cent of all participating companies were large and these companies accounted for 14 per cent of private sector funding. In H2020, large companies accounted for 11 per cent of private-sector participation and 30 per cent of funding.

DNV is by far the most frequent private-sector participant with 38 projects granted in the period 2007-2018 (including projects coordinated by others than DNV). Equinor, Marlo, Nor-Tek[106] and Telenor are examples of other companies with participation in several FP projects. Borregaard is the company that has been awarded most FP funding. However, private-sector participation is clearly dominated by companies that have only participated once (75 per cent of all companies in FP7 and H2020); only one per cent of FP companies have participated in 10 or more projects and 20 per cent have participated in two or three projects.

Figure 0.44 Share of private-sector FP participants that have participated in multiple FP projects. 2007-2018.



Source: Samfunnsøkonomisk analyse AS based on data from eCorda,
Note: RCN's research sector categorisation

Funding to small companies is also higher in H2020 than it was been FP7, and higher than for RCN. We interpret this as an indication of the H2020 being more relevant for small companies than FP7 was.

[106] Nor-tek went into bankrupcy in 2017

Figure 0.45 Private-sector FP participants by number of employees. FPs and RCN. Share of funding to private sector and share of unique private sector participants. 2007-2018.

	FP7		H2020		RCN		IN		SkatteFUNN		Enova	
	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants	Share of FP funding	Share of unique participants
No empl.	3 %	5 %	4 %	6 %	2 %	6 %	11 %	18 %	5 %	10 %	4 %	4 %
1-4 empl.	28 %	26 %	29 %	30 %	22 %	27 %	44 %	49 %	29 %	35 %	19 %	11 %
5-9 empl.	14 %	17 %	9 %	10 %	9 %	12 %	11 %	11 %	13 %	15 %	6 %	5 %
10-19 empl.	11 %	15 %	10 %	12 %	11 %	12 %	11 %	9 %	14 %	14 %	5 %	11 %
20-49 empl.	15 %	14 %	11 %	17 %	14 %	16 %	11 %	8 %	17 %	13 %	13 %	23 %
50-149 empl.	10 %	10 %	8 %	9 %	12 %	14 %	6 %	4 %	12 %	7 %	11 %	24 %
150-249 empl.	6 %	4 %	2 %	4 %	5 %	6 %	2 %	1 %	3 %	2 %	6 %	8 %
250+ empl.	14 %	8 %	26 %	11 %	25 %	7 %	5 %	1 %	7 %	3 %	35 %	14 %
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: Samfunnsøkonomisk analyse AS based on data from eCorda, accounting statistics, SSB and RCN Source: Note: RCN's research sector categorisation. Funding refer to funding from awarded projects. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. RCN funding does not include PES. 2017 is the most recently available year for RCN and Enova.

Co-usage

Many FP participants also benefit from funding from national instruments. It is reasonable to see such interactions as the FPs and national instruments can play different roles in the companies' R&I work. An investigation of Samfunnsøkonomisk analyse' database on R&I instruments reveal that many FP participating companies have participated in RCN instruments, but not vice versa. 88 per cent of Norwegian FP companies have participated in at least one RCN project during the period of 2007-2017[107], but only about 14 per cent of RCN companies have participated in a FP project during the same period. Reducing the assessment period lowers the share of co-usage but share of FP companies with RCN experience is still higher than vice versa. Many FP beneficiaries has also at benefitted at least once from IN (82 per cent) and SkatteFUNN (90 per cent), but again a smaller share of all IN and SkatteFUNN projects have FP experience (18 per cent for both).

[107] Excluding PES.

Table 0.95 Co-usage cross main instruments.

		FP	RCN	IN	Skatte-FUNN
	Total number of unique participants 2007-2017	444	3225	8359	2516
FP	Unique Participants	**444**	390	366	400
	Share of of FP participants with participation	***100 %***	*88 %*	*82 %*	*90 %*
RCN	Unique Participants	438	**3225**	2135	2314
	Share of unique participants	14 %	**100 %**	66 %	72 %
IN	Unique Participants	415	20	**2303**	1901
	Share of unique participants	18 %	1 %	**100 %**	83 %
SkatteFUNN	Unique Participants	449	2202	1917	**2516**
	Share of unique participants	18 %	88 %	76 %	**100 %**

Source: Samfunnsøkonomisk analyse AS based on data from eCorda, accounting statistics, SSB and RCN Source: Note: RCN's research sector categorisation. Funding refer to funding from awarded projects. IN only covers grant based instruments and Enova does not included instruments that SØA has categorised as energy efficiency. RCN funding does not include PES. 2017 is the most recently available year for RCN and Enova.

Size of funding to Norwegian participants varies greatly cross instrument portfolios (and also cross single instruments and year). Enova and FP projects are generally larger than RCN projects. SkatteFUNN and IN projects are even smaller.

Table 0.96 Value in thousand 2018-NOK to Norwegian participants. Co-funding is not included.

	Max	Average	Median
FP7	64 053	3 373	2 269
H2020	244 675	4 693	2 672
RCN	133 356	1 278	732
IN	68 265	1 141	393
SkatteFUNN	37 054	526	458
Enova	1 721 774	20 956	5 045

Source; Samfunnsøkonomisk analyse AS, eCorda
Funding per observation (participant and project). Only covers grants and not institutional funding to research instituts, STIM-EU nor PES, nor funding from Enova instruments categorised as energy efficiency.

Econometric impact assessment

In this appendix we describe the econometric analysis of the performance of companies that have received funding from FP7 and H2020 up to and including 2018. First, we give an introduction and refer to similar assessments. Second, we describe and discuss our methodological approach to analysing company performance, before we give a brief description of the data used in the impact assessment. We then show the results of the analyses and discuss them.

R&D investment carried out today yields a return for project participants tomorrow. Measuring the return to R&D has been done in several studies on Norwegian data, most recently and relevantly in the SkatteFUNN evaluation conducted by Samfunnsøkonomisk analyse (2018), and Statistics Norway's evaluation of the effects of a selection of R&D policy instruments on innovation and value added (2016) and contribution to the evaluation of BIA (2017).

In the SkatteFUNN evaluation, the focus was on measuring effects of SkatteFUNN support on R&D expenditure (input additionality), innovation and labour productivity (output additionality). In brief, we found that every krone of support from the scheme yields two kroner of R&D expenditure, but that input additionality from Skattefunn were inversely related to firm size and experience with R&D. Furthermore, we found that SkatteFUNN contributes to more product and process innovation, as well as patenting. We also found that R&D investment enhances labour productivity in companies. Moreover, our results indicate that the effect on labour productivity is the same for RCN and SkatteFUNN projects, as for other R&D projects.

Statistics Norway's evaluation of the effects of a selection of R&D policy instruments (IN, RCN and SkatteFUNN) on innovation and value added (2016)[108] analysed effects of public R&D project funding schemes on growth in the number of employees, income, value added, profitability, labour productivity and the number of patents in recipient companies. Their results indicate projects with 500 000 NOK or less in funding have no effect on the before mentioned indicators, while projects with between 500 000 NOK and 1 500 000 NOK in funding have little or no effect, except in the case of SkatteFUNN projects. However, for larger projects Statistics Norway found positive and statistically significant results for several of the indicators, primarily no. of employees, turnover and value added. The results were generally more significant for newly established companies than for older companies.

As part of RCN's evaluation of BIA (Brukerstyrt innovasjonsarena) in 2017, Statistics Norway did an econometric analysis to evaluate the effects of BIA participation on company performance. Statistics Norway estimated effects on growth in income, no. of employees, productivity and value added for private sector companies that received funding through from RCN (BIA and other programmes), compared to private sector companies that did not receive funding, but are otherwise very much alike the companies with RCN funding (by using matching techniques). They find positive and statistically significant effects on income, no. of employees and value added for companies with funded projects. The effects are strongest for entrepreneurial (newly established) companies, for whom Statistics Norway also find a statistically significant and positive effect on productivity that is non-existent for established companies. Further, they find that the above-mentioned effects are equivalent to those for companies with SkatteFUNN projects, but that there are more significant effects for companies with RCN funding than for companies with funding from Innovation Norway. When they concentrate on the BIA programme and its recipients, they only find positive and statistically significant effects for companies with large projects,

[108] SSB reports 2016/12

measured by the amount of funds awarded in support. These significant effects are regarding productivity and no. of employees. The BIA results are equivalent to the IPN results.[109]

Neither the above-mentioned studies nor previous FP evaluations test the effects of Norwegian FP participation. Recently, a Finnish evaluation of the effects of Finnish participation in the framework programmes (Piirainen, et al., 2018) included an econometric analysis of company performance, using difference-in-differences and matching. They compare companies with FP funding with companies with “only” national (Tekes) funding and estimate the performance of the groups of companies, using indicators such as employment, income, value added, labour productivity, profits and R&D expenditure. The main result of their analysis is that they find no statistically significant difference in the economic performance of FP funded companies compared to Tekes funded companies. However, when they include companies with both FP and Tekes funding in the treatment group, they get some statistically significant results: Turnover and value added has grown relatively more in the FP group than the Tekes group.

Methodology

To assess the effect of Norwegian participation in the FP programmes, we will conduct a quasi-experimental study. A quasi-experimental study is a study where (i) the objective is to clarify cause-and-effect relationships (causal relationships) and (ii) it is not feasible to use controlled experimentation, in the sense of being able to impose the procedures or treatments whose effects it is desired to discover (Cochran & Chambers, 1965). The main challenge is to determine how the beneficiaries would have performed in absence of the scheme and it is generally a challenge for ex-post assessments to identify proper quasi-experiments.

To apply a quasi-experimental design, we identify a group that has been exposed to the intervention (treatment group) and a control group that is as identical as possible to the treatment group but have not been exposed to the intervention. These groups can then be compared over time to evaluate whether there is a significant difference between them in relation to a given result indicator.

We compare the performance of companies that received FP project funding to that of the companies who have received funding from national R&D funding schemes, such as BIA or SkatteFUNN. To improve comparability, we use matching to compare companies of similar, observable characteristics. The characteristics we match on are company size, capital assets[110], industry affiliation and age. We match on the value of these variables in the year before R&D funding is given. Our methodology is based on the Finnish impact assessment (Piirainen et al., 2018), as well as Samfunnsøkonomisk analyse AS’s work on Innovation Norway’s MRS system[111].

[109] IPN is an abbreviation of «Innovasjonsprosjekt i næringslivet» in Norwegian, or Innovation Project for the Industrial Sector
[110] «Aktiva» in Norwegian
[111] See Cappelen et al. (2015) for documentation of the methodology

A difference-in-differences approach requires at least two groups at two or more time periods (before and after). Assume for now that the treatment variable (defining the intervention), denoted by D, is binary, i.e. $d \in \{0,1\}$. Also, variables are measured at most in two time periods, T, where $t \in \{0,1\}$. The first period (t=0) indicates a time before treatment (pre-treatment) and the second period (t=1) indicates a time after the treatment took place (post-treatment).

Let “potential” outcome variables be indexed by the potential state of the treatment, so that Y_t^d denotes the outcome that would be realised for a specific value of d in period t. Then, the *average treatment effect on the treated* in period t is defined as:

$$ATT_t = E(Y_t^1 - Y_t^0 | D = 1) \tag{1}$$

ATT_t denotes the average effect of the treatment for those who are treated.[112]

Assuming linearity, for simplicity, the set-up of the model is:

$$\begin{aligned} Y_t = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 T \times D \\ + \varepsilon_t \end{aligned} \tag{2}$$

The mean potential outcome if treated is then equal to β_3, which can be shown by comparing changes for the treated before and after treatment with changes for controls:

$$\begin{aligned} &(E[Y_1^1|D = 1] - E[Y_0^1|D = 1]) - (E[Y_1^0|D = 0] - E[Y_0^0|D = 0]) \\ &= \big((\beta_0 + \beta_1 + \beta_2 + \beta_3) - (\beta_0 + \beta_2)\big) - \big((\beta_0 + \beta_1) + (\beta_0)\big) \\ &= \beta_3 \end{aligned} \tag{3}$$

The difference-in-differences estimator ($\hat{\beta}_3$) can be obtained by estimating equation (2) with OLS.

This set-up can easily be extended to multiple groups and time periods, as well as adding additional time-varying regressors.

The pre-treatment differences are to be identified and should not be due to the scheme. When the pre-existing trend is identified, any observed difference in performance between these two groups in the period after implementation of the scheme is explained by the scheme. More precisely, one compares the difference in outcomes between the companies receiving support from the scheme, and the control group, before and after the support is received, and then attribute the change in the difference between the two groups to be a result of the scheme.

[112] For a more comprehensive description see Lechner, M. (2010). The Estimation of Causal Effects by Difference-in-Difference Methods. Foundations and Trends(R) in Econometrics, vol. 4(3). 165-224

One crucial assumption for the validity of the result is that the difference in the outcome variable between the treatment and control group is stable over time before the intervention, also known as parallel or common trend assumption[113]. Any external shock should have the same impact on both groups. The probability of this being the case is increased by performing matching before estimating the treatment effect, assuring we have comparable groups of companies.

In addition to classic selection problems discussed in the evaluation literature[114], we are faced with some specific issues regarding support from funding schemes:

- How long does it take from a project is initiated until potential and measurable effects occur?
- How long do the effects last?
- How do we treat repeated support to the same company over time?
- How do we treat the fact that the company can receive support from several schemes at the same time or at relatively close points in time?

It is difficult to isolate the effect of FP funding, since many of the companies with project funding from the EU also have R&D projects funded by national sources, like RCN. However, this is not necessarily our aim. Rather, our goal is to evaluate the extra effect on company performance of having FP funded R&D projects as compared to “just” nationally funded R&D projects.

Thus, our results cannot be called causal effects, since it is very challenging to control for all potential factors that impact the company indicators we analyse. Rather, the results will give indications as the effects of FP participation for the companies.

There is however a potential issue regarding selection bias. We use matching to compare companies with FP funding to companies with funding form national sources with the same size (no. of employees.), industry classification and age. Still, there might be an unobservable difference between the two groups of companies: Some companies have FP funded R&D projects, and some have projects with funding from national sources, the latter being, generally, easier to get. Our impact assessment can therefore be called a comparison of the excellent to the good. However, assuming this unobservable difference between the two groups is constant over time, the diff-in-diff method nulls constant differences, since we compare groups over time.

We measure the effects of projects from the year the project starts until our company observations end. For example, if a company received FP7 funding in 2008 and we observe their company accounts until 2017, the effect is measured over the years 2008-2017. This way, we try to capture long-term effect for

[113] See for example Lechner, M. (2010), for more information on the assumption that the common trend between treatment and control group.
[114] See Blundell, R. & Dias, M. C. (2009). Alternative Approaches to Evaluation in Empirical Microeconomics. Journal of Human Resources. University of Wisconsin Press, vol. 44(3). 565-640

those companies that received funding early in our estimation period. The average effect we end up with is then a combination of long-term and short-term effects. We have not split the sample up to divide the two because we have few company observations.

Repeated support to companies is ignored, since we start measuring the treatment effect from the first project we observe in time for each company. This means that a part of the treatment effect is based on companies with multiple projects. However, as these are mostly R&D intensive companies, this is a trait of both the treatment and control group. It is therefore reasonable to assume that ignoring repeated support does not cause a bias in our estimates.

Our impact assessment will focus on the effects of FP7 and H2020 funding on growth in company productivity, income, profitability, employment and value added. To capture the full economic effects of R&D projects, one must consider the externalities. This is outside the scope of this assessment and will not be addressed.

Data

To utilise the methodology described above, we need project data, as well as company data. The evaluation period is from 2008 until today. FP7 started in 2008 and H2020 replaced FP7 in 2014, but FP7 projects are still ongoing. However, company accounts for 2019 are not available before the fall of 2020, meaning the latest data we are able to use is from 2018. [115] Hence, companies that only have projects that started in 2018 or later will not be included.

There were about 660 unique projects with funded participation by Norwegian companies in the private business sector[116] with funding from FP7 or H2020 that started before 2018. These 660 projects meant funding for about 540 unique companies. Of these, about 450 projects originated in FP7, with funding for about 350 companies. About 200 unique companies (with 216 unique projects) participated in H2020 projects with contracts that were signed in 2017 or before.

Our level of observation is the company level, not the project level, since we want to evaluate the effects of FP funded projects for companies.

When constructing our groups, we only include companies that are observed over a four-year (uninterrupted) time period. This means only companies that "survive" are included in the analysis, implying a survival bias. However, since both groups possess this bias, the survival bias does not pose a problem (create a bias) in our estimation of the treatment effect, but it imposes a reservation on our conclusion: We estimate the treatment effect only for the companies that survive, not for those that are dissolved in some way or another.

[115] The analysis was carried out in the summer/fall of 2019
[116] Excluding public enterprises, state owned companies, municipal owned companies, non-profit organisations, universities, colleges and the institute sector

We exclude public enterprises, state owned enterprises, municipal owned enterprises, non-profit organisations, universities, colleges and the institute sector because we only want to observe private market-oriented business. We also exclude extraction of crude oil and gas, support activities for petroleum and gas extraction and transport via pipelines in order to remove the most oil price dependent behaviour, which could bias our results due to large changes in the oil price over the period.

By imposing restrictions on our observed companies, we lose observations in both our treatment and control groups. However, these restrictions are implemented to achieve a balanced, high quality dataset that allows us to observe company performance over time. The restrictions lead to the exclusion of about 200 unique companies with FP funding.

The matching procedure also results in a loss of observations. Here, we lose about 100 unique companies in the treatment group (about 1/4), because we do not find matches for them in the control group.[117] After the matching procedure, we are left with about 300 unique companies with FP funding in the years 2007-2018, with the added restriction that 2018 should not be the first year of funding.

Our measure of productivity is value added per man-labour years, which differs from the measure used in the evaluation of SkatteFUNN, where value added per hours worked was used.[118] Our definition of productivity is due to a lack of data and our measure is therefore somewhat less precise, but still a good measure of productivity.

At the outset, the national funding sources include all RCN and Innovation Norway schemes, as well as SkatteFUNN. However, the companies are subjected to the matching procedure, ensuring that these companies are comparable with the FP funded companies. Including so many national funding sources was a necessity due to a lack of data.[119]

Results

In the following, we present the results of an econometric analysis of the performance of companies that have received funding from FP7 and H2020 up to and including 2018.

Table 0.97 displays the results from the diff-in-diff regressions comparing companies with FP funding with companies with only national R&D funding. Our results show no statistically significant effects of FP funding on our indicators: income, value added, productivity, no. of employees and profitability.[120]

[117] Big companies like Borregaard, Yara, Hydro, Rolls-Royce Marine and Kværner are dropped due to a lack of matches
[118] Man-labour years is calculated by Samfunnsøkonomisk analyse AS using wage costs from company accounts and data on average wage costs in 64 industries from Statistics Norway
[119] We need a sizeable number of companies in the control group in order to find enough matches for the treatment group.
[120] As a robustness check, we tested whether removing “extreme observations” (the top and bottom five per cent of the indicator variable’s distribution) had any impact on the results reported in table 7.1, but it did not. We also checked whether removing those with only Innovation Norway or SkatteFUNN projects had any impact on the results, but it did not.

Thus, we cannot say that company performance is improved by having FP funding when compared to national funding.

Table 0.97 Econometric results

Indicator	Coef.	Average yearly added growth (percentage points)	Standard error	P>|z|	z	Obs.	Treated obs.	Control obs.
Income	0.0210	2.10	0.0204	0.302	1.03	7901	1627	6274
Value added	-0.0019	-0.19	0.0176	0.912	-0.11	7002	1355	5647
Productivity	0.0009	0.09	0.0097	0.925	0.09	6531	1281	5250
Man-labour years	0.0019	0.19	0.0106	0.859	0.18	7356	1589	5767
Profitability	0.0045	0.45	0.0040	0.263	1.12	7837	1592	6245

Why do we not find any positive and statistically significant results? There are several possible answers to this question. Our estimation period is 2006-2018, but we do not observe all companies over the entire period. R&D investment take a long time to produce a return, and it's possible that we're not able to observe the results of FP projects because we don't have enough observations post projects.[121] As stated earlier, we only have a few H2020 projects in the sample and there were still ongoing FP7 projects in 2018. Hence, it's reasonable to assume that a re-estimation in a few years with data until 2022 or -23 will be better able to capture the effects of FP7 and H2020 projects.

Another possible reason why the results show no difference in company performance between the groups is that the matching procedure does not find matches for all the recipients of FP funding. If many of the FP project success stories originate in companies that drop out of our sample due to a lack of matches with our control group, then they do not impact our results at all. For example, some of the frequent participants and participants with large projects like DNV, Borregaard, Equinor etc. fall out of the sample (treatment group).[122] Previous studies of national instruments indicate that project size matters, which could mean that we do not measure the effects of the most effective projects. However, similar studies also reveal that effects are larger for smaller companies than large companies, a possible explanation being that one extra research project alone does not affect the overall performance of large companies. Interviews reveals that some FP projects have led to the establishment of new companies

[121] To check whether post-project observations are important we excluded companies who only have/had H2020 projects, but the results were still statistically insignificant.

[122] As a remainder DNV is by far the most frequent private sector participant with participation in 38 unique projects in the years 2007-2018. Equinor, Marlo, Nor-Tek and Telenor are examples of other companies with participation in several FP projects. Borregaard is the company that has acquired the most FP funding.

(as spin-offs) because of new technology, processes or products discovered in the projects. Our sample only includes the "mother company", that was involved in the FP project in the first place.

Company level indicators react both to price changes and volume changes. Therefore, another possible reason why we do not find any results is that the impact of FP projects on companies drowns amongst market changes and business cycle effects. One important example is the oil market: A large part of the Norwegian economy is tied to petroleum extraction and transport, and the oil price has been very volatile in the estimation period (2006-2018).[123] Sudden and large changes in the oil price are more important than the output of R&D investment, and will likely dominate to such an extent that we do not observe R&D project results in the accounts for the industries in question. Although we match our treated and control companies to make sure we control for such industry effects in the estimation, it is difficult to argue that the results of FP funded projects are more robust towards large price or volume changes than the results of projects with funding from national sources.

Analysis of CIS data (Innovation survey responses)

In this part, we analyse the innovation survey conducted by Statistics Norway, using Samfunnsøkonomisk analyse's database for public support schemes to provide information about R&D project funding. Combining the two datasets for the years 2010-2016[124], we can compare the responses of FP funded companies with RCN funded companies to unveil any potential differences between the two. We construct our groups such that a company is included in a group only when they have received funding from RCN or FP7/H2020 before or in the given year.

The innovation survey is a survey, and thus not a complete information set, but does include all companies with more than 50 employees. However, smaller companies are selected in order to cover a representative sample on an industry-company size spectrum.[125] This sampling leads to a bias due to an underrepresentation of small companies in the sample, compared to that of the population. However, as RCN and FP funded companies are quite similar in size, meaning this bias is not likely to be significant in our comparison of the two groups.

Another issue is the fact that many companies have more than one source of public support, which means that there can be cases where project results are connected to the wrong funding agency. However, both RCN and FP funded companies are active in seeking other public R&D funding, and since our aim is just as much to compare the groups, not (only) to observe the impact of a specific type of funding, we do not view this as a troubling issue. Furthermore, as mentioned, we construct our two groups such that they are not included in our sample before they receive funding.

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[123] Note that we have excluded companies involved in extraction and services connected to extraction from our dataset for the reasons discussed here.
[124] More recent data from the innovation survey was not available at the time of writing
[125] See this page for further information about this data source: https://www.ssb.no/teknologi-og-innovasjon/statistikker/innov

In the following, we focus on some of the indicators in the survey, namely:

- Innovations
- Product innovations
- Process innovations
- Innovations new to market
- Levels of intellectual property right:
- Patent applications
- Design applications
- Trademark applications
- Market location (both in terms of company presence in markets and market importance to companies)
- Locally/regionally in Norway
- Domestically in Norway
- EU/EFTA
- Other countries

Slightly higher share of product innovations than RCN funded companies

In Table 0.98, we show the share of companies in each group (FP funded and RCN funded) reporting on the introduction of product innovations. The FP funded companies have over time increasingly reported that they introduced product innovations, both in terms of goods and services. The same can be said for the RCN funded companies, but to a slightly lesser extent. In later years, and on average over time, a higher share of FP funded companies has introduced product innovations than the share of RCN funded companies. The same is true of the share of companies that reported whether the product innovation was new to the market.

Table 0.98 Innovation survey responses about product innovations by share of companies with positive response in group

	Introduced product innovation - goods		Introduced product innovation - services		Introduced product innovation new to market	
	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding
2010	0.40	0.41	0.19	0.17	0.47	0.47
2012	0.37	0.36	0.17	0.16	0.40	0.41
2013	0.54	0.52	0.40	0.30	0.61	0.58
2014	0.56	0.52	0.35	0.31	0.60	0.53
2016	0.65	0.62	0.38	0.34	0.49	0.46

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

Regarding the novelty value of the product innovation, we see from Table 0.99 that a higher share of FP funded companies responded that their product innovation was new to the world market, the European market or the Norwegian market, while a higher share of RCN funded companies reported that it was only new to the company. This means the FP funded companies' innovative activities are more innovative, since the novelty value of their product innovations are larger. Furthermore, the statistics indicate that the FP funded companies are closer to the technological front in Europe and internationally than the RCN funded companies.

Table 0.99 Innovation survey responses about novelty value of product innovations by share of companies with positive response in group

	New to the Norwegian market		New to the European market		New to the world market		New only to the company	
	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding
2010	0.28	0.25	0.20	0.16	0.31	0.28	0.17	0.17
2012	0.22	0.21	0.19	0.16	0.28	0.25	0.22	0.23
2013	0.39	0.35	0.32	0.25	0.44	0.39	0.37	0.34
2014	0.40	0.32	0.30	0.22	0.39	0.37	0.38	0.37
2016	0.36	0.29	0.22	0.17	0.30	0.27	0.43	0.45

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

Next, looking at process innovations, we observe the same pattern regarding process innovations related to the production of goods and services as with product innovations. A higher share of FP funded companies has introduced process innovations related to the production of goods and services than the share of RCN funded companies. The shares have grown for both groups in the period 2010-2016, but there has consistently been a higher share of FP funded companies that reported such process innovations.

In terms of other process innovations – logistical and administration-oriented innovations – the two groups report quite similarly on average over time, although a larger share of the RCN funded companies report that they have introduced an administration-oriented process innovation in the 2014 and 2016 survey.

Table 0.100 Innovation survey responses about process innovations by share of companies with positive response in group

	Introduced process innovation - production		Introduced process innovation - logistics		Introduced process innovation - administration	
	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding
2010	0.26	0.28	0.08	0.05	0.14	0.10

2012	0.26	0.22	0.04	0.06	0.13	0.14
2013	0.40	0.38	0.17	0.10	0.23	0.22
2014	0.42	0.38	0.13	0.13	0.21	0.24
2016	0.45	0.42	0.18	0.19	0.29	0.35

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

Slightly lower degree of protection of intellectual property rights than RCN funded companies

The result of a R&D project can be protected in terms of secrecy or be officially registered as a company patent, design or trademark. In Table 0.101, we show the share of companies in each group (FP funded and RCN funded) that reported they applied for a patent, design registration or trademark registration.

A higher share of the RCN funded companies reports such applications than the FP funded companies, but the difference is small. Most significantly, the difference in the shares that report applying for a trademark registration in the 2016 survey is about five percentage points.

Table 0.101 Innovation survey responses about protection of intellectual property rights by share of companies with positive response in group

	Applied for patent		**Applied for design registra-tion**		**Applied for trademark regis-tration**	
	Companies with FP fund-ing	Companies with RCN funding	Companies with FP fund-ing	Companies with RCN funding	Companies with FP fund-ing	Companies with RCN funding
2010	0.34	0.29	0.27	0.25	0.26	0.26
2012	0.37	0.38	0.57	0.57	0.44	0.46
2013	0.49	0.52	0.70	0.70	0.57	0.59
2014	0.33	0.36	0.11	0.11	0.22	0.20
2016	0.33	0.35	0.10	0.12	0.19	0.24

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

More present in export markets than RCN funded companies

In the innovation surveys, companies report where they sell their products and/or services and what market (geographically) is their most important market. We show the shares of companies by group reporting on these indicators in Table 0.102 and Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

Table 0.103. From this part of the surveys, we see a difference in the responses that is consistent over time: FP funded companies are generally present in more markets than RCN funded companies. Furthermore, regarding market importance, the difference in responses is not clear cut when it comes to export markets. As an average over time, FP funded companies and RCN funded companies have the same share of companies that report that their most important market is abroad. The difference between the groups is most evident in that RCN funded companies to a greater extent report that their most important market is a local/regional one, whereas the FP funded companies report that the domestic market is their most important.

To conclude, these statistics on geographical market presence and importance indicate FP funded companies are both larger and more global, since they are present in both more markets and larger markets than RCN funded companies.

Table 0.102 Innovation survey responses about market location by share of companies with positive response in group

	Sells products or services locally/regionally in Norway		Sells products or services domestically in Norway		Sells products or services in EU/EFTA		Sells products or services in other countries	
	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding
2010	0.65	0.67	0.78	0.78	0.78	0.70	0.71	0.59
2012	0.70	0.68	0.79	0.72	0.73	0.66	0.63	0.59
2013	0.77	0.76	0.85	0.81	0.78	0.73	0.64	0.61
2014	0.76	0.73	0.85	0.81	0.77	0.70	0.64	0.58
2016	0.65	0.64	0.76	0.70	0.70	0.61	0.57	0.55

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

Table 0.103 Innovation survey responses about most important market location by share of companies with positive response in group

	Locally/regionally in Norway		Domestically in Norway		EU/EFTA		Other countries	
	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding	Companies with FP funding	Companies with RCN funding
2010	0.25	0.27	0.34	0.32	0.18	0.22	0.22	0.19
2012	0.23	0.29	0.33	0.29	0.16	0.17	0.24	0.22
2013	0.24	0.31	0.38	0.34	0.19	0.16	0.19	0.19
2014	0.25	0.31	0.39	0.33	0.16	0.17	0.20	0.19

2016	0.17	0.15	0.32	0.29	0.18	0.17	0.16	0.19

Sources: Statistics Norway's innovation survey and Samfunnsøkonomisk analyse's database for public support schemes

EC contribution to Norwegian participants and to projects with NO involvement

Funding to Norwegian participants and total FP funding to projects with Norwegian participation based on so far awarded projects (March 2019). The ratio has been used to estimate the total size of projects up until 2018.

Table 0.104 EC contribution to Norwegian participations and to all projects with NO involvement

Total EC contributions (NOK million)	To NO project participations	To all projects with NO involvement (incl. funding to Norwegian participants)
H2020 overall	NOK 9 029	NOK 66 766
FP7 Overall	NOK 6 028	NOK 46 517

Source; eCorda, Technopolis

Note: Using project start date to determine year and applying average EUR: NOK exchange rate for that year. Where project start date is unknown, have applied average exchange rate for the whole FP7 or H2020 period.

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