

Work programme for the PETROMAKS 2
programme
2017 -

Large-scale Programme for Petroleum Research (PETROMAKS 2)

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1 Summary

The Large-scale Programme for Petroleum Research (PETROMAKS 2) has the overall responsibility for research to promote responsible, optimal management of Norway's petroleum resources as well as future-oriented industrial development in the petroleum sector. The scope of the programme is limited to upstream activities, and all research projects must clearly address research questions related to petroleum resources on the Norwegian continental shelf. Activities under the programme will encompass strategic basic research, knowledge and competence-building, researcher recruitment, applied research, and technology development.

The primary objective of the programme is to generate new knowledge and technology to facilitate the optimal utilisation of Norwegian petroleum resources and enhance the competitiveness of the Norwegian continental shelf compared with other petroleum provinces in relation to costs, greenhouse gas emissions and the environment.

There are five thematic priority areas under the programme:

- Reducing greenhouse gases, energy efficiency and the environment;
- Exploration and increased recovery;
- Drilling, completion and intervention;
- Production, processing and transport;
- Major accidents and the working environment.

In addition, there are four cross-cutting priorities that can be addressed across all five thematic priority areas:

- The Arctic areas;
- Reducing greenhouse gas emissions and energy efficiency;
- Digitalisation;
- Challenges related to the introduction and use of new technology.

The programme has important priorities for structuring the research effort targeted towards researcher recruitment, industry involvement and user participation as well as interdisciplinary and international cooperation. The programme will employ a wide range of application types. While the programme's core activity will be centred on dedicated funding announcements, steps will also be taken to initiate and take part in joint national and international calls for proposals involving other relevant parties.

2 Background and challenges

Underlying framework for the PETROMAKS 2 programme

The *Long-term plan for research and higher education*¹ states that Norway still needs new knowledge and technology in order to exploit the remaining petroleum resources on the Norwegian continental shelf in an optimal fashion. One of the objectives of the *Long-term plan* is for Norway to maintain its position as a world leader in technology development for offshore production of oil and gas. The plan states that continued cost-effective and sustainable exploitation of the petroleum resources on the Norwegian continental shelf requires a further investment in research, development and expertise.

¹ Meld. St. 7 (2014–2015) Long-term plan for research and higher education 2015–2024, white paper from the Ministry of Education and Research.

The petroleum sector needs more basic knowledge about the seabed and the subsurface in particular, as well as knowledge for testing new technology under realistic conditions. The industry also needs new know-how to maintain high health, safety and environmental standards in connection with petroleum activities in more vulnerable areas.

The Norwegian Government's new Ocean Strategy, *New Growth, Proud History*,² states that the Government will maintain a high level of activity under the DEMO2000 and PETROMAKS 2 programmes and facilitate the transfer of knowledge and competence to other industries.

Petroleum research is an important component of the Government white paper on Norway's petroleum activities, and the Government clearly states that steps must be taken to ensure favourable conditions for petroleum research.³

There are several EU instruments targeted towards cross-sectoral research questions and opportunities related to ocean space that are relevant for stakeholders in the petroleum sector. However, there are no national or international programmes or instruments aside from the PETROMAKS 2 programme that address the breadth of research needs related to the Norwegian continental shelf.

Opportunities and societal and industry-related challenges and needs that form the basis for the programme initiative

Norway's petroleum resources belong to the Norwegian people and must be managed in a manner that benefits Norwegian society as a whole. This has been the principle underlying the management of the country's petroleum resources for the past 50 years.⁴ There are still large oil and gas resources on the Norwegian continental shelf, in both mature and immature areas, with the potential for major value creation and revenues for Norway. Most of the resources lie in the North Sea where the challenges are primarily related to ageing fields with higher water production. A large share of the undiscovered resources lie to the north (in the Barents Sea and Norwegian Sea). This offers new opportunities for industrial development in North Norway. The High North is also one of Norway's foreign policy priorities, and key focus is placed on petroleum resources in the Government white paper on the High North.⁵

Anthropogenic climate change is a major global problem. In 2016 Norway ratified the Paris Agreement on climate change, under which it is committed to achieving a minimum 40 per cent reduction in greenhouse gas emissions compared with 1990 levels by 2030.⁶ Norway is aiming to work alongside the EU to achieve the 2030 climate targets. The development of new technology that enables Norway to fulfil its international climate obligations is crucial for ensuring the continued exploitation of Norway's oil and gas resources far into the future.

Steadily rising costs have posed a challenge to the petroleum sector for a number of years, and there is a pressing need to boost productivity in every segment. The decline in oil prices coupled with the

² <https://www.regjeringen.no/en/dokumenter/the-norwegian-governments-ocean-strategy/id2552610/>

³ Meld. St. 28 (2010–2011) An industry for the future – Norway's petroleum activities, white paper from the Ministry of Petroleum and Energy.

⁴ Meld. St. 28 (2010–2011) An industry for the future – Norway's petroleum activities, white paper from the Ministry of Petroleum and Energy.

⁵ Meld. St. 7 (2011–2012) The High North. Vision and policy instruments, white paper from the Ministry of Foreign Affairs.

⁶ <https://www.regjeringen.no/en/aktuelt/norge-har-ratifikert-parisavtalen/id2505365/>

preceding rise in cost levels on the Norwegian continental shelf has led to extensive restructuring of petroleum activities with major job cuts. Widespread downsizing has caused a loss of trust in the industry, which in turn entails a significant decrease in applicants to petroleum-related study programmes. The research groups that form the backbone of the long-term development of industry expertise are under considerable pressure as well, due to decreased willingness and capacity on the part of the companies to invest, also in relation to research. Viewed as a whole, there is uncertainty regarding the sector's access to future expertise both within the sector itself and within the research groups affiliated with the sector.

The Petroleum Safety Authority Norway's annual report⁷ on the risk scenario for petroleum activities on the Norwegian continental shelf evaluates a number of indicators reflecting conditions that may influence the risk of major accidents and the working environment. Trends up to 2014 have generally been positive in a number of areas, with some annual variation. However, from 2014 to 2015 the results show that a number of indicators are moving in the wrong direction. The Government has appointed a working group comprising representatives of the parties involved and the authorities to look at the potential connection between the serious incidents that have occurred and the focus on boosting efficiency and cutting costs during that same period.⁸

A study⁹ commissioned by OG21 identifies a number of different barriers to the application of new technology on the Norwegian continental shelf and points out that there are many advantages to be had by addressing these. Several of the proposed measures are linked to the public authorities' instruments for research, technology development and pilot testing.

The PETROMAKS 2 programme will employ basic research, applied research, technology development and researcher recruitment to address the above-mentioned opportunities and societal and industry-related challenges and needs.

Current state-of-the-art for research/knowledge underlying the programme's priorities

OG21¹⁰ brings together oil companies, universities, research institutes, suppliers, regulators and public bodies to develop a national petroleum technology strategy for Norway. The OG21 strategy has recently been revised and updated. The strategy document points out that publicly funded petroleum research yields high returns for society and is becoming increasingly important in the face of more complex technology challenges on the Norwegian continental shelf. OG21 is also of the opinion that the current organisation and structure of the public research and innovation system is working well, and therefore recommends:

- Continuing the current structure of the public research and innovation system.
- Strengthening public funding for petroleum research. The budget of the PETROMAKS 2 programme should be increased considerably during the period 2017–2021.

⁷ Petroleum Safety Authority Norway: Trends in risk level in the petroleum activity. Summary report 2015. Norwegian continental shelf.

⁸ <https://www.regjeringen.no/en/aktuelt/minister-hauglie-announces-new-white-paper-on-petroleum-safety/id2521940/>

⁹ OG21: Drivere og barrierer for teknologiutvikling på norsk sokkel [Drivers and barriers to technology development on the Norwegian continental shelf], 2013.

¹⁰ www.og21.no

The most important knowledge and technology needs for the Norwegian continental shelf are reviewed in the strategy document, with clear recommendations on how to address these. The main priorities are reflected in the four Technology Target Areas (TTAs):¹¹

- Energy efficiency and the environment;
- Exploration and increased recovery;
- Drilling, completions and intervention;
- Production, processing and transport.

In addition to identifying concrete technology needs, OG21 recommends incorporating interdisciplinary research including social sciences in publicly funded petroleum research programmes, particularly in connection with drivers and barriers to technology development, adoption and implementation as well as transfer of technology and competence across sectors.¹²

The Research Council, with the help of a group of external experts, has drawn up a state-of-the-art review for research and development related to health, safety and working environment (HSE) in the petroleum sector.¹³ This is an area not encompassed by the OG21 mandate. The report points to a need to intensify efforts in a number of areas if Norway is to achieve the objective of becoming a leader in HSE.

Both the OG21 strategy and the report on R&D for HSE identify research needs that are best addressed when social science methods are used as a supplement to or in alignment with technology and natural science methods. The policy-oriented Programme for Social Science Research Related to the Petroleum Sector (PETROSAM 2) will be concluded in 2017, and its project portfolio will be integrated into the PETROMAKS 2 programme. This will allow more research groups to collaborate across disciplines in order to address the above-mentioned challenges.

The 2016 mid-term evaluation¹⁴ of the PETROMAKS 2 programme supports OG21's assessment of the programme. It also shows that the programme has high additionality and a good reputation among users, and that the funding instruments harmonise well with the programme objectives. The evaluation report states that the programme maintains a sound balance between basic research and applied research. At the same time, the report points out that it is difficult for young project managers to succeed in the competition for funding. There is also a question of whether it is too difficult for small and medium-sized enterprises (SMEs) to win funding.

The priorities set out in this work programme are based on the OG21 strategy's updated analyses and recommendations, the report on R&D for HSE and the new opportunities inherent in greater integration of social science disciplines into the programme, as well as on the recommendations of the mid-term evaluation.

¹¹ www.og21.no

¹² OG21: Oil and Gas for the 21st Century Strategy Document.

¹³ Forskning og utvikling for å redusere storulykkes- og arbeidsmiljørisiko i petroleumsvirksomheten [Research and development to reduce the risk of major accidents and risk in working environments within the petroleum industry].

¹⁴ Oxford Research AS: Underveisevaluering av PETROMAKS 2 – Sekretariatets rapport til ekspertgruppen [Mid-term evaluation of the PETROMAKS 2 programme – Secretariat's report to the expert group].

The 2015 report on Research Council activities in the area of petroleum research¹⁵ provides a detailed overview of how the Research Council initiatives as a whole combine with activities in trade and industry to address key challenges on the Norwegian continental shelf. Together with the Research Council's DEMO 2000 programme and the Research Centres for Petroleum Activities (PETROSENTER) scheme, the PETROMAKS 2 programme covers the entire value chain from basic research and applied research to testing and pilot testing of technology. The Research Council's funding instruments are well coordinated with those of Innovation Norway and Enova. A key perspective underlying public funding of petroleum research is that Norwegian petroleum resources must be sustainably managed and exploited. The societal mission and socio-economic significance of the Research Council's petroleum-targeted research initiatives are therefore critical. It is expected that public investment will lead to:

- long-term knowledge and technology development that combined leads to optimal utilisation of Norway's resources;
- industrial development that promotes the transition to a low-emission society and gives greater consideration to climate and environmental challenges;
- openness to research-based knowledge;
- competence development and researcher training within research groups;
- structuring effects, particularly in terms of the establishment of collaboration that would not otherwise have been established;
- targeted international cooperation, where Research Council efforts help to activate research groups and trade and industry;
- launch of research and innovation activities that would not have taken place without public funding.

In light of the societal and industry-related challenges and research needs described above, the programme addresses the needs of the Ministry of Petroleum and Energy, the Ministry of Labour and Social Affairs, the Ministry of Education and Research, and the Ministry of Foreign Affairs.

3 Objectives for the programme

The PETROMAKS 2 programme has the overall responsibility for research to promote responsible, optimal management of Norway's petroleum resources as well as future-oriented industrial development in the petroleum sector. The scope of the programme is limited to upstream activities, and all research projects must clearly address research questions related to petroleum resources on the Norwegian continental shelf. Activities under the programme will encompass strategic basic research, knowledge and competence-building, researcher recruitment, applied research, and technology development.

Primary objective

The primary objective of the PETROMAKS 2 programme is to generate new knowledge and technology to facilitate the optimal utilisation of Norwegian petroleum resources and enhance the competitiveness of the Norwegian continental shelf compared with other petroleum provinces in relation to costs, greenhouse gas emissions and the environment.

¹⁵ Petroleumsforskningen i 2015 – Forskningsrådets innsats [Petroleum research in 2015 – activities at the Research Council]. 978-82-12-03539-3.

Secondary objectives

The programme will provide support for basic research and applied research in technology, natural science and social science disciplines to generate new competence and innovations that will lead to:

1. increased recovery and more discoveries;
2. reduction of greenhouse gas emissions and environmental impacts;
3. cost-effective and energy-efficient solutions;
4. prevention of major accidents and an improved working environment;
5. stronger petroleum-related industrial development, a more rapid pace of innovation and increased competitiveness;
6. competence-building and recruitment adapted to the needs of society and the industry.

4 Cross-cutting priorities and thematic priority areas

Four of the thematic priority areas set out in this work programme are based on the Technology Target Areas (TTAs) described in the OG21 strategy, and the fifth is based on the report on R&D for HSE. In addition, there are four cross-cutting priorities that can be addressed across all the thematic priority areas.

4.1 Cross-cutting priorities

Applicants seeking to address the cross-cutting priorities described below must direct their grant proposal towards one or more of the five thematic priority areas set out in this work programme and explain how the cross-cutting priority will be integrated.

4.1.1 The Arctic areas

Roughly half of Norway's undiscovered petroleum resources lie in the Barents Sea.¹⁶ The area is also home to large, important fisheries resources. The aim of this cross-cutting priority is to develop knowledge and technology to solve particular challenges in the currently opened areas of the Norwegian parts of the Barents Sea, including shallow reservoirs, carbonates, long distances and logistics, and emissions to the external environment.

4.1.2 Reducing greenhouse gas emissions and energy efficiency

Petroleum activities on the Norwegian continental shelf accounted for approximately one-fourth of Norway's total CO₂ emissions in 2015.¹⁷ Most of the emissions from this sector, roughly 81 per cent, are linked to the use of gas turbines for power production. The use of power production methods with lower greenhouse gas emissions in the petroleum sector may help to reduce total national greenhouse gas emissions considerably and is therefore a cross-cutting topic in this work programme.

Projects of relevance for reducing greenhouse gas emissions and improving energy efficiency are to include competence-building and technology development focusing on:

- heat and power production with higher efficiency and lower greenhouse gas emissions;

¹⁶ Norwegian Petroleum Directorate: Resource report 2016. <http://www.npd.no/en/Publications/Resource-Reports/2016/Chapter-1/>

¹⁷ <http://www.norskpetroleum.no/en/>

- energy leadership and energy efficiency.

The use of CO₂ for enhanced oil recovery (EOR) and storage can help to improve resource utilisation and reduce greenhouse gas emissions at the national level.

4.1.3 Digitalisation

The term *digitalisation* has at least two definitions. One is to recreate a physical process, event or phenomenon digitally. Another is to use data technology, methods and tools to replace or increase the efficiency of manual or physical tasks.¹⁸

Digitalisation technology and expertise are becoming increasingly important for the petroleum industry, which is undergoing a digital transformation. Technology and expertise are needed from the component level to the system level and in the following areas:

- data acquisition;
- data management and data quality;
- data integration, optimal data use, decision support and autonomous systems;
- data security and digital vulnerability.

Competence and technologies are needed across all the thematic priority areas that are based on automation, autonomy and ICT.

4.1.4 Challenges related to the introduction and use of new technology

There is a need for social science and inter- and multidisciplinary research to generate knowledge about challenges facing the industry in relation to optimal utilisation of new technology. One of these challenges is that industry does not fully apply the technology and knowledge that is available within both its own sector and other industries. Prioritised research needs:

- drivers and barriers to the development and use of new technology;
- new business and management models that can accelerate adoption and application of technology;
- opportunities for transfer of technology and expertise between the petroleum industry and other new or established industries;
- research-based knowledge about forces that affect costs and profitability and trigger investment in the petroleum industry.

4.2 Thematic priority areas

4.2.1 Thematic priority area 1: Reducing greenhouse gases, energy efficiency and the environment

This thematic priority area encompasses research on and development of technology and expertise that supports exploration, development and production which will lead to reduced greenhouse gas emissions, improved energy efficiency and a smaller environmental footprint.

Knowledge about the long-term effects of contamination from the petroleum sector on plant and animal life, as well as knowledge about and an understanding of the marine environment and ecosystems is covered by the Programme on Marine Resources and the Environment (MARINFORSK).

¹⁸ Store Norske Leksikon, translated from the Norwegian.

Knowledge about carbon capture, transport and storage in connection with land-based activities is covered under the Norwegian RD&D CCS Programme (CLIMIT). Knowledge about renewable energy sources is addressed under the Large-scale Programme for Energy Research (ENERGIX). Environmental technology related to the processing industry on land is covered by the Programme for User-driven Research Based Innovation (BIA).

Prioritised technology and knowledge needs:

- improved efficiency of and reduced greenhouse gas emissions from power and heat production;
- low-emission solutions;
- methane emissions and flaring;
- cleaning produced water, including EOR chemicals;
- cost-effective subsea safety barriers;
- integrated environmental monitoring and modelling systems;
- oil spill preparedness;
- technical safety barriers for the Arctic areas;
- improved weather forecasting and communications for the Arctic areas.

4.2.2 Thematic priority area 2: Exploration and increased recovery

This thematic priority area is limited to Norwegian oil and gas resources. Exploration encompasses knowledge, expertise and technology related to the development of exploration models relevant for the Norwegian continental shelf.

Increased recovery under thematic priority area 2 is limited to knowledge, expertise and technology for the development of and production in the reservoir in order to achieve a higher degree of utilisation. The term “enhanced oil recovery” (EOR) is used to refer to new, advanced injection techniques beyond standard water and gas injection. EOR methods encompass polymer flooding, deep water diversion, chemical water flooding, low-saline water flooding, microbial enhanced oil recovery (MEOR) and CO₂ injection for increased recovery.

This thematic priority area does not include CO₂ storage, which falls within the scope of the CLIMIT programme.

Prioritised technology and knowledge needs:

- improved methods for identification of oil and gas prospects;
- improved exploration technologies;
- improved reservoir understanding and management;
- water diversion and radical new EOR methods;
- CO₂ for EOR and storage.

4.2.3 Thematic priority area 3: Drilling, completion and intervention

This thematic priority area encompasses knowledge, expertise and technology related to offshore drilling, well intervention and completion for recovery of petroleum resources. It also encompasses more climate- and environment-friendly, cost-effective drilling, completion and intervention, as well as plugging and abandonment of wells.

This thematic priority area shares an interface with the Innovation Programme for Maritime Activities and Offshore Operations (MAROFF) with regard to maritime construction and vessels. Research questions related exclusively to geothermal energy are covered by the ENERGIX programme.

Prioritised technology and knowledge needs.

- drilling and completion technologies for challenging reservoirs;
- drilling automation and autonomy;
- smart well solutions and well productivity;
- solutions for improved well bore positioning and navigation in the Arctic areas;
- reduced intervention costs and increased reservoir exposure from existing subsea wells;
- downhole instrumentation and power supply;
- plugging and abandonment of wells.

4.2.4 Thematic priority area 4: Production, processing and transport

This thematic priority area encompasses the technology and expertise necessary for safe, effective transport of the well stream from the well head to a platform, onshore facility or subsea facility. It also encompasses processing technology, marine operations, risers and platform technology.

Downstream gas and oil processing, gas conversion and refining are considered downstream activities and therefore lie outside the scope of this work programme. Knowledge about carbon capture, transport and storage is covered under the CLIMIT programme. This thematic priority area shares an interface with the ENERGIX programme with regard to power supply and subsea distribution. The design and construction of vessels and other maritime constructions is covered by the MAROFF programme.

Prioritised technology and knowledge needs:

- life extension of infrastructure;
- improved utilisation of host platform by subsea developments;
- flexible and lean field development concepts;
- energy management, including power and heat production;
- produced water handling;
- integrated monitoring;
- process simulation and optimisation;
- unmanned operations, autonomous systems and decision support;
- efficient marine operations;
- multiphase transport, particularly for the Arctic areas;
- subsea technology, including all-electric subsea wells;
- solutions for tackling challenges related to ice and icing of installations and equipment.

4.2.5 Thematic priority area 5: Major accidents and the working environment

This thematic priority area is limited to R&D activities that can help to prevent major accidents or improve the working environment in connection with petroleum activities on the Norwegian continental shelf or at onshore facilities in Norway. The thematic priority area encompasses all segments of the value chain, from exploration, development, production, maintenance and modifications to termination of petroleum activities.

R&D related to helicopter safety is covered by the Research Council's Transport 2025 programme, not the PETROMAKS 2 programme. The topic of security also lies outside the scope of this thematic priority area.

The following R&D needs are prioritised in the state-of-the-art-review on reducing the risk of major accidents and risk in working environments ¹⁹ (Norwegian only):

- methods for integrated barrier control and monitoring;
- simplified and improved risk management;
- risk indicators for major accidents;
- technical integrity and human-organisation interaction;
- ramifications of changes in organisational and operational models for the working environment and health;
- risk factors in the working environment that may have serious health outcomes;
- particular challenges in the working environment in the Arctic areas;
- exposure mapping and job-exposure matrices;
- significance of changes in framework conditions and regulatory regimes;
- safety culture during periods of restructuring;
- digitalisation: application and ramifications for safety and the working environment.

5 Priorities for structuring the research effort

5.1 Types of support and type of research

Activities under the PETROMAKS 2 programme will encompass strategic basic research, knowledge and competence-building, applied research and technology development. It will be necessary to employ a wide range of types of support to achieve programme objectives. The main types of grants will be Innovation Projects for the Industrial Sector, Knowledge-building Projects for Industry and Researcher Projects. Funding will be announced for these applications types on a regular basis to address the long-term needs of the industry and the research community and to satisfy the need and desire for collaboration between researchers and users of the research.

Other funding instruments will be developed under the programme to provide support to projects with a high level of risk but even higher potential, i.e. projects to develop breakthrough technology.

Consideration will be given to using the application type Young Research Talents or other funding instruments to support young researchers in the early stages of their career.

5.2 Competence-building and researcher recruitment

The PETROMAKS 2 programme attaches great importance to promoting high-quality research projects and developing a high level of expertise within the research groups. The programme will work to reach new research groups as well as expand capacity among those already in the forefront by encouraging excellence and top-level competency at the international level.

The industry has a great need for engineers and personnel with a background in the natural sciences. Priority will be given to recruitment of doctoral and post-doctoral research fellows as an important

¹⁹ Review on reducing the risk of major accidents and risk in working environment [Kunnskapsgrunnlag PETROMAKS2 – Storulykker og arbeidsmiljø](#)

aspect of the research projects. Within the framework of Researcher Projects, particular priority will be given to incorporations of doctoral research fellowships. Projects headed by stakeholders at universities and university colleges should also disseminate the results through research-based teaching at the bachelor and master's levels.

In its recruitment policy, *Recruitment to research*, the Research Council recommends providing funding for positions that are an alternative to post-doctoral positions, such as researcher positions, in projects aimed at *capacity building*. The Council also states that it will strengthen the role of *post-doctoral researcher positions* as a career-promoting instrument, e.g. by requiring that the contract between the fellowship-holder and the degree-conferring institution includes a professional development plan and plans for academic mentoring. The PETROMAKS 2 programme will follow this up in its funding announcements.

The mid-term evaluation of the PETROMAKS 2 programme shows that it can be difficult for early career researchers to succeed in the competition for funding and thereby obtain project manager experience. The programme will therefore use its funding announcements to create a better framework for young project managers from universities/university colleges and research institutes.

5.3 Cooperation and user participation

5.3.1 Applicants from industry

Public funding for research and innovation in industry should be concentrated on projects and research questions where this funding is pivotal for implementation of the activity or will result in changes to the way the project is designed and implemented. This can be achieved in different ways for various stakeholders. Innovation projects can be targeted towards small and medium-sized enterprises (SMEs). Public co-funding could be important for SMEs as a means of reducing the level of risk or providing a catalyst to attract other industry financing and users. For larger companies, priority will be given to projects involving long-term research to develop new business areas or to projects focusing on competence-building and a high degree of openness and sharing of results. It is important that such projects clearly reflect the applicant institution's strategic priorities.

In the case of SMEs that do not possess sufficient resources or research expertise on their own, the programme will work to enable these companies to gain access to such expertise through cooperation with the industry and research institutions.

Operators on the Norwegian continental shelf will act primarily as partners and contribute co-financing and user participation in projects funded under the programme. Only in special cases will priority be given to oil and gas companies as applicants for project funding.

5.3.2 User participation

User participation will be a key component in the programme's funding announcements. User participation enhances the relevance and benefit of the research for suppliers and petroleum companies on the Norwegian continental shelf. It also fosters close contact between the industry and the best research groups in the field and enables companies to apply knowledge and technology that they cannot acquire on their own. Furthermore, user participation gives younger researchers and research fellows insight into industry needs and helps them to establish networks for future cooperation.

Operators on the Norwegian continental shelf primarily finance their research activities by charging these costs to their licences through a sliding scale financing mechanism under a dedicated research

and technology scheme. By giving priority to types of projects and collaboration models in which petroleum companies participate as users, the PETROMAKS 2 programme can help to steer private financing towards key national objectives and promote national cooperation.

The operators' role as end-user will be important both for projects based in research groups and for projects based in the supplier industry.

5.3.3 Interdisciplinary cooperation

The mid-term evaluation of the PETROMAKS 2 programme points out that there is extensive task distribution and cooperation in the funded projects and that a wide variety of environments have been awarded funding. The evaluation report also points out, however, that HSE-related research has remained somewhat detached from the natural science and technology research carried out within the other defined thematic priority areas and that this research should be better integrated in the revised work programme.

Expanding the programme scope to encompass more social science-related research questions and employ social science research methods should increase the relevance of the programme to new research groups. This will open up opportunities for new collaborative constellations and new networks.

The programme will therefore work to attract new research groups and will be open to collaboration among research groups across disciplines to address prioritised knowledge and technology needs within all of the programme's thematic priority areas. In special cases the programme may issue targeted funding announcements requiring projects to incorporate multidisciplinary cooperation and interdisciplinary integration.

5.3.4 International cooperation

The PETROMAKS 2 programme will give priority to targeted bilateral international cooperation in keeping with the allocation letters from the ministries, the Research Council's Strategy for International Cooperation 2010–2020 and the Research Council's roadmaps for bilateral research cooperation with eight priority partner countries outside of the EU/EEU. The programme will continue to collaborate with its partner organisations in Russia and Brazil to issue joint cross-border calls for proposals. Cooperation with Russia is important for addressing the cross-cutting priority on the Arctic areas.

There are no targeted EU instruments for petroleum research, but the PETROMAKS 2 programme will work to help research groups and companies to find relevant opportunities in the open competitive arenas. Instruments that may be relevant for the petroleum sector include Horizon 2020, EUREKA and the Eurostars Programme.

The PETROMAKS 2 programme contributes funding to the ERA-NET Cofund MarTERA, which focuses on cross-sectoral development of marine and maritime technologies. The programme will also consider participation in other instruments if these are relevant for and advance the achievement of programme objectives.

In addition to targeted international cooperation, the programme will always allow projects to set their own priorities for cooperation with strong stakeholders in other countries as they see fit. The programme will help to cover the costs of Norwegian partners in such projects. The international partners are expected to cover their own costs.

International cooperation must be structured to adequately safeguard Norwegian interests and value creation in Norwegian trade and industry. Cooperation with leading international research groups will help both to generate knowledge to strengthen the Norwegian competence base and to promote the internationalisation of Norwegian technology. International studies and geological analogues may be used in the research if they are relevant for the Norwegian continental shelf and enhance learning in terms of utilisation of Norwegian resources.

5.4 Gender balance

The proportion of women under the programme is generally high, given that the petroleum industry has traditionally been male-dominated. The proportion of women project managers in active projects was roughly 17 per cent in 2015. The proportion of women doctoral research fellows and post-doctoral research fellows was 28 per cent and 37 per cent, respectively, in 2015. Compared with previous years the proportion of women project managers and post-doctoral research fellows has risen somewhat, while the proportion of doctoral research fellows has shown a small decline.

In accordance with the Research Council's gender policy, the programme will apply moderate gender quotas in the distribution of research funding. The following sentence will be included in all funding announcements: "Assuming that all factors relating to scientific merit and relevance are essentially equal, priority will be given to projects led by women project managers."

The PETROMAKS 2 programme will encourage and promote the recruitment of more women to doctoral and post-doctoral research fellowship positions in funded projects. The programme will also recruit more women to sit on referee panels, expand the number of women giving presentations at the programme's meeting places and place greater focus on recruitment in project follow-up meetings with users.

5.5 Dissemination activities and increasing participation

Dissemination activities will be targeted towards providing guidance to applicants and to increasing participation of new applicant groups. The programme will give priority to taking part in important meeting places and organising project workshops, applicant seminars and start-up meetings, as well as to giving companies the opportunity to submit project outlines and providing advice and guidance.

Dissemination of research results and research-based knowledge is important for demonstrating the benefit to society of the programme and for compiling a fact base for use by the public authorities and decision-makers. The programme will give priority to disseminating results and facts at the aggregate level, placing results and technology in the same context.

All projects awarded funding must actively disseminate their own research results via both scholarly and popular science channels. The projects themselves are responsible for disseminating individual results. The Research Council will help to give the results a wider profile.

6 Cooperation with related instruments at the Research Council

The PETROMAKS 2 programme shares an interface with several related programmes activities at the Research Council. The most relevant are the DEMO 2000, MAROFF,²⁰ ENERGIX,²¹ MARINFORSK,²²

²⁰ Innovation Programme for Maritime Activities and Offshore Operations (MAROFF)

SYKEFRAVÆR,²³ CLIMIT,²⁴ NORRUSS,²⁵ POLARPROG,²⁶ IKTPLUSS,²⁷ NANO2021,²⁸ and BIA²⁹ programmes. Specific delimitations between the PETROMAKS 2 programme and several of these programmes are described under the individual thematic priority areas.

www.forskingsradet.no/demo2000

www.forskingsradet.no/maroff

www.forskingsradet.no/energix

www.forskingsradet.no/marinforsk

www.forskingsradet.no/sykefravaer

www.forskingsradet.no/climit

www.forskingsradet.no/norruss

www.forskingsradet.no/polarprog

www.forskingsradet.no/iktpluss

www.forskingsradet.no/nano2021

www.forskingsradet.no/bia

The DEMO 2000 programme is the Research Council's programme for qualification and pilot testing of technology in the petroleum sector. The programme promotes collaboration between the Norwegian supplier industry and the petroleum companies in order to ensure the development and application of new technology that can reduce the cost of activities on the Norwegian continental shelf. The PETROMAKS 2 and DEMO 2000 programmes have the same industrial target group and will collaborate to develop integrated, well-defined instruments for the supplier industry. Data show that projects developed under the PETROMAKS 2 programme perform well in terms of winning funding under the DEMO 2000 programme as they advance along the technology development pathway.

The PETROMAKS 2 programme will engage in ongoing dialogue with other related programmes and activities in order to realise synergies and create added value in areas of common interest.

Research on topics of relevance to the PETROMAKS 2 programme is being carried out at two research centres for petroleum activities (PETROSENTER) as well as several Centres for Research-based Innovation (SFI), Centres of Excellence (SFF) and Centres for Environment-friendly Energy Research (FME). As a large-scale programme, the PETROMAKS 2 programme will help to support these centres through open-competition funding announcements, while at the same time ensuring diversity and competitiveness among the research groups.

The Research Council has a dedicated initiative for research infrastructure, the National Financing Initiative for Research Infrastructure (INFRASTRUKTUR), so the PETROMAKS 2 programme, like the other Research Council programmes, will not issue its own infrastructure-related funding announcements. Concrete costs for procurement and operation of equipment for research and innovation projects must comply with the Research Council's guidelines for equipment costs and depreciation.

²¹ Large-scale Programme for Energy Research (ENERGIX)

²² Programme on Marine Resources and the Environment (MARINFORSK)

²³ Research Programme on Sickness Absence, Work and Health (SYKEFRAVÆR)

²⁴ Norwegian RD&D CCS Programme (CLIMIT)

²⁵ Research Programme on Russia and the High North/Arctic (NORRUSS)

²⁶ Polar Research Programme (POLARPROG)

²⁷ Initiative for ICT and digital innovation (IKTPLUSS)

²⁸ Research Programme on Nanotechnology and Advanced Materials (NANO2021)

²⁹ Programme for User-driven Research Based Innovation (BIA)

7 Anticipated results, impacts and societal outcomes

The PETROMAKS 2 programme will employ the Research Council's general quantifying mechanisms and programme-specific performance indicators to measure and assess whether the programme is on course in achieving its objectives. Certain indicators are related to the volume of grant proposals received, while others are related to the research results from the project portfolio. Each year the programme will analyse the portfolio of concluded and ongoing projects, as well as prepare an annual report as a basis for drawing up action plans and funding announcements.

In order to assess the programme's impacts and societal outcomes, the programme administration or programme board may initiate or conduct its own analyses and studies. External evaluations will be required to obtain a comprehensive assessment of the programme's impacts and societal outcomes in terms of reputation, governance and organisation, additionality and achievement of objectives. External evaluations are resource-intensive and should be carried out when the programme is facing a major cross-road or when there are changes in framework conditions, and not as part of the ongoing monitoring of the programme. The decision to carry out an evaluation will be taken by the division research board.

A diagram showing the connections between the primary objective, secondary objectives, thematic priority areas and priorities for structuring the research effort and the performance targets, effects and societal outcomes to be followed over time may be found as an attachment to this work programme.

8 Resources and budget

The PETROMAKS 2 programme has a budget of NOK 297.3 million for 2017:

- NOK 224 million from the Ministry of Petroleum and Energy;
- NOK 47.8 million from the Ministry of Education and Research;
- NOK 21.5 million from the Ministry of Labour and Social Affairs;
- NOK 2.5 million from the Ministry of Foreign Affairs;
- NOK 1.5 million from Statoil, including the donation matching scheme.

The funding from the Ministry of Labour and Social Affairs is earmarked for HSE-related research for the petroleum sector. NOK 25 million from the Ministry of Petroleum and Energy is earmarked for research on improving energy efficiency and reducing greenhouse gas emissions. Aside from following the guidelines in the allocation letters from the funding ministries, the programme will not specify budget use for each of the thematic priority areas or for the priorities for structuring the research effort. The programme will work to achieve all of the secondary objectives in parallel to ensure that the measures introduced in the funding announcements will have an optimal effect. The programme will plan its budgets based on zero growth in accordance with the guidelines for long-term budgeting.

The Research Council allocated a total of NOK 543 million in funding to petroleum research and demonstration activities in 2015, which is the most recent year with complete figures. Two-thirds of this amount was targeted funding awarded under the PETROMAKS 2, DEMO 2000 and PETROSAM 2 programmes and the PETROSENTER centres. Thus the PETROMAKS 2 programme plays a key role in

the Research Council's activities to finance strategic basic research, applied research and innovation in the petroleum sector.

9 Governance and organisation

The programme board of the PETROMAKS 2 programme is appointed by and reports to the Research Board of the Division for Energy, Resources and the Environment. The activities of the programme board must comply with the framework documents approved by the division research board, including the work programme, action plan, long-term budget and schedule for funding announcements. The programme board's activities must also be in compliance with the Research Council's overall principles and guidelines for the operation of research programmes.

The Research Council administration is responsible for all aspects of the programme's day-to-day operation and for ensuring that this complies with the framework documents, plans and guidelines for the programme. The Research Council administration will serve as the secretariat for the programme board and is responsible for ensuring that the programme board can carry out its tasks.

The valid [terms of reference](#) (Norwegian only) set out the roles of the programme administration and programme board in the operation of the programme. A list of the members of the programme board may be found [here](#).