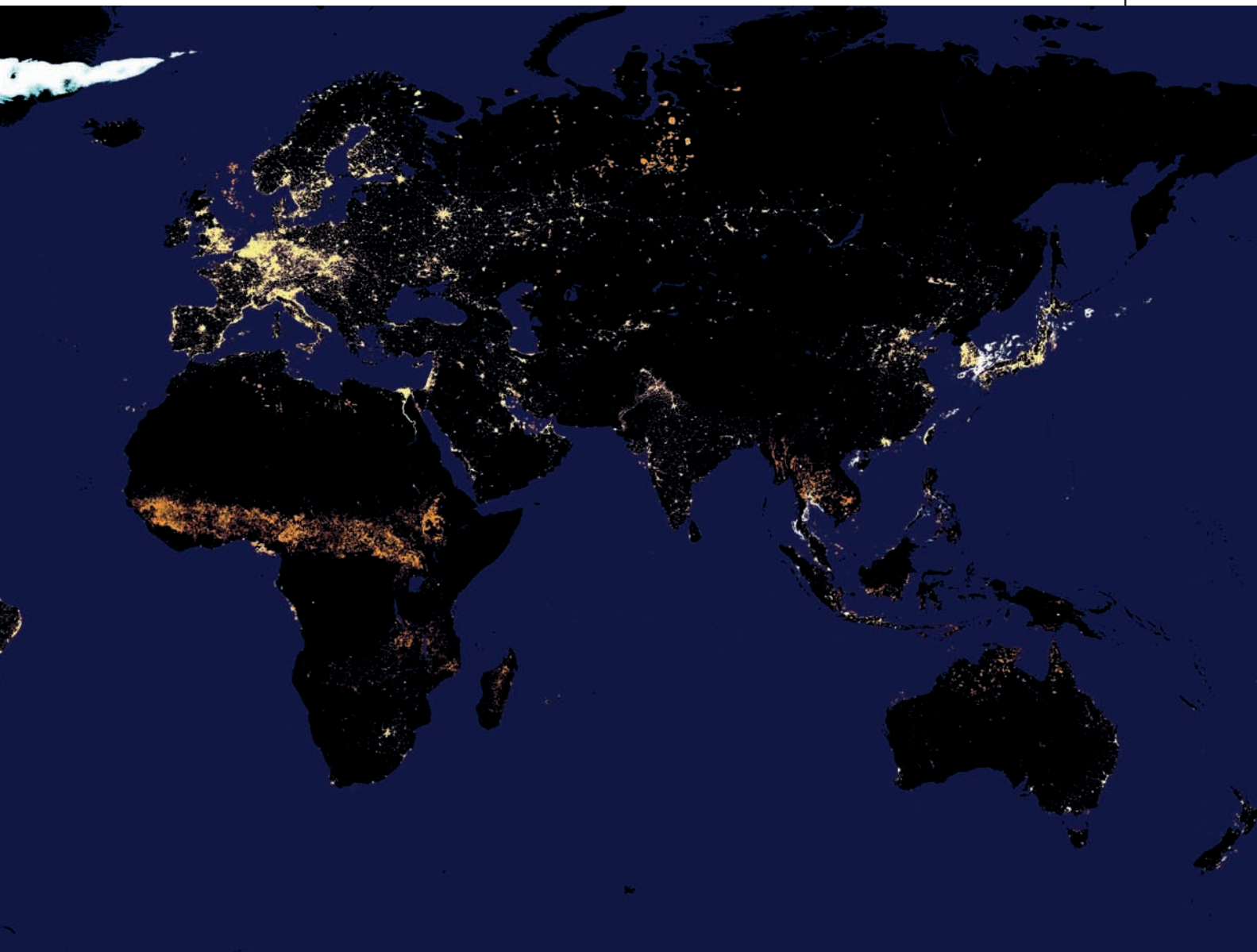
NORWEGIAN MINISTRY
OF PETROLEUM AND ENERGY

Meld. St. 28 (2010–2011) Report to the Storting (white paper)

An industry for the future – Norway´s petroleum activities



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Recommendation of 24 June 2011 by the Ministry of Petroleum and Energy, approved in the Counsil of State the same day.
(White paper from the Stoltenberg II Government)

1 Objective and summary

1.1 Objective

Norway's petroleum resources belong to the Norwegian people, and they must be managed in a way that benefits the entire Norwegian society. This has been the foundation for the management of our petroleum resources for the past 50 years. The licensing legislation dating back to 1909 deals with regulation of hydropower, but it has also been relevant for the petroleum activities. The legislation stipulated the right of reversion (to the State), emphasised that the Norwegian people are the owners of the water resources, and that economic rent should fall to the greater community. These same principles have been followed in the administration of the petroleum resources.

About 50 years have passed since the possible existence of petroleum deposits on the Norwegian Shelf became a topic of discussion. In 1963, Norway declared dominion over the continental shelf, giving the Norwegian state the right to explore for and exploit subsea petroleum deposits. Two years later, Norway, the United Kingdom and Denmark agreed to apply the "median line principle" to establish the maritime boundaries. In its consideration of White Paper No. 76 (1970 – 1971), *Exploration for and exploitation of subsea natural resources on the Norwegian Continental Shelf, etc.*, the Storting (Norwegian Parliament) endorsed what later became known as "the Ten Oil Commandments". These "oil commandments" point out that petroleum policy must be comprehensive and that national management and control are important to ensure that management of the resources benefits the entire Norwegian society. A few years later in White Paper No. 25 (1973 – 1974), *Petroleum activity and its position in the Norwegian society*, the Bratteli Government set the objective that the petroleum resources should be used to develop a "qualitatively better society". The development of Norwegian petroleum expertise, both in a management and a commercial context, were important secondary goals which led to the establishment of the Norwegian Petroleum Directorate (NPD) and Statoil. Together with the development of Norsk Hydro and Saga Petroleum, this made a significant contribution to building a Norwegian industrial environment around the petroleum industry. Shipyards, shipping companies, seismic companies, engineering firms, research and development communities were key components in this effort. Sound competition and diversity at all levels of the value chain have been important preconditions for good exploitation of resources on the Norwegian Shelf. The Government will continue to facilitate this development.

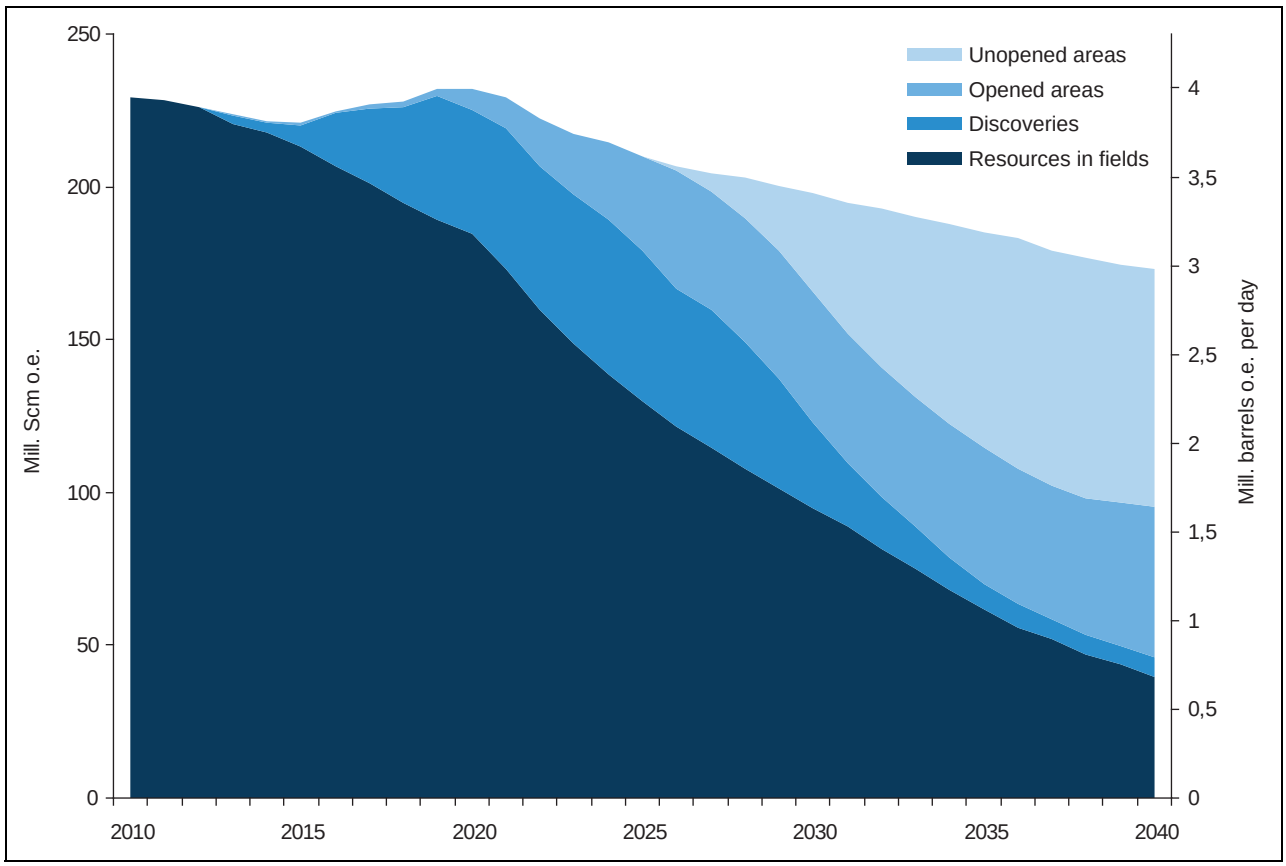

Figure 1.1 Production scenario with a broad commitment on the Norwegian Continental Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

Our management of the petroleum resources has been a success. The objective of achieving a qualitatively better society is a good description of some of the results of our petroleum activity. Today, the petroleum activity is Norway's largest industry measured in value creation, state revenues and export value. The petroleum industry currently employs approx. 43,000 people, while more than 200,000 jobs can be directly or indirectly linked to demand from the petroleum sector. Since the 1970s, the substantial revenues from the activity have helped build the Norwegian welfare society. The excess funds are managed in the Government Pension Fund – Global; whose market value has now surpassed NOK 3000 billion. According to the fiscal policy guidelines, the size of the Fund indicates annual revenues to the fiscal budget of more than NOK 120 billion.

The primary objective of the petroleum policy is to facilitate profitable production of oil and gas in a long-term perspective. The petroleum resources should also contribute to improving the quality of life in Norway in the years to come. To achieve this objective, our management must be comprehensive and based on knowledge and facts. Management of the resources must take place within a prudent framework as regards health, safety and the environment. The role of petroleum producer must be combined with an ambition to lead the field in environmental and climate policy. Petroleum activity carries a risk of major accidents. A necessary precondition for long-term development of the petroleum resources is that the industry manages this risk prudently. Continuous improvement in the fields of health, safety and environment must be pursued and reinforced.

The main features of our petroleum policy remain firm. It is important that we continue to build on our successful management of the resources. The main challenges we face in achieving this goal are improved recovery from fields, development of discoveries and proving undiscovered resources. In order to achieve this, it is important that we make adjustments in our use of policy instruments when this is indicated by developments in the industry and/or the resource base. The interplay between state, oil companies,

supply industry and the research sector is an important part of Norwegian petroleum management.

Offshore petroleum activity, the demand it generates on the mainland and the state revenues it currently supplies are of great significance for the Norwegian economy. It is important to keep the overall picture in mind when discussing individual issues and specific cases within the industry. Names are important symbols. This is also the case for petroleum deposits. The names of many fields in Norway are taken from Norse mythology, with strong roots and steeped in national tradition. This is a tradition that should be continued. However, the strongest names from Norse mythology are already in use, which means that we should also consider new types of names. The names given to larger fields in new areas should reflect the industry's importance, both for specific regions and for the nation as a whole. The Ministry therefore plans to make adjustments in the naming of petroleum deposits, to ensure that they fit into a national context and history.

1.2 International framework

The prospects for both oil and gas markets in the years to come form the foundation for profitable production of Norway's petroleum resources, assuming that we maintain control over cost developments.

Reliable access to energy is a key factor in the development of the world economy, and is closely connected to national prosperity and development. Energy consumption allows us to free-up labour from low-productive manual work. Large parts of the world's population consume very little energy. 1.5 billion people are without access to electricity. Improved access to modern forms of energy is needed in order to lift these people out of poverty. The time currently spent gathering fuel can be used for other purposes. Light will facilitate better education. More resources can be used to produce, obtain and prepare food. The Government intends to work to achieve efficient and highly functional oil and gas markets, and to expand the energy dialogue between producer nations and consumer nations.

Fossil energy sources account for about 80 per cent of the world's energy supply, and are the main cause of greenhouse gas emissions and human-induced global warming. Wide-ranging changes in energy consumption are necessary if we are to avoid harmful climate change. Increased production of renewable energy, energy efficiency, replacing coal with gas and capture and storage of CO_2 are some of the most important measures that could lead to lower CO_2 emissions. Norway is, and has always been, a stable and predictable supplier of oil and gas. In today's world, this is a competitive advantage. Gas can unite the European objectives of secure energy supply and reduced emissions of greenhouse gases. If gas replaces coal in production of electricity in Europe, this measure alone will suffice to fulfil the region's CO_2 objectives for 2020. Gas also possesses certain qualities in power generation that facilitate the phase-in of renewable power generation, and can therefore contribute to further CO_2 reductions. Gas-fired power plants function well together with e.g. wind or solar power, as gas power can be produced quickly and efficiently during calm or overcast days. The Government therefore will to intensify its work to ensure that the advantages of natural gas as compared with use of coal are taken into consideration when setting the framework for Europe's energy structure.

The ultimate goal of the Norwegian Government's climate policy is to contribute to curtailing the human-induced temperature increase to a maximum of two degrees, as compared with the pre-industrial level. A comprehensive change in the global energy system is required in order to reduce emissions so that the two-degree goal can be achieved.

The Government wants to combine Norway's role as a major energy producer with the ambition of being a world leader in environmental and climate policy, through continuing to exploit the petroleum resources while simultaneously pursuing efforts to streamline the activity on the continental shelf. The activity on our continental shelf should also be best-in-class when it comes to energy-efficient production of oil and gas. The policy instruments applied in the sector facilitate implementation of measures and development of new and more efficient solutions.

1.3 An industry for the future

The oil and gas activity is in a different phase than was the case ten years ago. Production of oil has declined, while gas production has increased. The cost level is substantially higher. Technological development has continued. The opened areas have become more mature, producing fields are aging, and exploration activity has shown a definite increase. Considerably more upstream com-

Box 1.1 The 10 Oil Commandments

The 10 Oil Commandments are Chapters in a declaration of principles underpinning Norwegian oil policy, submitted by the Standing Committee on Industry in a Storting White Paper dated 14 June 1971. These principles have subsequently been dubbed the 10 Oil Commandments, and represented a clarification of what was needed to make sure that the oil activities would "benefit the entire nation":

1. That national supervision and control of all activity on the Norwegian Continental Shelf must be ensured.
2. That the petroleum discoveries must be exploited in a manner designed to ensure maximum independence for Norway in terms of reliance on others for supply of crude oil.
3. That new business activity must be developed, based on petroleum.
4. That the development of an oil industry must take place with necessary consideration for existing commercial activity, as well as protection of nature and the environment.
5. That flaring of exploitable gas on the Norwegian Continental Shelf must only be allowed in limited test periods.
6. That petroleum from the Norwegian Continental Shelf must, as a main rule, be landed in Norway, with the exception of special cases in which socio-political considerations warrant a different solution.
7. That the State involves itself at all reasonable levels, contributes to coordinating Norwegian interests within the Norwegian petroleum industry, and to developing an integrated Norwegian oil community with both national and international objectives.
8. That a state-owned oil company be established to safeguard the State's commercial interests, and to pursue expedient cooperation with domestic and foreign oil stakeholders.
9. That an activity plan must be adopted for the area north of the 62nd parallel which satisfies the unique socio-political factors associated with that part of the country.
10. That Norwegian petroleum discoveries could present new tasks to Norway's foreign policy.

panies are involved in the activities, and the player scenario has widened. Expectations regarding future oil and gas prices are optimistic.

A key precondition for further developing the petroleum resources is that we have a resource base to exploit. During the past 40 years, we have extracted around 40 per cent of the expected recoverable resources. We have produced a larger percentage of oil than of gas. Sixty per cent of our resources remain in the subsurface. In addition come parts of the previously disputed area to the west of the delimitation line in the Barents Sea and the areas around the island of Jan Mayen. The Government places great emphasis on the upside potential when considering exploration of our least-mapped areas.

A practical way of categorising the remaining resources is listed below, cf. Figure 1.1:

- resources in fields
- resources in discoveries
- unproven resources in opened areas
- unproven resources in unopened areas

We can maintain production from the sector at a very high level for decades to come, through a deliberate and simultaneous commitment throughout this value chain. The potential production scenario illustrated in Figure 1.1 are higher than the authorities' expectations with a continuation of current policies. This is because the scenarios embrace additional possibilities that lie in fields, discoveries and exploration. The estimate falls well within the NPD's range of uncertainty for estimated remaining recoverable resources on the Norwegian Shelf.

A steady activity level must be maintained in order to achieve the goal of long-term management and value creation from the petroleum resources. Welfare and employment will follow the activity. This can best be facilitated through a parallel and active commitment in three areas:

- Increase recovery from existing fields and development of commercial discoveries.
- Continue active exploration of opened acreage, both in mature and frontier areas.
- Implement the opening processes for Jan Mayen and the part of the previously disputed area to the west of the delimitation line in the Barents Sea South, which can provide a basis for new economic activity in Northern Norway.

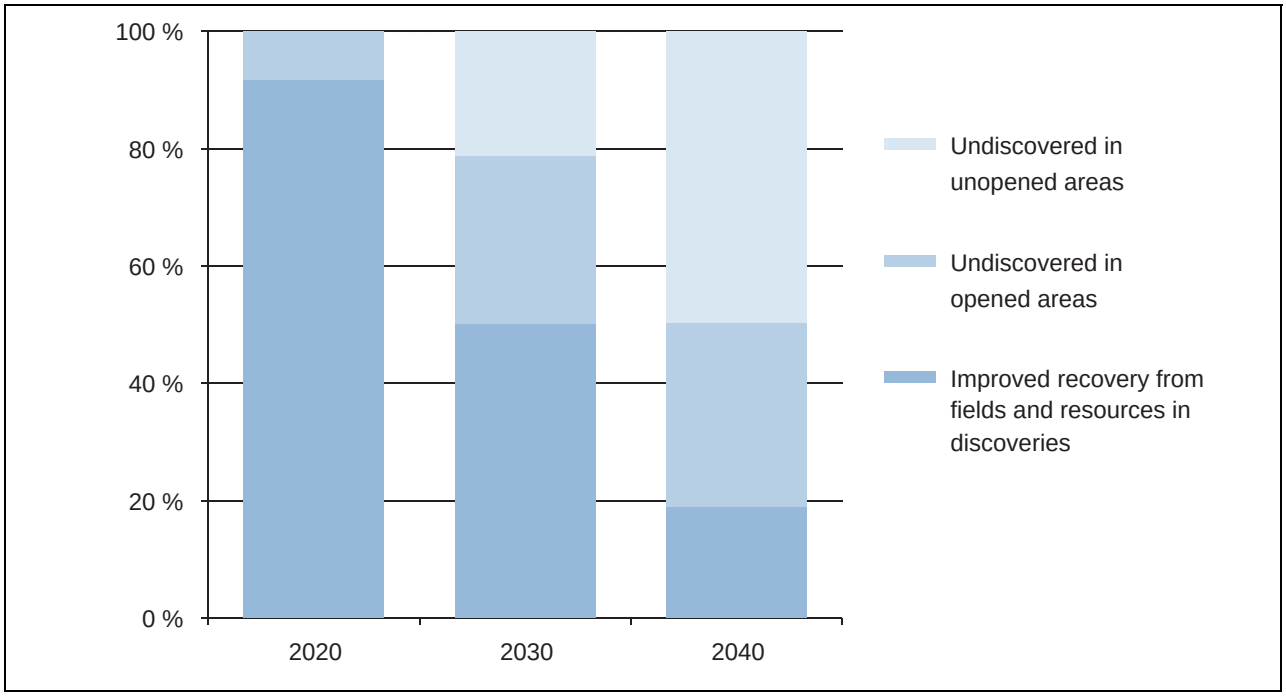

Figure 1.2 Share of production from various categories.

Source: Norwegian Petroleum Directorate.

New solutions and measures on existing fields will yield value creation, welfare and employment in the short and medium term. New discoveries in mature areas will also contribute in the short and medium term perspective. New discoveries in less mature areas will contribute to achieving our goals in the medium-term perspective. Relatively speaking, it takes a long time from an area is opened until activity in the area starts to make an actual contribution.

These differences in the time perspectives for when the various measures will have an impact on value creation, welfare and employment mean that we must initiate parallel processes in all areas in order to facilitate an activity level that is as stable as possible. This White Paper presents a plan designed to facilitate such a development.

The petroleum industry is an industry for the future. The plan for long-term management and value creation from the petroleum resources presented in this White Paper will facilitate the existence of the petroleum industry as a key activity in Norway for decades to come. The Government's petroleum policy is therefore based on a generational perspective.

A good example of this is the development of Ekofisk – the first field ever developed on the Norwegian Shelf, which has been producing for 40 years. In the spring of 2011, the licensees submitted a new plan for further development of the area. Another NOK 65 billion will be invested in the fields in this region, under this plan alone. This will enable another 40 years of oil production from this very important part of the Norwegian Shelf. Another example is the new oil discovery in the Barents Sea – Skrugard. Based on current knowledge, this discovery will set the stage for further development activity in the north, also after Goliat starts producing. The discovery marks the opening of a new oil province that can yield additional resource growth.

The Norwegian coastal and maritime areas are important to a number of commercial activities, such as the petroleum activities, fisheries, shipping and tourism. Increased activity and more users demand good coordination so that different industries can co-exist. A number of measures have been implemented to ensure the best possible coordination between the petroleum activity and the fisheries, and good interaction must remain in focus in the years to come. Therefore, the Government will continue to work to promote good coordination between the fisheries and the petroleum industry by restricting exploration and drilling activity based on knowledge obtained through comprehensive management plans. The resources and expertise of the fishery industry will also be applied in oil spill preparedness.

1.4 Measures

1.4.1 Recovering proven resources

Contributing to high value creation from fields and discoveries is an important task for both the Ministry and the NPD. Substantial parts of the available resources are devoted to this long-term work. Many more fields in production, aging fields and infrastructure, cost developments, a wider player scenario and the large number of smaller discoveries made since 2000 have led to a change in these challenges.

In 2010, the Ministry appointed a panel of experts to study measures that could contribute to increased resource exploitation from existing fields. A number of the panel's suggestions relate to aspects dealing with the relationships between the players in the industry. The Ministry has assigned the task of evaluating these proposals to the industry itself, through KonKraft, and this work is well underway. This White Paper discusses the proposals made by the panel in relation to the authorities' framework conditions.

The Government will implement the following measures to increase recovery from proven resources:

- In connection with processing of new developments:
  - Introduce a practice whereby plans for development and operation (PDOs) are submitted earlier in projects with more rapid progress.
  - Ensure that installation of fixed rigs is considered by the licensees in connection with relevant new developments.
  - Contribute to coordination of developments and fields when this is the best solution from a resource management point of view.
  - Require evaluation of power from shore as an energy solution for new fields and in connection with major modifications of existing fields, including an evaluation of relevant lifetime. Follow up to ensure that operators of new field developments in the petroleum sector apply for connection to the grid in cases where power from shore is a relevant alternative. Statnett will facilitate future power consumption, e.g. major and specific increases in power consumption in the petroleum sector, if this is profitable from a socio-economic perspective.
- Amend the Petroleum Regulations so that licensees cannot lease production facilities from associated companies.
- Intensify the follow-up of late phase fields. Require new production plans for late phase fields, where this is deemed appropriate. Consider the need for additional reinforcement of the regulations to ensure adequate focus on increasing recovery and good resource management.
- Approve applications for further extension of license periods for a production license with the same ownership structure if the application substantiates better exploitation of the resources, unless special factors indicate otherwise. For some licenses, special factors such as low state involvement and/or significant remaining reserves may indicate that the SDFI percentage should be increased, or that other terms should be renegotiated in connection with an extension of the production license.
- Place greater emphasis on majority shares when determining voting rules when new production licenses are awarded.
- Work to achieve a better flow of vessels involved in the petroleum activities in the North Atlantic, including appointing an expert group to illuminate and identify obstacles that lead to restrictions in the rig capacity on the Norwegian Shelf, and propose measures that can improve the flow of vessels involved in drilling activities on the Norwegian Shelf. The expert group must assume a safety level at least equivalent to the current level. Encourage the licensees on the Norwegian Shelf to establish rig cooperation schemes, where rigs are contracted on a long-term basis.
- Together with key players on the Norwegian Shelf, work to achieve greater efforts towards piloting new technology. Consider establishment of a research centre in the field of improved recovery, based on an open competition.

Through more than 40 years of activity on the continental shelf, a number of facilities have been established and many pipelines have been laid for transport of gas and oil. Regulating the use of this infrastructure is an important part of good resource management. An important consideration is to ensure that the maximum profit from a development is extracted on the fields themselves – and that it does not fall to the infrastructure owners. To achieve this objective, the Government will:

- Regulate access to and tariffs in the gas transport system to ensure equal access to the system for any party with gas transport needs.

- Establish an expert panel to resolve disputes in individual cases where there is disagreement concerning access to the transport system.
- Strengthen the existing Gassled user forum to ensure that the users' viewpoints are heard as regards how the system is developed and operated.
- Amend the regulation relating to third party use of facilities with the objective of more efficient use of resources and that maximum profit is extracted on the new fields.

Measures to contribute to spin-off effects are described in Chapter 1.4.5.

1.4.2 Find more in open areas

The objective of our exploration policy is to make the new discoveries necessary to ensure a steady level of activity, the highest possible value creation and state revenues over the medium and long-term perspective. This can best be achieved through an efficient and timely exploration of the Norwegian Shelf. Areas of the Norwegian Shelf opened for petroleum activity include large parts of the North Sea, the Norwegian Sea and the southern part of the Barents Sea. Significant volumes of undiscovered resources are still expected in the opened areas, which can provide a basis for activity for many years to come. Activity has already been underway for many years in large Chapters of the Norwegian Shelf. These areas are characterised by known geology and well-developed infrastructure, and are referred to as mature areas.

Other parts of the shelf are characterised by less knowledge about the geology, greater technical challenges and a lack of infrastructure. Such areas are called frontier areas. Two equally statused licensing round processes have been established to achieve expedient exploration of both mature and frontier areas: the awards in predefined areas (APA) for mature areas and the numbered licensing rounds for frontier areas.

To ensure efficient exploration and development of discoveries, changes were made in the petroleum policy ten years ago to bring in players with strong focus on the more mature areas of the Norwegian Shelf. Today's player scenario is well-balanced, and consists of companies that focus on new, large and more financially risky projects alongside companies that focus on smaller projects with lower economic risk.

The Government wants to maintain exploration activity and will award production licenses in mature and frontier areas so as to curb the decline in petroleum production. The following framework will be established for exploration policy in the years to come:

- In areas with an established management plan, apply the environmental and fishery conditions from the relevant management plan to new production licenses. No additional environmental or fishery requirements will be stipulated for petroleum activities in the area.
- Within the framework of the management plans, use professional petroleum assessments as a basis for determining which areas will be part of the APA area, and which areas are announced through the numbered licensing rounds.
- Carry out the APA scheme as an annual licensing round for all mature areas on the Norwegian Shelf to contribute to maintaining activity and production.
- Carry out numbered licensing rounds on the Norwegian Shelf, usually every other year, as a contribution to maintaining activity and production.
- Introduce a public consultation process in connection with APA rounds. For areas with management plans, only input relating to significant new information after adoption of the relevant management plan will be solicited.
- Carry out a public consultation process in connection with announcement of acreage in numbered licensing rounds. For areas with management plans, only input relating to significant new information after adoption of the relevant management plan will be solicited.
- Publish the work programs from and including the 21st licensing round and in APA licenses to ensure transparency in the petroleum activities and equal treatment in the licensing rounds.
- Facilitate the establishment of competent new companies on the Norwegian Shelf, including actively seeking out interesting oil companies to inform them about business opportunities on the Norwegian Shelf.
- Prevent fallow licenses by following up the activity in mature areas and using the area fee to achieve good area management.

1.4.3 Management of unopened areas

Over the past 40 years, the Norwegian Continental Shelf has been mapped in a step-by-step exploration process. This means that we currently possess the best knowledge about the geology in the opened areas, but also that the opportunity of

making major new discoveries is greatest in the less-explored Chapters of the Norwegian Shelf. The last time a new area was opened for petroleum activity was in 1994. The last major discovery on the Norwegian Shelf so far, Ormen Lange, was made in this area in 1997.

In the numbered licensing rounds conducted today, all of the acreage has been available for nomination by interested companies in several rounds. The most attractive parts of this area are, in part, already thoroughly explored. Opening new areas is necessary in order to make significant new discoveries and to maintain significant petroleum production, value creation, investment, employment and state revenues in the years after 2020. Therefore, the Government will:

- Conduct an opening process in the sea area around Jan Mayen, including environmental and resource mapping, acquisition of seismic data and shallow drilling. Safeguard Norwegian interests in the cooperation area with Iceland.
- Carry out knowledge acquisition regarding the effects of petroleum activity in the unopened parts of Nordland IV, V, VI, VII and Troms II. The knowledge acquired will be used in a potential impact assessment for the petroleum activity, and used as a basis for the next revision of the management plan. Enhance knowledge about the petroleum resources in the unopened parts of Nordland IV and V through seismic surveys and other geological data acquisitions under the direction of the Norwegian Petroleum Directorate and in dialogue with the fishery industry and fishery authorities. Release data sets with relevant seismic data from Nordland VI, VII and Troms II for sale.
- When the agreement with Russia on maritime boundaries and cooperation in the Barents Sea and the Arctic Ocean enters into effect, initiate an impact assessment under the Petroleum Act with a view towards awarding production licenses and data acquisition in the previously disputed area west of the delimitation line in the Barents Sea South.
- Facilitate new petroleum activity in the area from 35 – 50 km from the baseline along the coast from Troms II to the border with Russia and in Eggakanten by including these areas in future licensing rounds.
- Consider the future need for new knowledge about petroleum resources in Skagerrak.

1.4.4 Employment, spin-off effects and research

An important pillar of Norwegian petroleum policy is to exploit the petroleum industry's expertise in order to achieve the highest possible value creation and ensure a qualitatively better society. The resource input on the Norwegian Shelf is extremely high, and this will likely continue in the next few years. The activity level in the petroleum activity over time depends on how much of the remaining resources are exploited. A commitment to existing fields, to new, profitable field developments and exploration will provide a basis for a high and stable activity level in the future as well. In a time perspective beyond 2020, access to new exploration acreage will be essential to maintaining the activity level.

New discoveries provide a basis for new developments and associated spin-off effects. The greatest potential for making major new discoveries is in the sea areas outside Northern Norway. Through expanded activity in opened areas and through mapping and opening of new acreage, we will facilitate new activity and spin-off effects in the north. The Snøhvit, Goliat and Skarv developments illustrate that the petroleum activities provide significant value creation and employment, both locally and regionally.

Through profitable exploitation of the resource potential on the Norwegian Shelf, the oil and gas industry will also lay the foundation for considerable activity in the mainland economy for decades to come, with associated jobs and positive spin-off effects in large parts of the country. Exploiting the resource potential will contribute to research activity and building expertise. Research and development are important for achieving improved resource recovery, and for ensuring the industry's international competitiveness. The industry is, and must be, a driving force in research and development. The authorities play an important role as facilitator, and public funds are needed in certain key areas where the industry's efforts fall short.

In order to maintain an effective petroleum industry in Norway over time, the Government will facilitate profitable production of oil and gas in a long-term perspective. The Government will also:

- Work to reinforce the oil and gas industry's international market access, and to ensure that the industry can compete on equal terms with its competitors. Together with INTSOK, contribute to Norwegian-based enterprises win-

ning assignments and contracts, also outside the Norwegian Shelf.
- Conduct an active dialogue with Russia on energy issues. Facilitate partnerships between Russian and Norwegian companies, including through INTSOK and Innovation Norway. Stimulate increased cooperation with Russia as a result of the agreement on maritime boundaries and cooperation in the Barents Sea and the Arctic Sea.
- Facilitate increased industrial application of gas in Norway, including contributing to an industrial arena as a meeting place for industrial players and oil companies.
- Ensure good terms for petroleum research.
  - Prioritise research in improved recovery from existing fields on the Norwegian Shelf, including considering establishment of a research centre for improved recovery.
  - Consider establishing a research centre to address challenges faced by the petroleum industry in arctic regions.
  - Continue the work to qualify and test new technology.
- Contribute to strengthen recruiting to science and technology subjects in schools and higher education to ensure access to qualified labour for the petroleum sector.

1.4.5 Opportunities in the north

The High North is the Government's most important strategic commitment area in foreign policy. The Government wants to contribute to positive development in the northernmost areas. The prime objective of the Government's policy is to ensure peace and stability in the region. Another objective is to ensure sustainable and environmentally responsible exploitation of resources for the future. As part of this effort, the Ministry will consider establishing a research centre addressing the challenges the petroleum industry faces in arctic areas.

The Government wants, and intends to facilitate, a situation where profitable offshore activity also provides spin-off effects on the mainland. The Ministry will gradually increase capacity at the NPD's office in Harstad from the current situation in May 2011. This will take place in step with the general growth in the industry. New discoveries provide the basis for new developments and associated possible spin-off effects. The sea areas outside Northern Norway are the most interesting in terms of making large new discoveries. These areas have figured prominently in the most recent numbered licensing rounds.

Business and industry in Northern Norway must have the opportunity to participate as competitive suppliers to the petroleum activity in the region. Although the starting point for Northern Norwegian petroleum activity is quite different from the situation in the North Sea 40 years ago, the same fundamental drivers for development are in place.

The Government will facilitate additional new discoveries off the coast of Northern Norway by pursuing an active licensing policy. The Government will include the area from 35 – 50 km from the baseline along the coast from Troms II to the Russian border and Eggakanten in future licensing rounds. Furthermore, the Government will initiate impact assessments and data acquisition in the previously disputed area west of the delimitation line in the Barents Sea South when the agreement with Russia takes effect. The Government will carry out acquisition of knowledge in the northeastern Norwegian Sea.

One of the Government's objectives is for the development of new discoveries to create the greatest possible values for society, which can also form the basis for profitable local and regional spin-off effects. This applies to discoveries on the entire shelf. The key precondition for achieving spin-off effects is further development of profitable activity. When developing discoveries, identifying socio-economically sound development and operations solutions is important. Experience from developments such as Skarv, Ormen Lange, Snøhvit and Goliat shows that major new developments yield significant local and regional spin-off effects, regardless of development solution. The dialogue and interaction between local and regional authorities and business and industry are important when drawing up plans for development and operation. The guidelines for preparing development plans (PDO/PIO guide) state the authorities' expectations for developments in terms of local and regional spin-off effects.

The Government will pursue the following policy in connection with new developments:
- Ensure that new discoveries create maximum values for the society, and facilitate positive local and regional spin-off effects.
- Ensure early contact between operator and local/regional business and industry, and relevant authorities.
- Set demands requiring study of socio-economic factors in connection with plans for

development and operation, including regional and local spin-off effects.
- Facilitate qualification of relevant local/regional suppliers in the development and operations phase.
- Facilitate establishment of tender processes in connection with new developments that allow participation by companies in the region where the development will take place.
- Ensure an efficient base and operations structure, which also contributes to local and regional business and expertise development.
- Operators of new independent developments must conduct an analysis of regional and local spin-off effects of the development within two years after the field comes on stream.

1.4.6 Revenues to the state

The resources on the Norwegian Shelf belong to the greater community and are a significant contribution in financing the welfare society. The additional profit in the industry is the main reason that the State takes a significant percentage of the income from the petroleum activities on the Norwegian Shelf through taxes, fees and the SDFI scheme.

Petoro manages the SDFI interests on behalf of the Norwegian state. As part of the State's joint ownership strategy, Statoil ASA handles marketing of the State's petroleum together with the company's own resources. The Ministry has defined the following main tasks for Petoro:

Figure 1.3 Oceanic Vega, representing a new generation of Norwegian-built seismic vessels.

Source: Eidesvik.

- Safeguarding the State's direct participating interest in those partnerships where the State participates at any given time.
- Monitoring Statoil's marketing of the petroleum produced from the State's direct participating interests, in line with Statoil's marketing instructions.
- Financial management, including keeping accounts, for the State's direct financial interests.

The Government will pursue the following policy for the State's Direct Financial Interest:

- Ensure maximum value creation through efficient management of the SDFI portfolio.
- Reinforce Petoro's expertise in the follow-up of mature fields.
- Retain participating interests in new production licenses awarded.

1.4.7 The external environment, emergency preparedness and safety

Since the very beginning, considerations for other industries and safeguarding the external environment have formed an integral part in the management of the petroleum activities. Over a period of 40 years, an extensive policy instrument scheme has been developed to safeguard the interests of other industries and the external environment throughout all phases of the activities – from the opening of new areas, via the award of licenses, exploration, development and operation and up to cessation of a field. As a result, the Norwegian Shelf is a world leader when it comes to safeguarding these considerations in offshore petroleum activity. The Government will further develop stringent requirements for safety and protection of the external environment, also for late-phase fields.

The responsibility for managing the petroleum sector is shared between several ministries and directorates. The Ministry of Labour is responsible for health, working environment and safety. These factors will be assessed in more detail in an upcoming Storting white paper on working environment, working conditions and safety in Norwegian working life. The Ministry of Fisheries and Coastal Affairs is responsible for the State's preparedness for acute pollution, and for coordinating private, municipal and State players in a national preparedness system. The Ministry of the Environment and the Norwegian Climate and Pollution Agency are responsible for regulating emissions to air and discharges to sea through emission/discharge permits, as well as for stipulating requirements for emergency preparedness against acute pollution in the petroleum activities. In an upcoming White Paper on Norwegian climate policy, the Ministry of the Environment will present a broad review of the status and objectives of this policy. The main focus of this Petroleum White Paper is on the Ministry of Petroleum and Energy's area of responsibility.

2 The Norwegian Shelf in change

The petroleum sector is Norway's largest industry, measured in value creation, revenues to the State and export value. The industry currently contributes about one-fifth of the total value creation and one-fourth of the State's revenues. Half of Norway's export value consists of oil and gas. The petroleum industry currently employs about 43 000 people, while more than 200 000 jobs are directly or indirectly linked to the activities on the shelf.

Since the beginning almost 50 years ago, the oil and gas industry has created values totalling around NOK 9000 billion, expressed in current worth. No other Norwegian industry or sector can compare with the petroleum activities when it comes to value creation, revenues to the State or export value. Value creation in the oil and gas industry is 2.5 times that of land-based industry, and about 15 times the total value creation in the primary industries, cf. Figure 2.1. A large part of the value creation in the petroleum industry is linked to economic rent from the petroleum deposits.

Oil and gas are non-renewable resources. After 40 years of production, the Norwegian Shelf still has a significant resource potential. The remaining resources form the basis for vigorous activity on the Norwegian Shelf for decades to come.

The petroleum resources are owned by the State, which means that a large portion of the revenues from the activities must go to the greater community. The State's net cash flow from the petroleum activities is transferred to the Government Pension Fund – Global. At the end of 2010, the market value of the fund was about NOK 3000 billion.

Some projects in the oil and gas industry are of formidable size, with Snøhvit, Ormen Lange and Langeled being some recent examples. The scope of investments in the further development of the Ekofisk area alone, approved by the Storting (Parliament) in the spring of 2011, is NOK 65

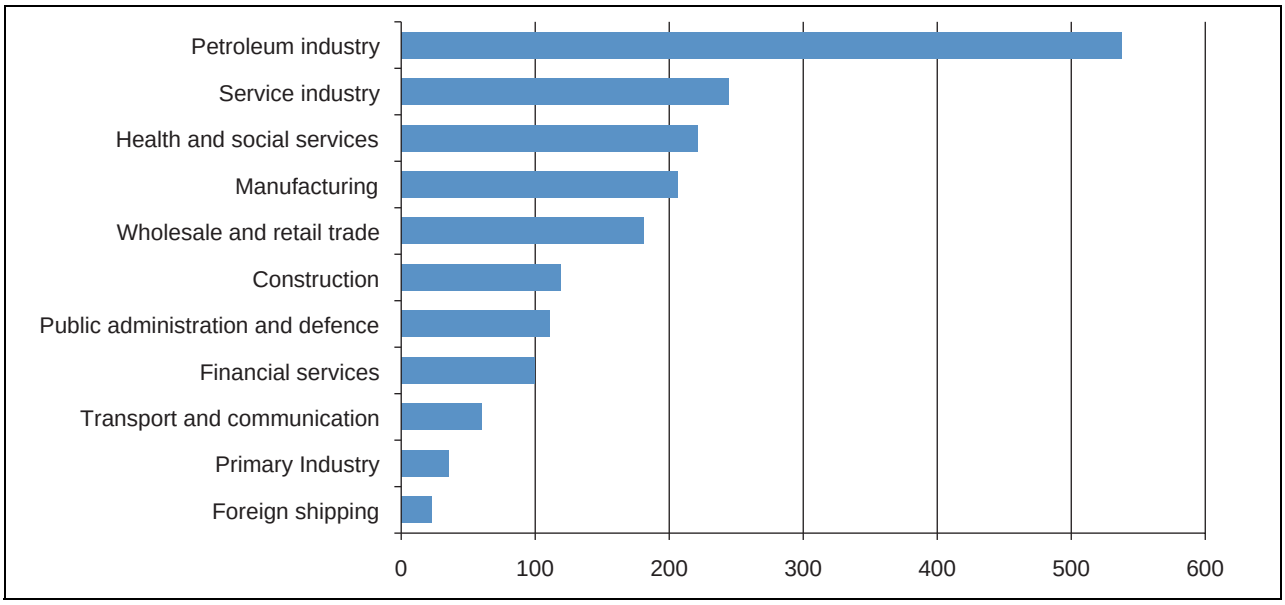

Figure 2.1 Value creation for selected sectors in 2010, in billion NOK. The value creation in the petroleum sector is very high because the resources that are proven and produced are of high value, also called economic rent.

Source: National accounts, Statistics Norway.

billion. This type of project receives great attention and somewhat overshadows the many smaller projects on the Norwegian Shelf. Even these smaller and less well-known development projects on the shelf are large in a Norwegian industrial context. Very few industrial projects on the mainland can compare to the offshore projects as regards value creation, State revenues or export value. Marulk and Gaupe are examples of such smaller developments.

Today, the oil and gas activities are in a different phase than was the case ten years ago. During the last ten years, exploration activity has increased, the opened areas on the shelf have matured and producing fields have become older. Both cost levels and oil prices have shown significant increases. The player scenario is much broader.

Parts of the shelf constitute well-established petroleum provinces, including large parts of the North Sea, parts of the Norwegian Sea as well as the area near Snøhvit in the Barents Sea. We have several fields in the North Sea and parts of the Norwegian Sea that have produced for quite some time, and they still have considerable remaining resources. Substantial undiscovered resources are also expected in the areas near these fields. Proper cost control and greater focus on new drilling methods, new drilling technology and new production solutions can allow recovery of a larger percentage of the resource base, thus curbing the decline in oil production from the old fields and extending their lifetime.

It terms of petroleum deposits, other parts of the shelf are less-explored, or not explored at all. Recent years' exploration in less mature areas has not lived up to our expectations. The discovery of Skrugard in the Barents Sea is a recent exception. New exploration areas are needed in order to contribute to maintaining production and value creation on the Norwegian Shelf after 2020. The Ministry has initiated an opening process for the waters around the island of Jan Mayen, and will also initiate an opening process for the southern part of the previously disputed area west of the delimitation line in the Barents Sea. This will lay the foundation for access to new exploration areas. The Ministry will also conduct acquisition of knowledge in the northeastern Norwegian Sea.

The potential on the Norwegian Shelf is still significant, particularly if we are able to extract more of the resources in place by implementing measures that can yield improved recovery from existing fields, develop discoveries and prove more of the undiscovered resources.

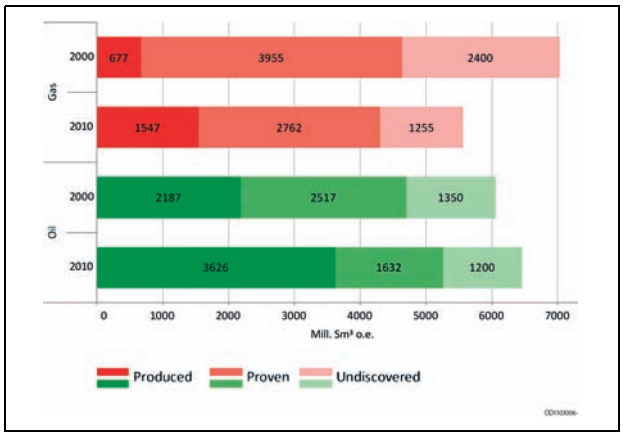

Figure 2.2 Development of the statistical expected value of recoverable resources, status as of 31 December 2000 and 31 December 2010. Oil does not include condensate and NGL.

Source: Norwegian Petroleum Directorate.

2.1 The resource base

There is no way to accurately predict exactly how much oil and gas can be produced from the Norwegian Continental Shelf. Considerable uncertainty is associated with factors such as geology, reservoir conditions, technology and knowledge development, costs and commodity prices.

The Norwegian Petroleum Directorate's resource accounts provide an overview of the expected total recoverable petroleum resources, including undiscovered resources. The resource accounts are based on data reported by the operating companies, as well as the Directorate's own data.

The resource accounts include all areas on the Norwegian Continental Shelf, with the exception of areas where the available data is not good enough. This applies to that part of the previously disputed area that lies west of the delimitation line with Russia and the continental shelf around Jan Mayen. Other areas that are not currently open for petroleum activities are included in the resource accounts.

The resource base and the assessments of the resource base change over time. Resources are matured through several phases, finally ending in production. New knowledge about geology and reservoir conditions changes the assessment of the resource base. The current picture of the resource base is considerable different than the picture we had just ten years ago, cf. Figure 2.2.

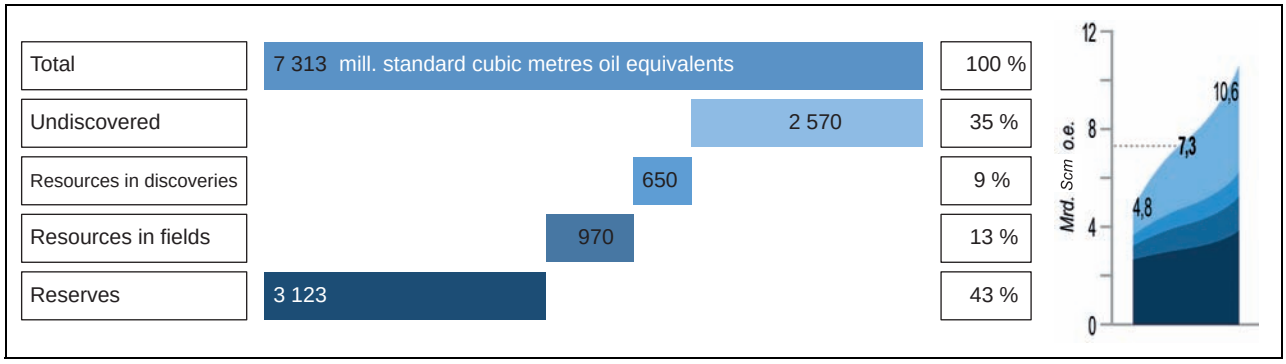

Figure 2.3 Total remaining petroleum resources (liquid and gas) distributed by resource categories (left). The figure on the right shows the uncertainty associated with remaining volumes.

Source: Norwegian Petroleum Directorate.

The estimate for undiscovered resources, particularly gas, was reduced in 2011.

At the end of 2010, the total recoverable resources are estimated at between 10 and 16 billion scm of oil equivalents (o.e.)[1], with 13 billion scm o.e. as the expected value. A total of 5.5 billion scm o.e. has been produced, which means that about 40 per cent of the expected recoverable resources have been produced to date.

There is great uncertainty associated with these estimates. If we use the figures in the lower or upper parts of this range of uncertainty, we have so far produced about 50 and 30 per cent respectively, of the total recoverable resources. This does not take into account the resources in that part of the previously disputed area that lies to the west of the delimitation line with Russia, or in the waters around Jan Mayen.

The basis for future activity lies in fields, discoveries and undiscovered resources. The Norwegian Petroleum Directorate's estimates show that proven resources so far are almost as large as what has already been produced. Most of the proven resources are found in existing fields, but some are also linked to discoveries that have not yet been developed.

Of the expected remaining recoverable resources, about 55 per cent are in existing fields, 35 per cent have not yet been proven, and 10 per cent are in discoveries that have not been developed, cf. Figure 2.3.

Today's approved plans indicate that more than half of the original oil on the Norwegian Shelf will be left in the ground after fields are shut down. The potential entailed by additional recovery from current fields is thus quite large. This is linked both to extracting resources planned in existing projects (reserves) as well as new measures on the fields (resources in fields). At the same time, achieving annual production ambitions is proving challenging on a number of fields. How

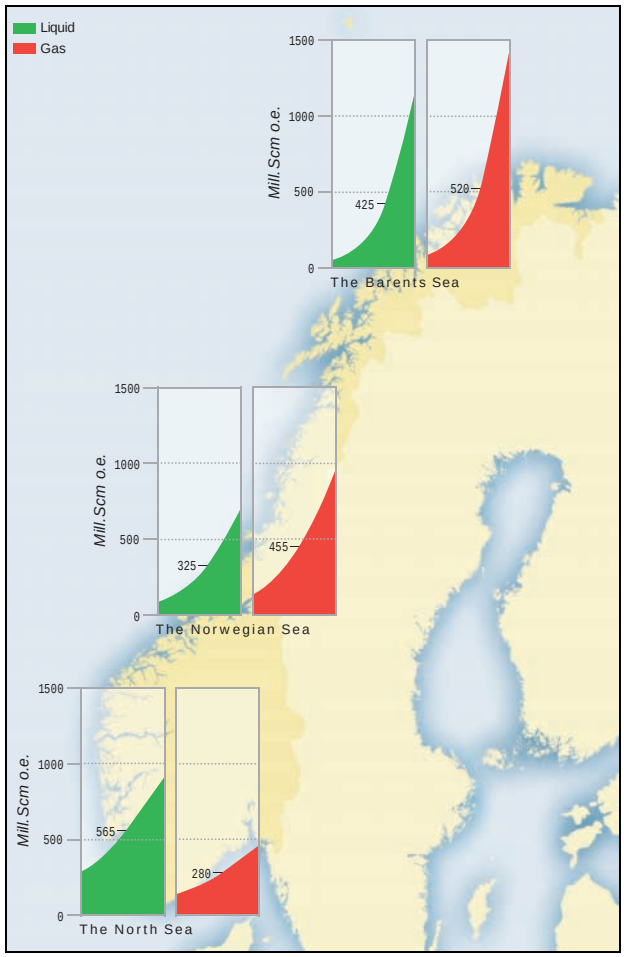

Figure 2.4 Undiscovered resources distributed by area. The number in each column shows the expected recoverable volume, while the uncertainty in the estimate is shown by the diagonal line.

Source: Norwegian Petroleum Directorate.

[1] Oil equivalents (o.e.) are used to summarise volumes of oil gas, NGL and condensate.

Box 2.1 Consultation

In its declaration, the Norwegian Government stated its intention to review petroleum policy in a dedicated white paper. On 30 November 2009, then Minister of Petroleum and Energy Terje Riis-Johansen signalled the start of the work on the white paper at a consultation council meeting in Stavanger and a visit to Bergen Group Rosenberg.

The council in Stavanger was the first in a series of twelve such meetings held throughout the country; in Stavanger, Kristiansund, Grenland, Arendal, Sandnessjøen, Harstad, Kongsberg, Sogn og Fjordane, Bergen, Hammerfest, Trondheim and Oslo. The purpose of the councils was to obtain input for the white paper. At these events, the cabinet minister, other political leaders and government officials met with representatives of the supply industry, oil companies, employees in the oil industry, local and regional politicians and organisations. Important topics raised at the councils included future prospects for the Barents Sea, the need for new solutions on the Norwegian Shelf, improved recovery, the importance of research and development, spin-off effects and development of petroleum clusters. An attempt has been made to include the input from these events in this White Paper.

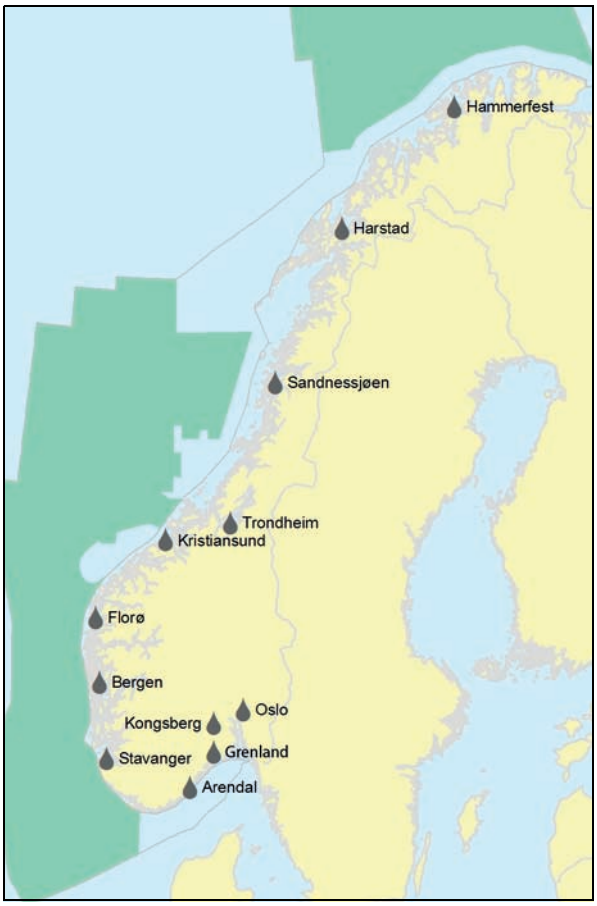

Figure 2.5 Consultations.

Source: Ministry of Petroleum and Energy.

to realise the potential in these fields is an important topic in this White Paper.

At the beginning of 2011, there were 100 undeveloped discoveries on the Norwegian Shelf. These discoveries are quite diverse in size, from very small discoveries to larger discoveries containing up to 40 million scm o.e. Analyses show that even it takes time, profitable discoveries are being developed. Important reasons for this include uncertain profitability (particularly related to the resource base and costs), technical challenges and insufficient marketing opportunities for gas. More than half of the resources in these discoveries are gas.

About a third of the expected remaining recoverable resources are not yet proven. The estimates for undiscovered resources are based on analysis of play models. These models are defined on the basis of geological knowledge. The estimates are associated with great uncertainty, particularly in areas where there is limited knowledge about the subsurface. Exploration drilling is necessary in order to clarify both the potential for petroleum deposits in an area, and in order to make new discoveries.

The Barents Sea contains large areas with little data and no exploration wells, thus making the uncertainly particularly high. Based on current knowledge, it is estimated with 90 per cent certainty that there are between 175 and 2460 million scm o.e. of undiscovered recoverable oil equivalents in the Barents Sea.

The knowledge base in the Norwegian Sea varies from good to limited. Resource estimates for the Norwegian Sea indicate with 90 per cent certainty that the area contains between 260 and 1580 million scm o.e. of undiscovered recoverable oil equivalents.

The best knowledge base on the Norwegian Shelf is in the North Sea, where many wells have been drilled and the geology well-known. Therefore, less uncertainty is linked to the estimates of

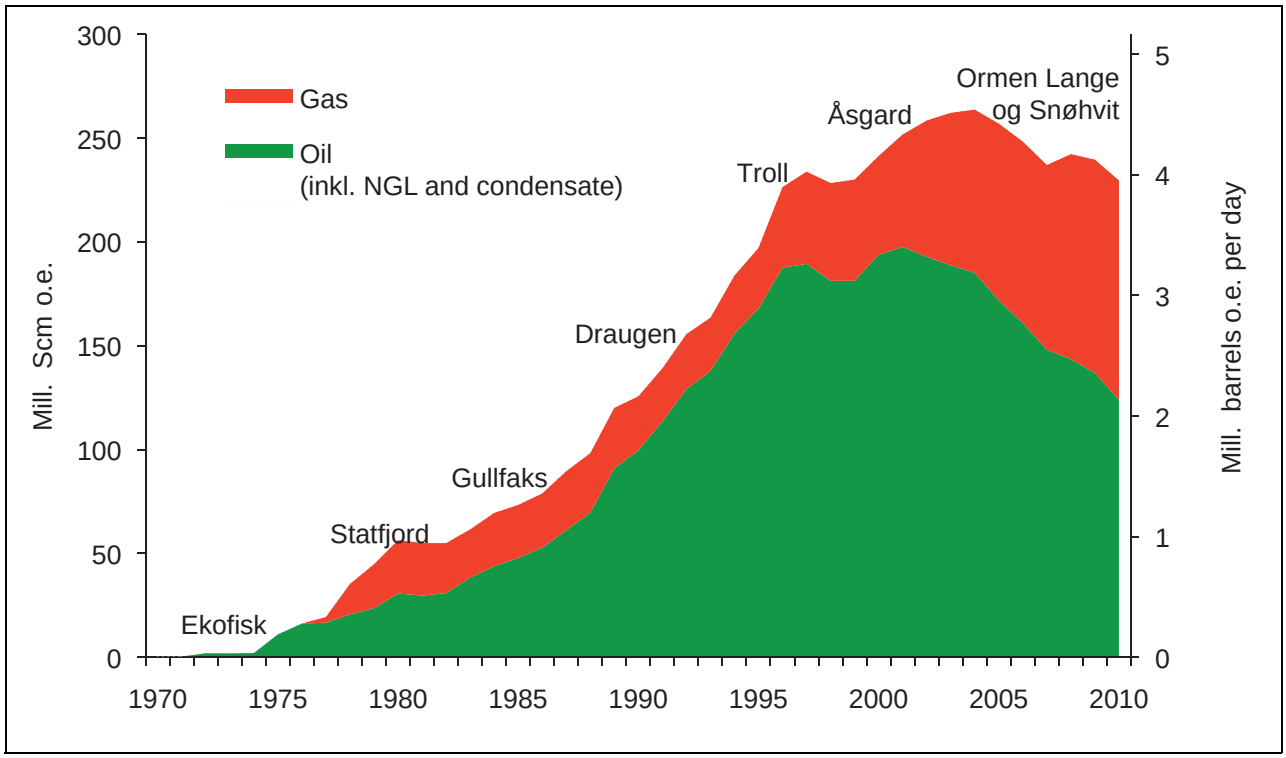

Figure 2.6 Production development on the Norwegian Shelf.

Source: Norwegian Petroleum Directorate.

undiscovered resources in the North Sea. Even though the area is well-explored and many major discoveries have been made, the North Sea still has considerable potential. The resource estimates for the North Sea indicate with 90 per cent certainty that between 470 and 1305 million o.e. of undiscovered recoverable oil equivalents is still present.

2.2 Activity level

2.2.1 Production

Since the petroleum activities in Norway started nearly 50 years ago, the industry has experienced economic fluctuations and shifting oil prices. While there have been downward business cycles, the sector has largely been characterised by growth and increasing production.

The first acquisition of seismic data started in 1962 and the first exploration well was drilled in 1966. The discovery of Ekofisk in 1969 proved the existence of very significant oil deposits on the Norwegian Shelf. A number of large, commercial discoveries were made through the 1970s, thus establishing the foundation for the Norwegian petroleum industry. Many large discoveries were also made in the 1980s, while a number of discoveries made in the 1970s were developed. Production more than doubled during this period. The last part of the 1990s was characterised by flattening oil production, along with sharp growth in gas exports. Oil production peaked in 2001, while total production was at its highest level in 2004, cf. Figure 2.6.

Oil production has declined since 2001 and the gradual drop in oil production is expected to continue, cf. Figure 2.7. By increasing our commitment to more production from existing fields and development of existing and new discoveries, we can limit this decline in the short and intermediate perspective. In a long-term perspective, the

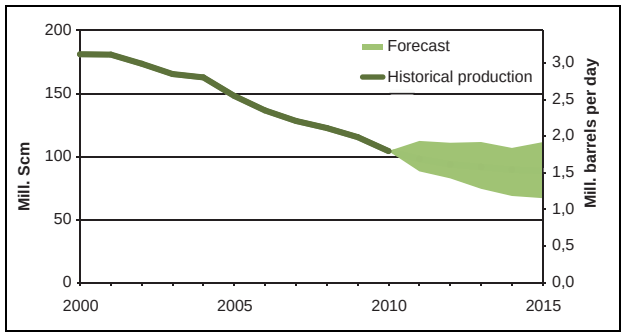

Figure 2.7 Oil production from the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

number and size of new discoveries is crucial for the production level.

Gas production is expected to peak around 2020, cf. Figure 2.8. At that time, annual gas production is estimated at between 105 and 130 billion scm o.e. The production level after 2020 will largely be determined by the new discoveries made in the years to come.

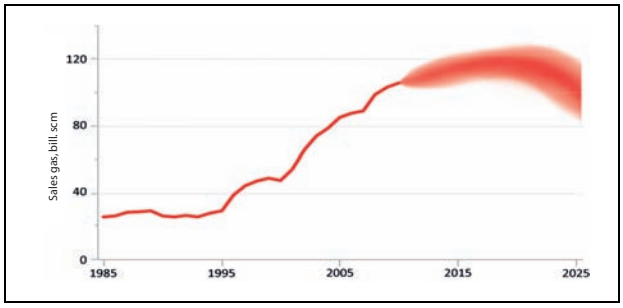

Figure 2.8 Gas production from the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

2.2.2 Exploration activity

A number of large discoveries were made on the Norwegian Shelf up to the mid-1980s. Ormen Lange, discovered in 1997, is the last major discovery made. This is reflected in resource growth over time, cf. Figure 2.9. As it is common for the companies to first explore the areas that are expected to be most prospective, the largest discoveries are usually proven in the early stages after an area is opened. Rapid development followed by levelling off is a normal development trend for resource growth in petroleum provinces.

The numbered licensing rounds are designed with a view towards areas where there is limited geological knowledge, and where stepwise exploration is expedient. The first licensing round was carried out in 1965. Area has been awarded through 21 numbered licensing rounds, with licenses awarded in the 21st round in the spring of 2011.

Exploration of less mature areas in the Norwegian Sea in recent years has not lived up to expectations. However, the Skrugard discovery has created new optimism in frontier areas in the Barents Sea. The discovery opens up a new oil province that could provide additional resource growth. The Norwegian Petroleum Directorate's analyses show that there are good chances of making discoveries in frontier areas both in the Norwegian

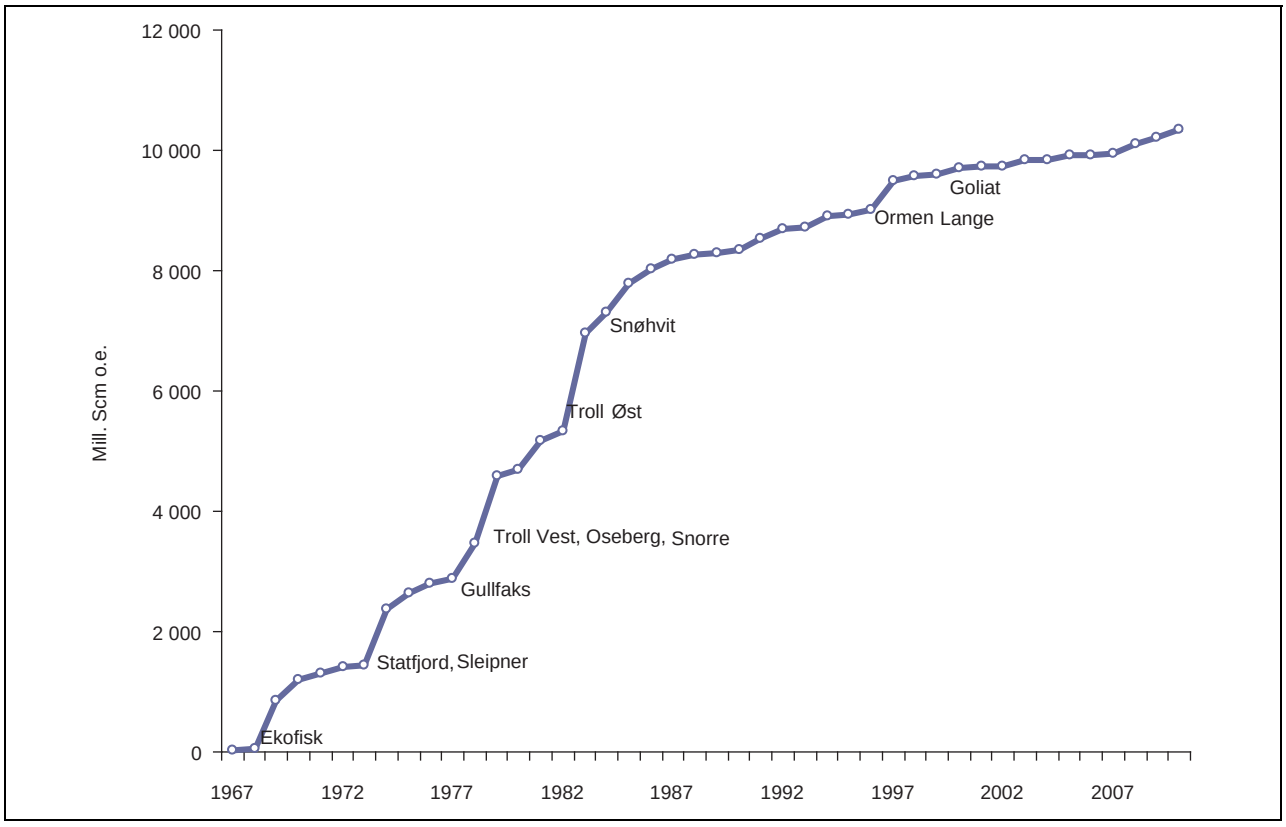

Figure 2.9 Resource growth over time.

Source: Norwegian Petroleum Directorate.

Sea and in the Barents Sea. There has been a broad interest in recent licensing rounds.

For mature areas, where the level of knowledge is more extensive, stepwise exploration is less important. Therefore, changes were made in Norwegian exploration policy to facilitate increased exploration activity in mature areas. These changes were made along three main lines: increasing access to acreage in mature areas, facilitating more efficient exploration of areas in part through stricter work commitments, as well as bringing in new companies.

The system for awards of licenses in predefined areas (APA) was an important measure introduced in 2003. The APA system is based on experience gained through the numbered licensing rounds. The main difference is that fixed, predefined exploration areas were established in mature parts of the shelf. These areas are subjected to an annual licensing round, thus laying the foundation for improved predictability and profitability in mature areas. In 2005, adjustments were made in the tax system which secured companies in and outside tax position equal tax treatment with regards to exploration costs. This has contributed to ease financing of exploration activity for new companies.

The measures that were implemented have yielded results. Interest in mature acreage has been high, and there has been a substantial increase in the number of production licenses awarded. The number of exploration wells has risen sharply and a number of discoveries have been made. The activity has been profitable and the net present value of proven resources in the period 2000–2010 is estimated at around NOK 700 billion. This illustrates that the changes made in exploration policy in the 2000s were successful, even though resource growth has been relatively low in a historical perspective, cf. Figure 2.9.

No new area has been opened on the Norwegian Shelf since 1994. There is a need to open new areas soon to contribute to maintaining production on the Norwegian Shelf after 2020. Therefore, the Government has decided to initiate an opening process for the waters around Jan Mayen and the part of the previously disputed area to the west of the delimitation line in the Barents Sea South.

2.2.3 Investment and employment

There has been a sharp increase in the investment level on the Norwegian Shelf in recent years, cf. Figure 2.10. The petroleum sector is responsible for about one-fourth of the total investments in Norway. The growth in investments can be attributed both to the high activity level as well as to significant cost growth. Investments linked to modifications and maintenance on fields in opera-

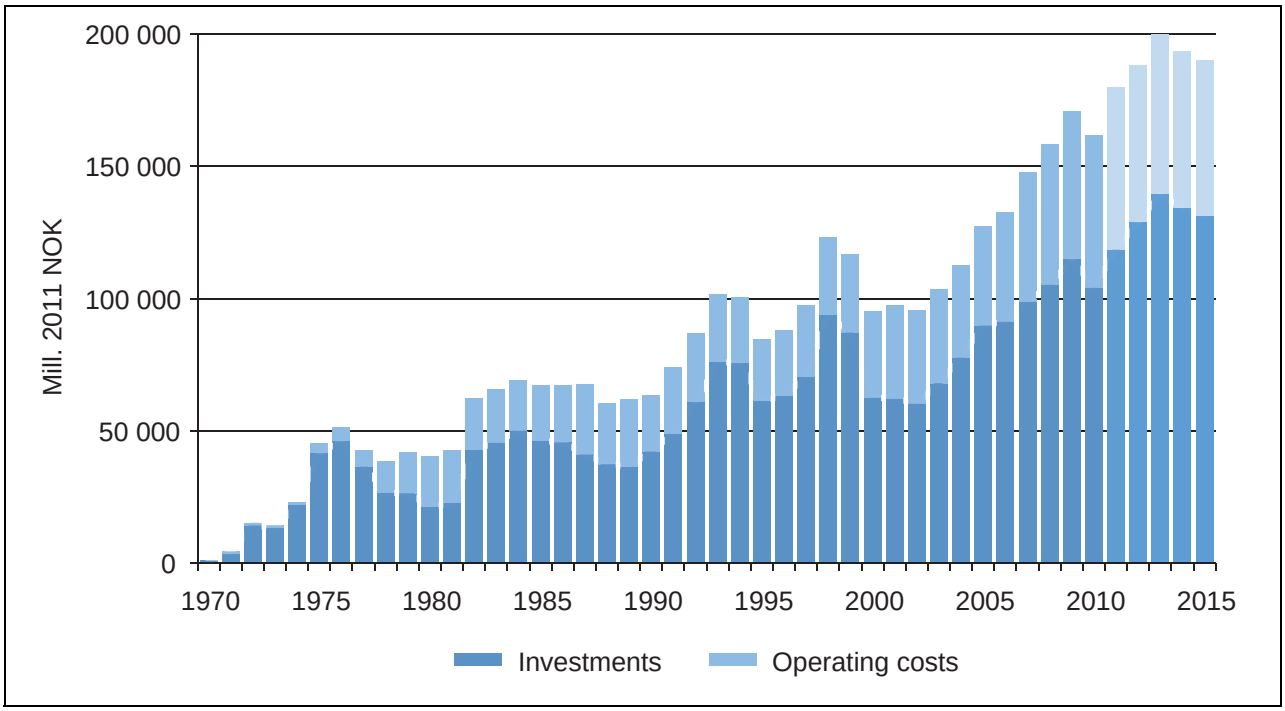

Figure 2.10 Historical investments and operating costs from 1971 to 2010 and forecast to 2015.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

tion account for an increasing percentage of the total investments.

Cost growth slowed in 2009, with the global financial crisis, declining commodity prices and thus postponement of projects, all being important factors. Today, we again see signs of a rising cost level. This is cause for concern. Cost growth in the petroleum industry can have consequences for resource utilisation both from today's fields and discoveries, as well as for proving resources that have not yet been discovered.

The petroleum activities create jobs throughout the country through oil companies, the supply industry, research and education institutions and other related activity. Employment in companies whose production mainly targets goods and services for the petroleum industry is around 43,000[2]. According to a report issued by Statistics Norway[3], around 8 per cent of Norwegian employment, or more than 200,000 jobs, are directly or indirectly linked to demand from the petroleum industry.

Today, employment in the petroleum sector is spread throughout the country, but the main part of the activity is found in south-western Norway. The activity on land has largely followed the offshore activity. The activity level on the continental shelf is crucial to ensuring employment in the petroleum industry in the years to come. Through a broad commitment to exploiting the entire resource base, including measures to improve recovery rates on fields and facilitating new discoveries through effective exploration and licensing policies, we can achieve a high level of employment for decades to come. New regions of the country, such as Northern Norway, can experience renewed growth stimulus as a result of such a broad commitment.

Many employees in the petroleum activities work in the supply industry. This industry started growing along with the many deliveries of goods and services to the shelf activities. Today, the sector is composed of a great number of specialised companies with great variation as regards geographical location, company size and type of deliveries. The oil and gas sector has always relied on a competent and innovative supply industry. Tomorrow's development solutions and technology will be different than what we have today. One notable development trend is that many of the smaller discoveries made today require less cost-intensive and more standardised solutions in order to achieve profitability. Furthermore, new solutions are needed in order to ensure that more of the resources in existing fields are profitable. The supply industry plays an important role in achieving this.

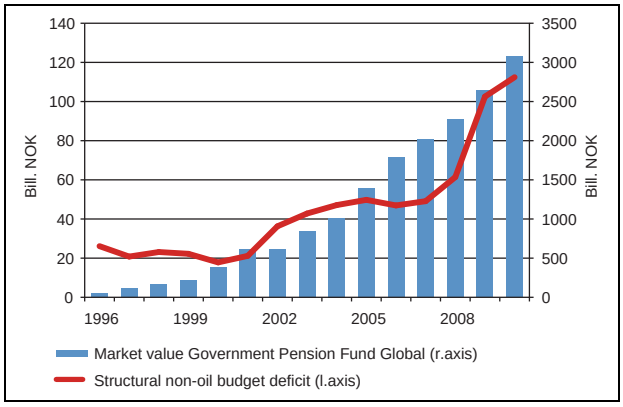

Figure 2.11 Structural, non-oil budget deficit[1] and market value of the Government Pension Fund – Global over time.

[1] Structural, non-oil budget deficit is a measure for oil revenues spent on the state budget. The State's revenues are divided between ordinary tax, special tax, production fees, area fees and environmental fees, cash flow from the State's Direct Financial Interest and dividend from Statoil.

Source: Ministry of Finance.

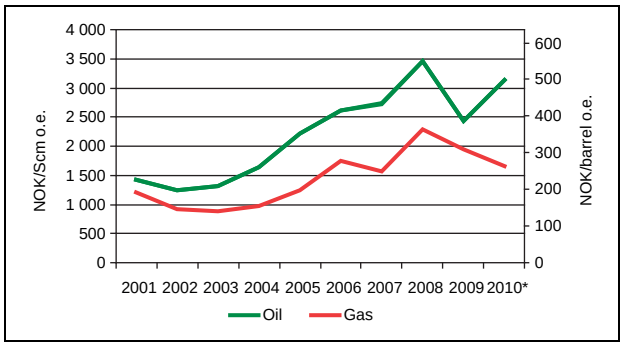

Figure 2.12 Average sales prices for oil and gas produced on the Norwegian Shelf. In current NOK.

Source: Statistics Norway.

2.2.4 Revenues to the State

Revenues from the petroleum sector account for about one-fourth of the State's total income. The cash flow from the petroleum activities is transferred in its entirety to the Government Pension Fund - Global. According to the fiscal policy guideline, the use of oil revenues over time shall be equivalent to the real return on the Government

[2] Statistics Norway report 55/2010.

[3] Economic analysis 3/2010; Demand from the petroleum activities. Impact on production and employment in Norway; Statistics Norway.

Pension Fund – Global. The guideline thus entails a gradual increase in use of oil revenues up to a level that can be sustained over a long-term perspective. The Government Pension Fund – Global is invested in financial assets outside Norway. The guideline and the management of the Government Pension Fund – Global is discussed in more detail in the annual national budgets and in reports to the Storting (Parliament) about the Government Pension Fund. Figure 2.11 shows the use of oil revenues and the market value of the Government Pension Fund - Global.

The basis of income from petroleum production is undergoing significant change. Since 2001, oil production on the Norwegian Shelf has been gradually reduced, while gas production has increased. The year 2010 marked the first time that more gas was sold than oil.

Prices achieved for oil have historically been higher than for gas, cf. Figure 2.12. The combination of reduced oil production, increased gas production and lower relative sales value for gas will impact cash flow from the petroleum activity. Income from the sector will fall more sharply than total production would indicate. Increased oil production will lessen this effect over the short and medium-term, while exploration and discoveries in new areas on the shelf can help maintain significant revenues, also over the long term.

2.3 Discharges to sea and emissions to air

The Norwegian petroleum sector is among the best in the world when it comes to environmentally friendly petroleum production. Norway's leading position can among other be attributed to strong government regulation over many years.

Waste products are generated in connection with the petroleum activity, such as drilled rock mass (cuttings) and formation water (produced water). These discharges are subject to permits from the authorities. In 1997[4] a zero discharge target was established for the petroleum activities. The main rule is that no environmentally harmful substances may be released, neither added chemicals nor naturally occurring chemical substances that could harm the environment. In 2009, radioactive substances were also included in the zero discharge targets. The zero discharge targets is considered to be achieved for environmentally hazardous chemical additives[5].

Production and transport of oil and gas are energy-intensive activities. Natural gas covers most of the sector's energy needs, while an estimated 5 TWh per year is met through electricity from land to terminals and fields. Emissions to air from the petroleum sector largely consist of exhaust gas from the combustion of gas in turbines, burning gas via flares and diesel consumption.

Disposal solutions are required for associated gas on the Norwegian Shelf. Flaring is only allowed for safety reasons. The petroleum sector is subject to strict regulations as regards emissions to air. The sector was subjected to CO_2 regu-

4 Storting White Paper No. 58 (1996–1997), *Environmental policy for sustainable development.*

5 Storting White Paper No. 26 (2006–2007), *The Government's environmental policy and the environmental state of the realm.*

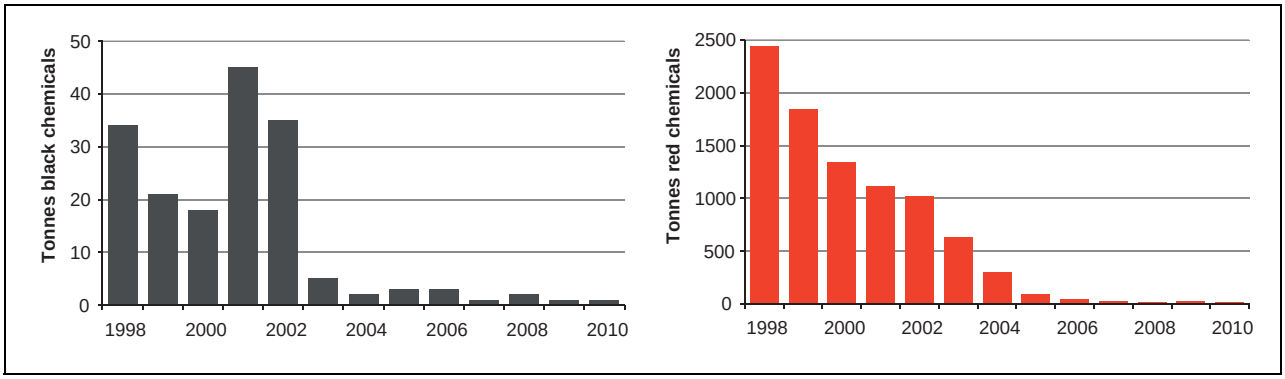

Figure 2.13 Development in discharges of black and red chemicals[1].

1 Added production chemicals are divided into categories (yellow, green, red and black) depending on the potential hazard they pose to the environment. Chemicals in the green category are naturally occurring substances and do not entail damage or disadvantages for the marine environment. Chemicals in the yellow category are normally not defined as environmentally hazardous, while chemicals in the red and black categories may have serious environmental impacts.

Source: Norwegian Petroleum Directorate.

lations at an early stage through introduction of the CO_2 tax in 1991. Since 2008, the sector has also been part of the emission quota system for greenhouse gases, in addition to paying the CO_2 tax. Rigorous policy instruments have triggered both inexpensive and relatively costly measures which have contributed to significant emission reductions. These regulations are one of the main reasons that the Norwegian Shelf is regarded as one of the world's cleanest petroleum provinces. Cost-effective policy instruments are important to ensure a sensible balance between resource utilisation, value creation and consideration for the environment.

CO_2 emissions from the Norwegian Shelf have increased from 10.8 to 12.6 million tonnes from 2000 to 2010, cf. Figure 2.14. As overall production is lower in 2010 than in 2000, CO_2 emissions per produced unit have increased. This is due to a number of factors. Firstly, petroleum production is declining on late-phase fields while the energy need on these fields remains fairly stabile. Secondly, Norwegian petroleum production has become more gas-intensive and gas transport over long distances is energy-intensive.

Emissions of NO_x have been reduced from 52,300 to 49,900 tonnes from 2000 to 2010. This has been achieved in part through the use of so-called low-NO_x burners on certain fields. Emissions of nmVOC have been reduced from 222,000 to 37,000 tonnes in the same period. This has been achieved by developing and applying recovery technology in connection with loading and storing oil.

2.4 Cost level and profitability

The petroleum industry has experienced significant growth in costs over the last decade. This growth has been even greater in Norway than in other comparable countries. High oil prices accompanied by all-time high investments and capacity utilisation in the supply chain have been key drivers of this development.

The International Energy Agency (IEA) has recorded a doubling of the international cost level during the period 2000–2008, cf. Figure 2.15. Accelerated cost growth was particularly evident after 2004, with an annual growth approaching 15 per cent. Analyses conducted by the consultant agency IHS CERA show a doubling of development costs in the period from 2004–2008. The price of factor inputs such as rigs, steel, labour and equipment are important explanatory variables. IHS CERA also points to a marked increase

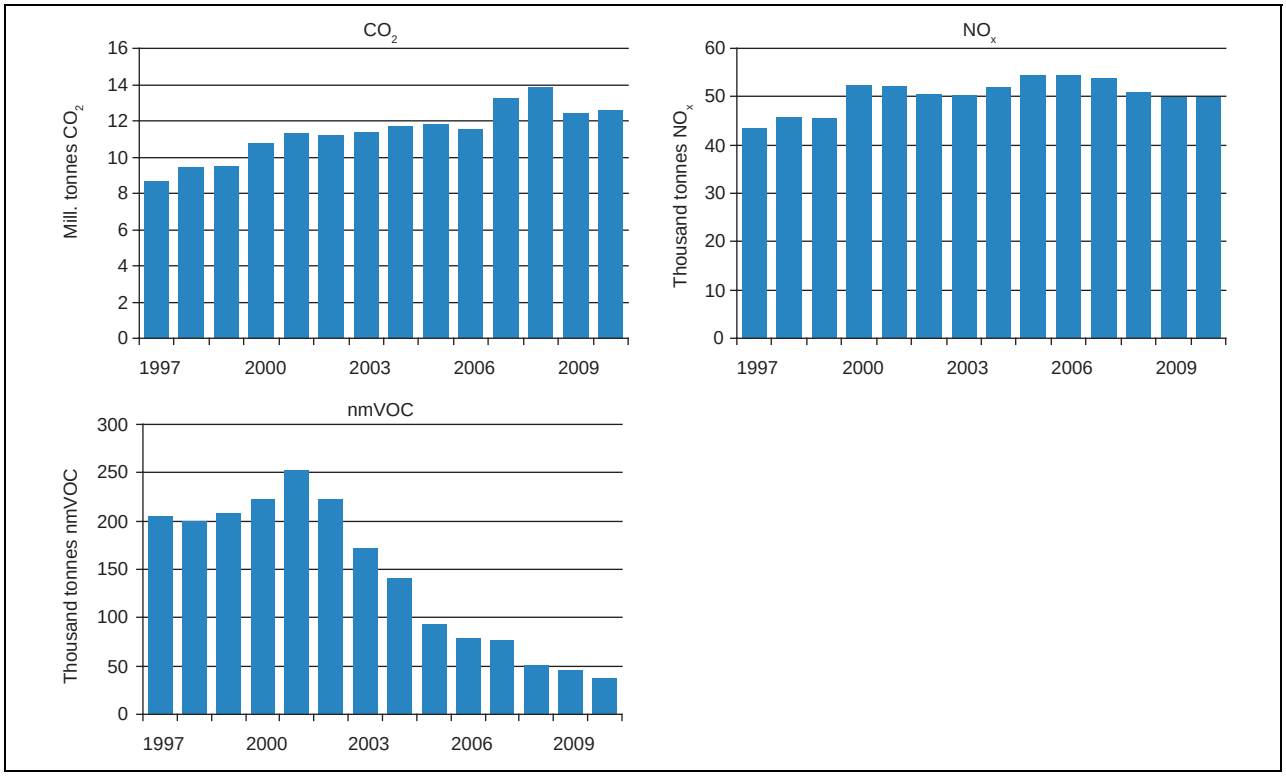

Figure 2.14 Development in emissions of CO_2, NO_x and nmVOC.

Source: Norwegian Petroleum Directorate.

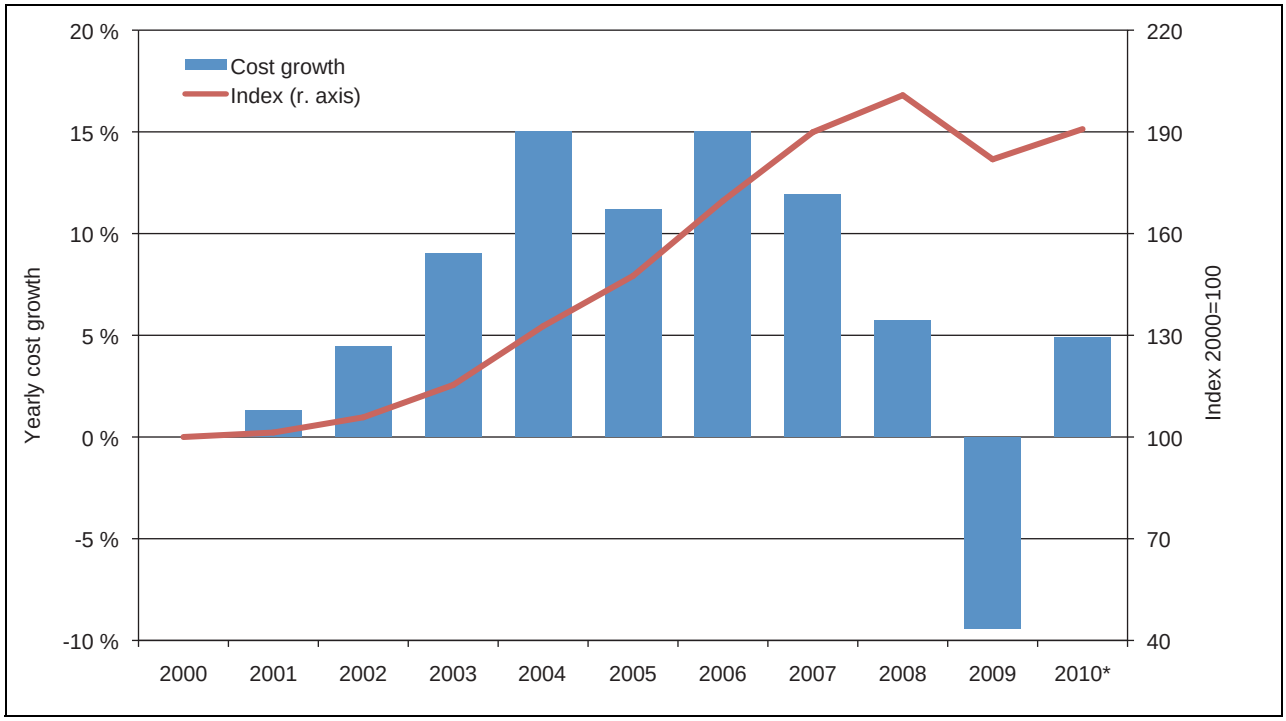

Figure 2.15 Global development in capital costs associated with exploration and development 2000–2010.

Source: IEA/WEO2010.

in operating costs in the 2004–2008 period, as a consequence of higher prices of factor inputs such as labour, energy and various consumables.

Costs are an important component when the companies assess whether new projects are profitable and can be carried out. Therefore, the long-term development of oil and gas prices necessary to make new developments profitable (the breakeven price) may be used as a measure for cost development. The breakeven prices in submitted plans for development and operation (PDOs) show a clear trend of higher development costs on the Norwegian Shelf since 2005, cf. Figure 2.16. While the breakeven price for new field developments in 2004 was around NOK 100 per barrel o.e., comparable prices in 2009 were more than NOK 300 per barrel o.e.. This represents a tripling of costs over a five-year period. There was a weak positive trend in the breakeven price for submitted development plans from 2009 to 2010.

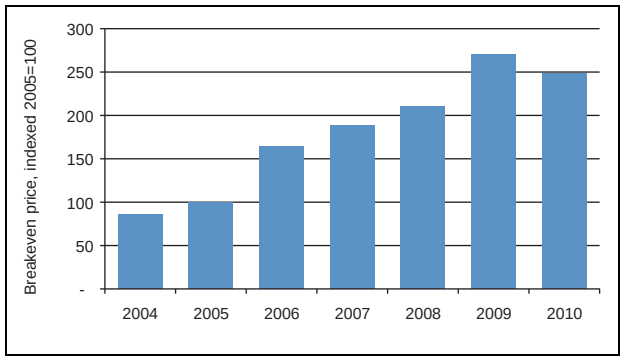

Figure 2.16 Volume-weighted breakeven prices for submitted plans for development and operation in the period 2004–2010.

Source: Ministry of Petroleum and Energy / Norwegian Petroleum Directorate.

The consultant firm Econ Pöyry has established a cost index for field development projects on the Norwegian Shelf which confirms this picture. Estimates for the period 2004–2008 show an average increase of 15 per cent per year. This trend continued through 2009, wherein the cost of completing a selected group of projects was 12.5 per cent higher than the previous year. Econ Pöyry points to the rig rates as an important driver in this cost development, with a near tripling of rig rates in the period 2004–2008[6]. It is presumed that this trend was largely caused by factors in the rig market.

On assignment from the Ministry, the consultant firm Wood Mackenzie compared costs on the Norwegian Shelf with other relevant petroleum provinces for the exploration, field development

6 OLF's Business Trend Report 2011

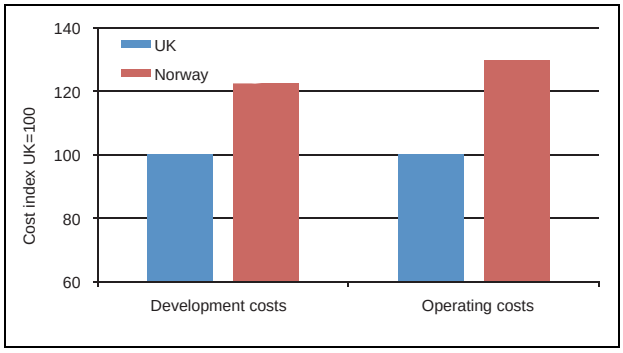

Figure 2.17 Development costs and operating costs for fixed platforms and FPSOs in Norway and the United Kingdom[1]. Includes projects under development or fields that started production after 2000.

[1] Two fields in the selection were developed using semi-submersible production facilities. FPSO (Floating production, storage and offloading) is a type of multi-purpose facility.

Source: Wood Mackenzie.

and operations. The study confirms a higher cost level in Norway than in comparable countries. When comparing the Norwegian and the UK shelves, Wood Mackenzie found that both development costs and operating costs are more than 20 per cent higher in Norway than in the United Kingdom, cf. Figure 2.17. The difference is in part due to activity associated with production drilling, including the cost of hiring rigs and drilling equipment. Higher prices for subsea services and process facilities also contribute to more expensive developments on the Norwegian Shelf. Taxes (CO_2 and NO_x) also contribute to higher operating costs. Costs associated with transport of oil and gas have not been part of the study.

Norway also emerges as a high-cost country when it comes to exploration activity, cf. Figure 2.18. The cost of drilling exploration wells on the Norwegian Shelf in waters shallower than 400 metres are about 85 percent higher than on the UK Shelf and 35 per cent higher than on the Brazilian Shelf. Hiring of rigs and associated personnel, field evaluation and other administration are the most important explanations for the cost differences.

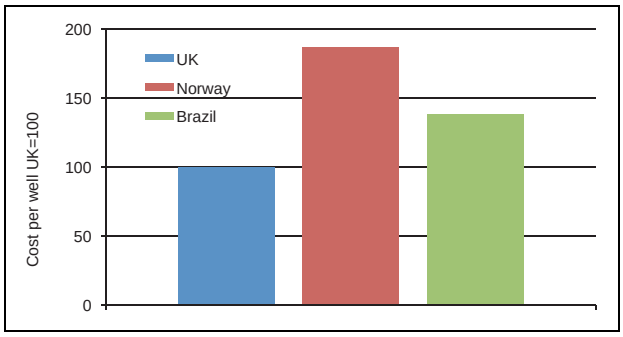

Figure 2.18 Exploration cost per well in water depths less than 400 metres. 2000–2009.

Source: Wood Mackenzie.

According to the IEA, the financial crisis and sharp drop in oil prices caused global investments in the petroleum industry to fall by 15 per cent in 2009. Upstream costs declined by 9 per cent over the course of the year. The situation in the first half of 2011 is different. Estimates provided by consultant firms, oil companies and the authorities all indicate that the industry is facing another period of record-breaking investments and activity level. Given the current cost level on the Norwegian Shelf, it is important that the players in the industry work together to achieve cost savings. Cost control is essential if we are to exploit the potential on the Norwegian Shelf. Marginal projects and late-phase projects on fields are threatened by high costs. The industry has implemented many good initiatives to keep cost development under control. However, stronger measures are needed if we are to realise the significant remaining resource potential on the Norwegian Shelf. Smarter and more efficient organisation, while also complying with the current regulatory framework, can yield considerable cost savings within all types of petroleum activities, and thereby create significant added value both for the Norwegian society and for the players themselves. The authorities must also contribute to cost control and the Government is implementing several measures. See Chapter 4 for a review of these measures.

2.5 Diversity of players

The paramount goal of the petroleum activity is to facilitate profitable exploitation of the oil and gas resources. A diversity of players and appropriate competition in all aspects are important contributions towards achieving this goal, and the Government will facilitate this.

Up until 2000, the player scenario on the Norwegian Continental Shelf was dominated by Statoil, Norsk Hydro and the major international oil companies. This player scenario also reflected the technically and financially demanding tasks the industry faced in Norway in the first decades. This picture has undergone substantial change over the last 10–15 years. Towards the end of the 1990s, the price of oil was around USD 10 per bar-

rel and the sector was characterised by consolidation. There were major mergers on the international stage, including companies such as Conoco and Phillips; BP, Amoco and Arco; Total, Fina and ELF; Chevron and Texaco; Exxon and Mobil. In Norway, the mergers included Hydro and Saga, while Shell took over Enterprise.

This consolidation had a direct impact on the player scenario on the continental shelf. The international companies became fewer in number and even larger in size. This happened at the same time that the Norwegian Shelf, particularly the North Sea, had become a well-established petroleum province with different opportunities and challenges than previously. These were business opportunities that many of the existing players on the continental shelf were not necessarily interested in pursuing.

The Norwegian authorities therefore implemented a number of measures to enhance value creation from mature areas. A key measure was to allow other companies to become licensees. Small and medium-sized oil and gas companies, along with foreign downstream companies, was established on the continental shelf, as did a number of new Norwegian companies, cf. Figure 2.19.

The fact that the player scenario changes along with the development on the shelf is positive. The Ministry wants to ensure that the player scenario reflects the challenges faced by the sector on the Norwegian Shelf, both in mature and less mature areas.

The presence of all the major international oil companies is unique to the Norwegian Shelf. These companies have extensive petroleum experience and unique expertise. They do business around the globe, and their main focus is often on exploring for and developing major projects, along with further developing their key fields and discoveries. Access to new areas on the Norwegian Shelf with the opportunity of making major discoveries will be important in ensuring that it remains attractive for these companies to participate on the Norwegian Shelf over time.

Competition and cooperation between companies with different expertise, different experience and different assessments of exploration, development and operation are important if we are to realise the greatest possible values from the oil and gas resources. This is why the activity on the continental shelf is organised under production licenses where several licensees work together. The licensees who are not the operator have a statutory responsibility to ensure that the operator plans and carries out the activity in a prudent manner, and to contribute to choosing the best solutions throughout the entire lifetime of the field. They must help the operator to do a good job by challenging all key choices made in the production license.

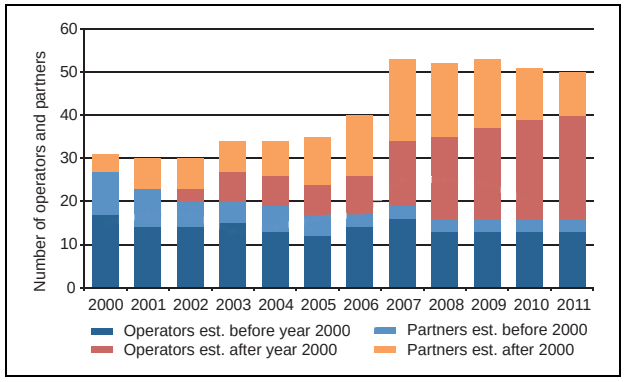

Figure 2.19 Number of operating companies and licensees divided between companies established before and after 2000.

Source: Norwegian Petroleum Directorate.

The operator is subject to stricter requirements than the other licensees. An operator must be capable of safeguarding all phases of the petroleum activity. It may take longer to mature operating companies than other licensees. The addition of more competent companies with operator ambitions is a desired development.

The development of player diversity on the Norwegian Shelf varies in the different phases of the activity. Licensee groups are put together when new licenses are awarded. The current ownership reflects historical awards as well as any subsequent transactions involving ownership interests.

2.5.1 The exploration phase

It is particularly important to have diversity in the exploration phase, in order to secure sufficient variation in geological assessments. There have been several examples where companies have made discoveries in relinquished area. This tells us that while one company may not believe a particular area is interesting, another company may see a business opportunity there. A diverse supply of geological assessments is necessary in order to prove as much of the resources on the shelf as possible. Diversity is particularly important in mature areas where phase-in of additional resources and small discoveries can be time-critical.

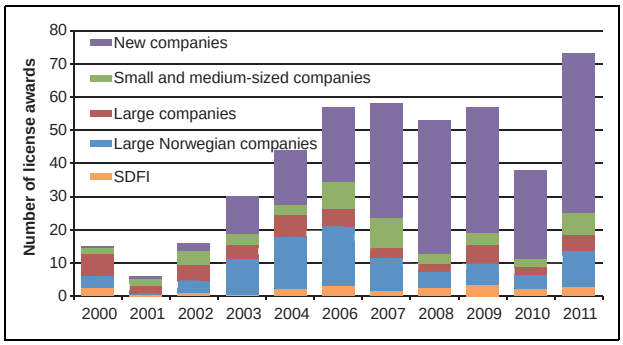

Figure 2.20 Award of ownership interests in production licenses, number distributed by company type 2000–2011[1, 2].

[1] No award in 2005.

[2] New companies since 2000 (4Sea Energy, Aker Exploration, Bayerngas Norge, BG Norge, Bridge Energy, Centrica, Concedo, Dana, Det Norske, Discover, DONG, Edison, Endeavour, Faroe, GDF SUEZ, Genesis, Lotos, Lundin, Mærsk, Marathon, Nexen, Noreco, North Energy, PGNIG, Premier, Repsol, Rocksource, E.ON Ruhrgas, Sagex, Skagen 44, Skeie, Spring, Talisman, VNG, Wintershall, Agora Oil & Gas). Small and medium-sized companies (AEDC, Hess Norge, Idemitsu, OMV, Petro-Canada, RWE-DEA, Svenska Petroleum), Large, international companies (BP, Chevron, ConocoPhillips, Eni, ExxonMobil, Shell, Total), Large, Norwegian companies (Petoro, Statoil).

Source: Norwegian Petroleum Directorate.

Since the new millennium, a number of new companies have been awarded production licenses on the Norwegian Continental Shelf. The new companies have been active applicants and have received many licenses, cf. Figure 2.20. These companies have been particularly active in the awards of mature areas on the shelf. Through license awards and transactions, these new players currently possess more than 55 per cent of the available license area, cf. Figure 2.21. These companies have received many licenses in the mature areas of the shelf.

The large companies still play a key role in the numbered licensing rounds. The major established companies are important when it comes to exploring for and developing new discoveries in mature areas and in deep water. If we are to ensure that these highly skilled companies maintain an active presence over time, we must have an active exploration policy in areas where there is a potential of making major discoveries. Opening of new exploration areas is important in this respect.

The development in the player scenario shows that different types of companies emphasise different areas, and that the companies complement each other in a manner which allows us to ensure exploration of both mature and frontier areas.

2.5.2 The development phase

The oil and gas industry has long lead times. For a company that relies on organic growth, it can take years from award of an area until commercial discoveries are made and production starts. This situation is the same for both operating companies and partners. An alternative strategy for companies that want to build a portfolio faster, including possible operatorship, is to take over ownership interests in existing discoveries or fields. Substantial – and different – resources are required to develop a discovery into a producing field than are required for merely being active in exploration. It may take quite a long time before a newly-established company can take the step forward to the production phase. The strategy of many of the new companies is to sell their ownership interest in production licenses when discoveries are made to companies that possess greater expertise in development and operation, and have greater financial strength. These are among the main reasons why the Norwegian Shelf currently has fewer companies in the development phase than in the exploration phase.

The trend in the development phase is towards more companies and greater diversity. We are now seeing the results of the restructuring of exploration policy carried out around the new millennium. Today we have a great diversity of companies with projects undergoing development or in the late planning stages, cf. Figure 2.22. Operatorship of new, independent developments is divided among eight different operating companies. The largest development projects often demand the most from the operating company. Statoil operates the most satellite developments, which is a natural result of the fact that Statoil is the operator of many of the major fields currently in operation. There are also gains to be extracted in the development and operations phases by operating both satellite and host field. Five of the operators of fields under development or in the planning phase are newly established companies on the shelf since 2000. Six of the 14 companies that have projects under development or in the late planning stages are currently field operators today, while eight are new field operators in Norway.

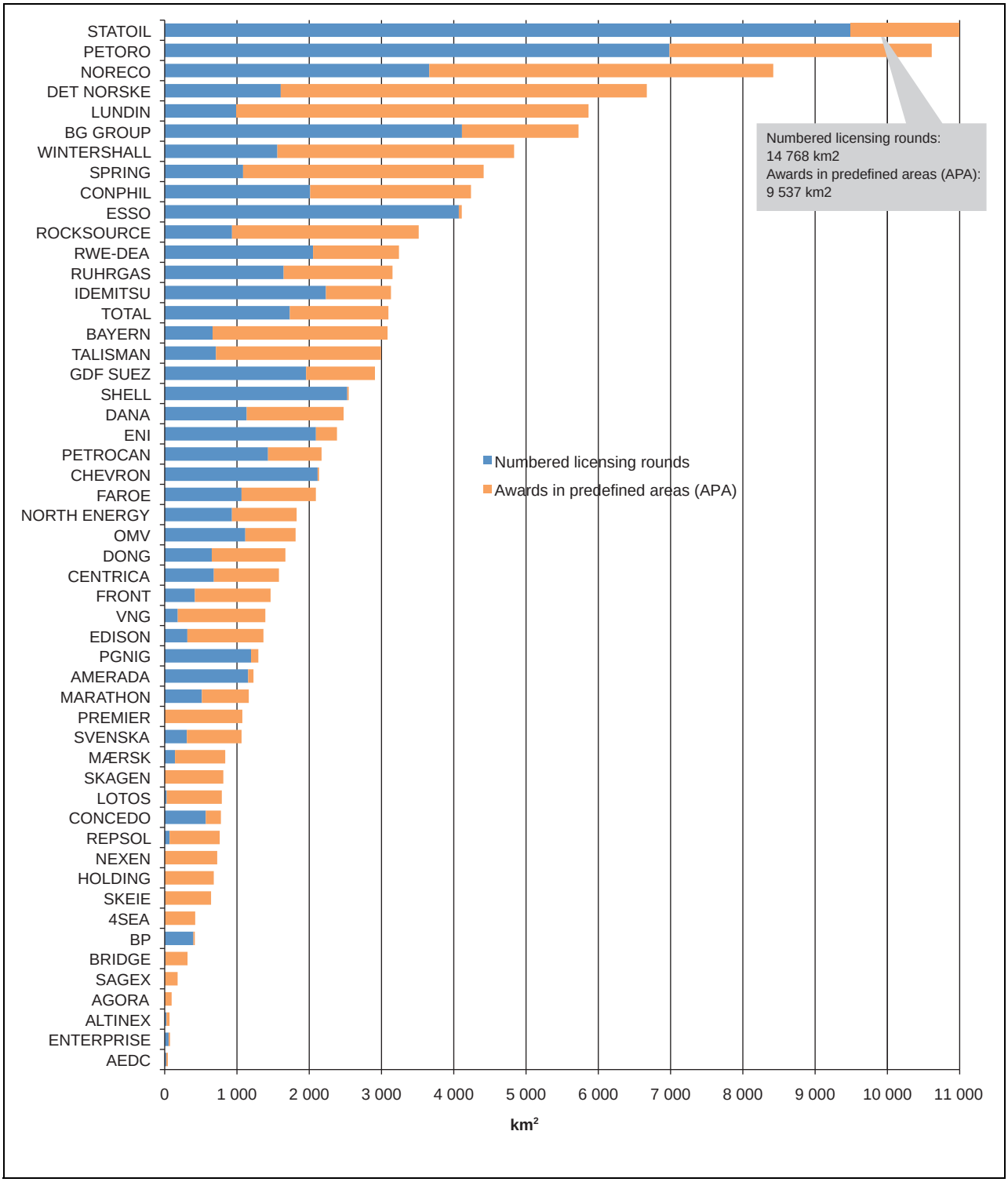

Figure 2.21 Licensed area as of 1 May 2011, awarded after 2000.

Source: Norwegian Petroleum Directorate.

2.5.3 The operations phase

The operator has a special responsibility for developing the individual field. At the same time, the other licensees have a special duty, e.g. under the statutory supervisory duty, to follow up the operator and contribute their expertise to ensure optimal development and production of the fields, and to ensure that the activities are carried out in a prudent manner. The fact that the partners actively contribute in the licensee groups is an

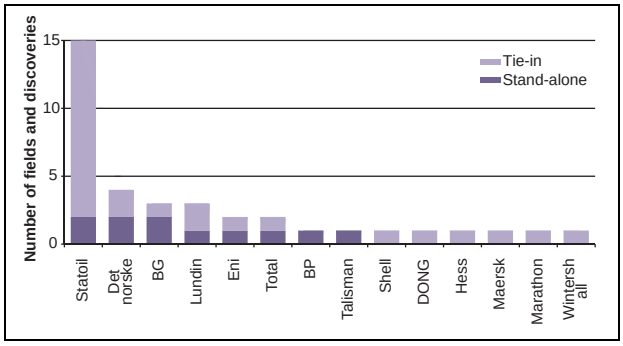

Figure 2.22 Operatorship of discoveries under development or in the late planning stages as of 2010.

Source: Norwegian Petroleum Directorate.

important part of the contract they have entered into through the production license.

Ownership of the reserves on the shelf is distributed across a broad range of companies, cf. Figure 2.23. As regards oil, Statoil and SDFI account for about one-half of the ownership, with 30 per cent and 21 per cent, respectively. They are followed by the major international oil companies Total, ExxonMobil, ConocoPhillips, Eni and BP, each of which own somewhere between four and ten per cent. Overall, this group owns more than a third of the oil reserves. The last group comprises about 30 different companies which together hold 13 per cent of the oil reserves.

Ownership of the gas reserves is somewhat more concentrated, but follows the same general pattern as for the oil resources. SDFI represents 40 per cent of the ownership of gas reserves, while Statoil owns 35 per cent. A group of major international oil companies comprising Shell, Total, ExxonMobil, ConocoPhillips, GDF Suez and Eni each own more than one per cent, and together they own 20 per cent of the gas reserves. The remaining gas reserves are owned by a group comprising more than 20 companies which together own a total of five per cent.

Statoil is currently the largest operator of producing fields on the Norwegian Shelf, cf. Figure 2.24. This is a consequence of the fact that the company was awarded a number of operatorships in the early years of the petroleum activity, including many of the major fields on the shelf. At the same time, Statoil has worked diligently to explore adjacent areas and to mature resources. This has contributed to many new field developments in recent years, particularly as regards satellite fields.

Statoil is a key player in the operations phase, although the number of operatorships alone does not provide the complete picture. There is a substantial difference between operating a small subsea tie-in and, e.g. a large field with many facilities, such as Ekofisk. Relatively speaking, ConocoPhillips has few field operatorships, but is the leading company when it comes to developing the southern part of the North Sea through its role in the Ekofisk area. Various operating companies have key tasks in different areas of the shelf. As mentioned, ConocoPhillips is the leading company in the south, while BP and Talisman also hold operatorships in the area. Marathon, Statoil and ExxonMobil operate fields in the central part of the North Sea, while Statoil plays a dominant role in the northern part of the North Sea. Shell has important operatorships on Ormen Lange and Draugen in the Norwegian Sea. Statoil operates many fields in the Norwegian Sea, while Eni and

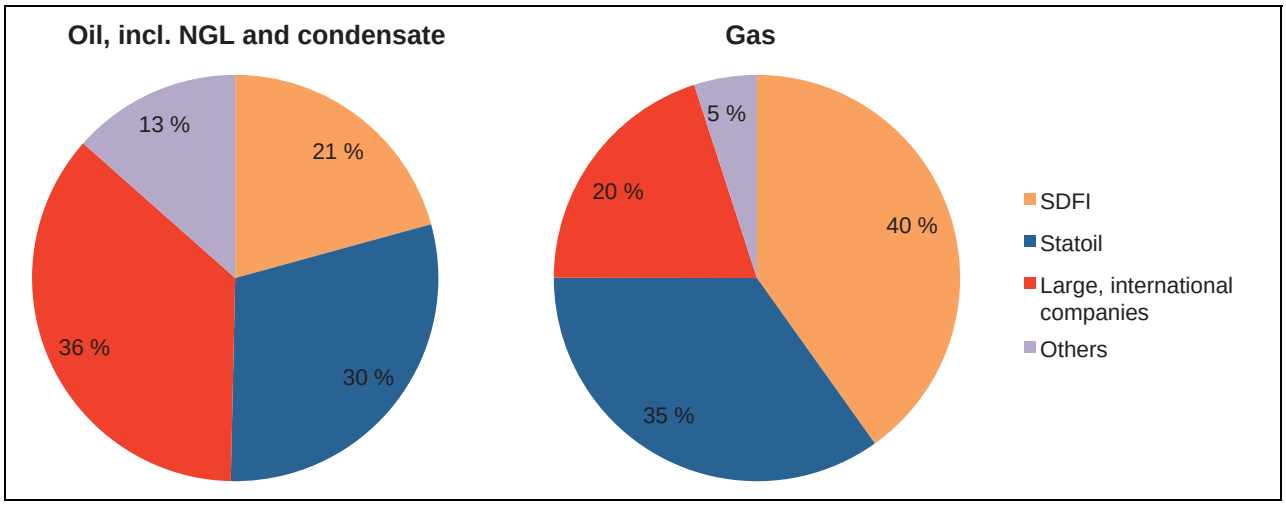

Figure 2.23 Ownership of the petroleum reserves divided by liquid and gas as of 31 December 2010.

Source: Norwegian Petroleum Directorate.

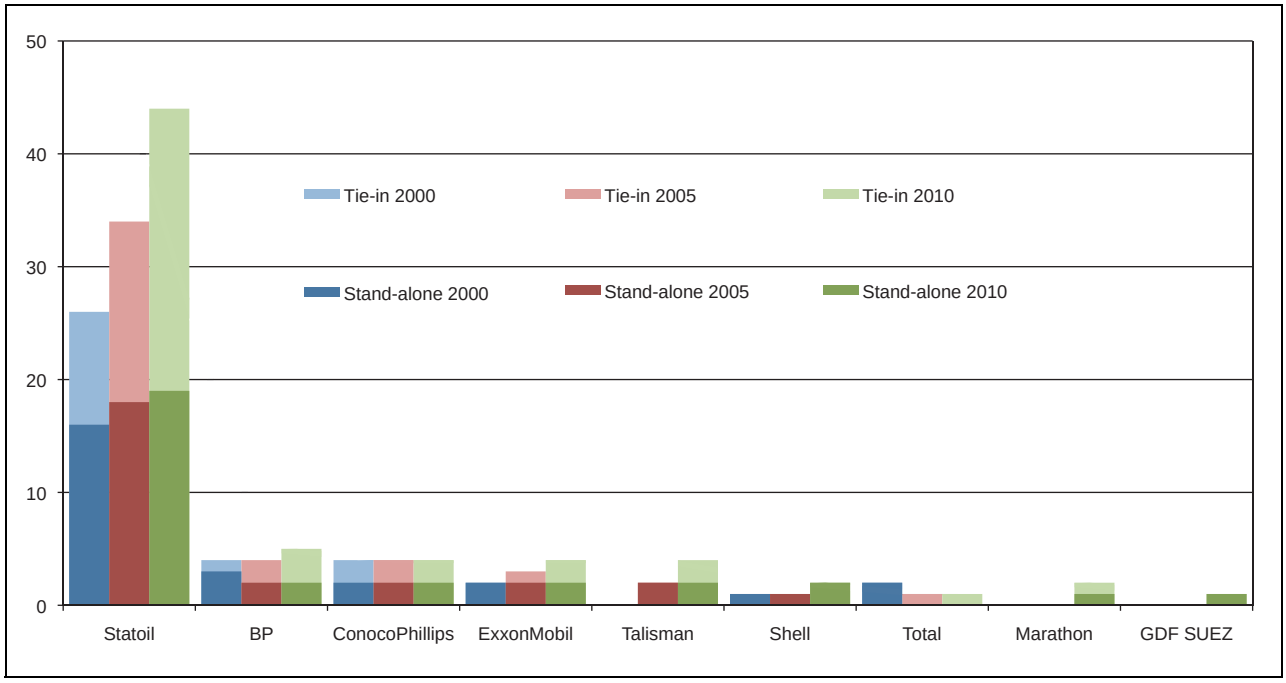

Figure 2.24 Operatorship of fields in operation as of 1 January 2000, 2005 and 2010. Mergers have been taken into account, e.g. the fields operated by Hydro in 2000 and 2005 are shown in the figure as Statoil.

Source: Norwegian Petroleum Directorate.

BP also operate fields in the area. In the Barents Sea, Statoil is the operator for Snøhvit, while Eni is the operator for Goliat.

The Norwegian Shelf depends on ensuring that large, competent companies also see attractive business opportunities within the petroleum activities here. These companies have the financial strength to explore relatively unknown areas, to develop new technology and to initiate and implement large and demanding developments. This is necessary if we are to realise the potential on the Norwegian Shelf.

Companies with strong operator and ownership interests in field clusters are responsible for, and benefit from, triggering economies of scale. Cost-efficient operation and development is a precondition for realising the potential in mature parts of the Norwegian Shelf. Most of the projects in mature areas are small and must be tied in to existing infrastructure. Rapid project progress and standardised development solutions will often be needed to ensure profitability in such projects.

A joint operator of multiple fields facing the same challenges can make it easier to realise projects that require cooperation across several production licenses. A large operator also streamlines transfer of experience between fields. Such a structure is also a good way to make sure that lessons learned on one field also benefit other fields.

A large operator is well-served by maintaining competitive supply communities, which helps ensure good, reasonable and secure deliveries over the longer term. The supply industry also benefits from competition. Today, the Norwegian supply industry is among the best in the world. It has developed this position in part by succeeding in tough competition both in Norway and internationally.

The merger of Statoil and Hydro's petroleum division meant that two strong groups were gathered in a single company. In its work on the report "Structural changes in the petroleum activities" in 2009, the Ministry laid the foundation for monitoring the consequences of the merger on the structure of the Norwegian petroleum industry, including how it would affect diversity among oil companies, suppliers and research communities.

Conducting this type of analysis is methodically demanding; and particularly demanding for an industry and a sector that has undergone major changes that are not related to the event one wishes to measure the effect of. To be relevant, such an analysis must be able to isolate the effects of factors such as the financial crisis, structural changes in the industry and fluctuations in oil and gas prices. The Ministry will consider whether it would be appropriate to conduct a new review of the effects of the merger.

The Ministry has no basis for saying that a consolidation of operatorships, such as the merger between Statoil and Hydro, has contributed to undermining performance of the operator's role on the affected fields. However, these two companies both possessed unique depth, scope and expertise concerning the Norwegian Shelf, which both companies actively used to challenge each other. These two groups are now joined in a single company. Therefore, in certain partnerships, the merger has created a gap which the other licensees must fill. There is great diversity among the licensees on the shelf. The fact that different companies make independent assessments and challenge the operator in the respective production license is positive for resource exploitation. Ownership in fields reflects the companies' financial exposure, and through the partnership, all licensees must contribute to good resource management, including good field operations. The Ministry has a clear expectation that licensees must make active contributions in their respective licenses, and intends to reinforce its efforts to ensure that this role is fulfilled.

Today's structure for operating fields, with a number of licensees who are to contribute to challenge and drive the operator forward, combined with areas that have the same operator for several key fields, has many good qualities. This applies both to generating and implementing good ideas, as well as to extracting the benefits of cooperation and economies of scale between different fields.

2.5.4 The supply industry

From its modest beginning about 40 years ago, Norway has succeeded in developing a competitive petroleum-related supply industry. Today, this is a huge industry. Companies deliver advanced technological products and services to domestic and international markets. The industry consists of a significant number of large, medium-sized and small companies located in all of the nation's counties. The supply industry is very dynamic. The individual companies position themselves through internal reorganisations, mergers and acquisitions. The supply industry has always had a substantial element of foreign ownership.

The oil and gas value chain can be roughly divided between exploration, development, operations/modifications and removal. There are market segments in each of these categories where the Norwegian supply industry occupies good positions. For example, exploration includes seismic surveys and drilling, which is a huge market for shipowners and companies that acquire and interpret geological data. Field development includes engineering, construction of platforms and facilities, as well as installation work. Operations include activities such as drilling and well services as well as operations and maintenance tasks, and sometimes also major modifications.

A consolidation has taken place in the supply industry within field development. Several competing environments in Norway are important to ensure that companies located in Norway can succeed in the competition for such assignments. With the acquisition of Kværner, Aker Solutions ASA became the largest Norwegian main contractor for turnkey field development contracts. It has been decided that large parts of Aker Solutions ASA's field development activity shall be split off as a separate listed company, Kværner ASA, from the summer of 2011. Aibel can also carry out relatively large development projects, and has a well-developed supply chain for implementing such development projects. There are also other suppliers with the capacity to be main contractors, but these companies normally pursue smaller or medium-sized projects, or enter into an alliance with others. Examples of such field development suppliers include Bergen Group, Grenland Group, Apply Group, Reinertsen, Fabricom and Nymo.

The operations and maintenance market is central in the production phase. Here the oil companies need a wide variety of deliveries, and here too, the main contractors are important players. With a growing number of fields in production and many fields in a mature phase with declining production, this has become a large market. Several suppliers have achieved a direct customer relationship with the oil companies through smaller and more specialised framework agreements. The operations and maintenance segment has the most supplier companies, as well as the highest rate of new establishments.

The level under the main contractors is often referred to as the system suppliers. These companies deliver major components that require engineering and integration of various components. Examples of system suppliers include FMC Technologies, Aker Subsea Production Systems and GE Oil&Gas, which are world leaders in delivery of subsea production systems. Other system suppliers include Kongsberg Maritime (control systems), Bjørge (system solutions for valves) and Dresser Rand (generator and compressor packages). These companies often purchase individual components from subcontractors and assemble the components in "product packages" or sys-

tems. These deliveries include more than a physical product; they also often include multiple service components, such as training in the use of equipment, installation and testing.

The major suppliers benefit from internal sub-deliveries, but also make use of tailor-made deliveries from external sub-suppliers. Several hundred companies can be part of a supply chain. For example, FMC Kongsberg and National Oil Well Varco have more than 1000 sub-suppliers.

A prominent feature of the supply industry is that the supply chains have become more international. In many cases, both fabrication and engineering are performed outside Norway in order to exploit the individual companies' special expertise, increase own capacity and reduce costs. This places new demands on project management and handling of commercial risk.

2.6 Opportunities in the various parts of the continental shelf

The overall picture of the Norwegian Shelf is more complex than ever. Opportunities and challenges vary between the areas on the continental shelf. This Chapter provides a review of some development trends, challenges and opportunities for the various parts of the Norwegian Shelf.

2.6.1 The southern part of the North Sea

Current production and future opportunities in the southern part of the North Sea are linked to the chalk reservoirs in the area. A common feature here is that it takes a long time to produce the oil and gas. Ekofisk came on stream in 1971 as the first field on the Norwegian Continental Shelf, and still has a long remaining lifetime. The area is a mature petroleum province with limited undiscovered resources. There is little likelihood of mak-

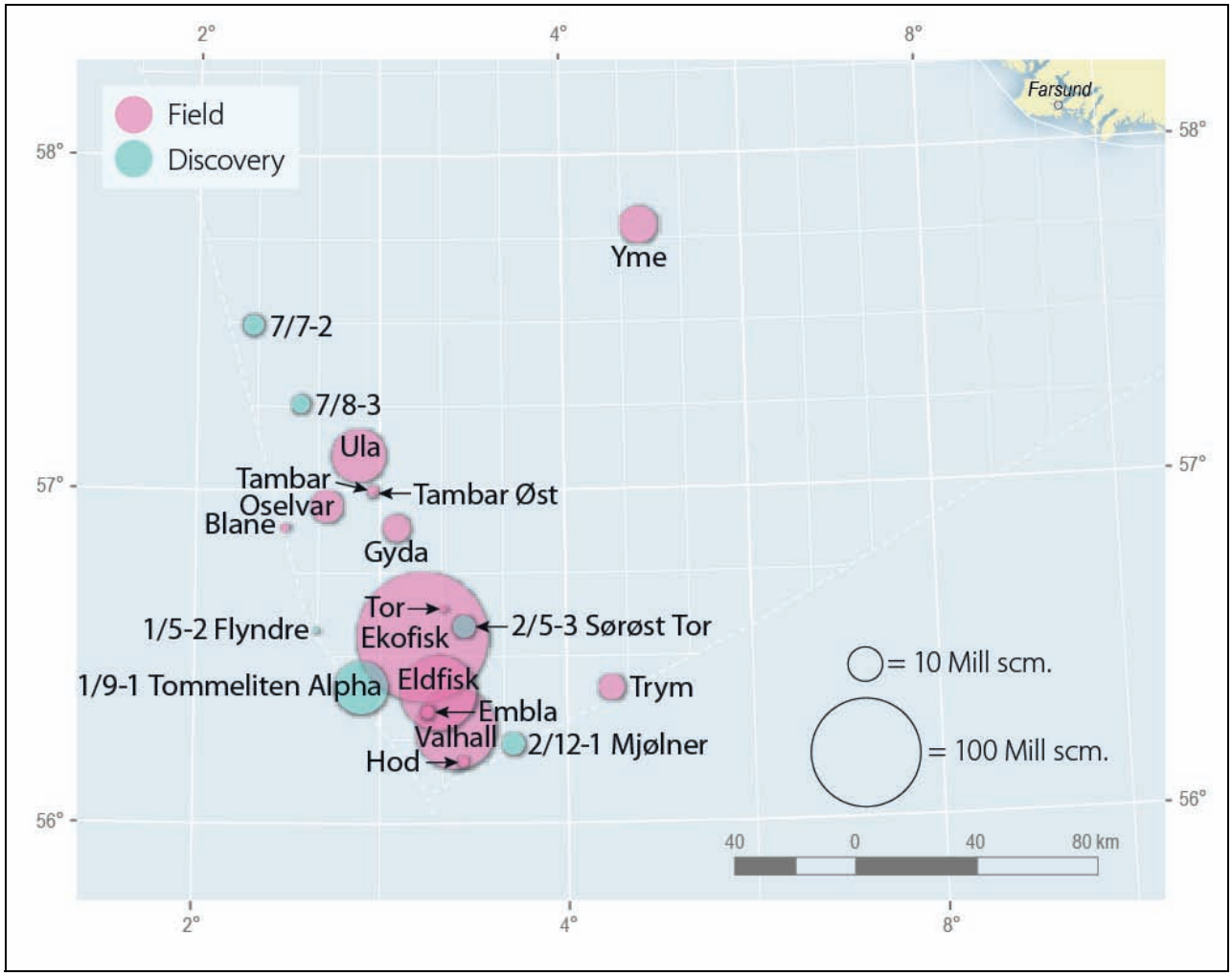

Figure 2.25 Fields and discoveries in the southern part of the North Sea. The size of the circle indicates the total remaining resource volume.

Source: Norwegian Petroleum Directorate.

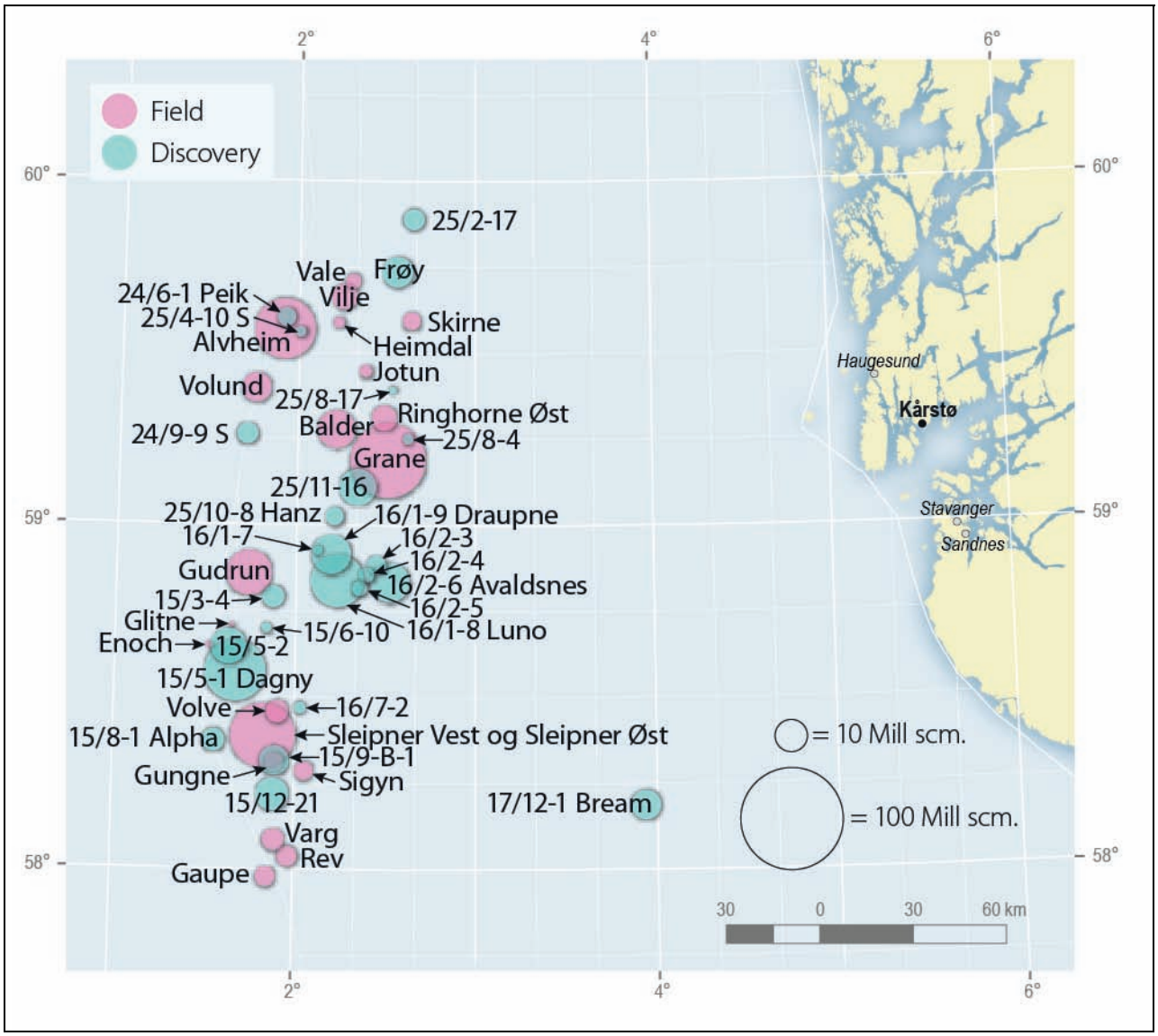

Figure 2.26 Fields and discoveries in the central part of the North Sea. The size of the circle indicates the total remaining resource volume.

Source: Norwegian Petroleum Directorate.

ing major discoveries that could trigger new infrastructure in the area.

The majority of today's production comes from the Ekofisk, Eldfisk, Tor, Valhall and Hod chalk fields. Together, these fields will contain very significant remaining oil volumes after production ceases, according to current plans. There are a number of shut down chalk fields in the area with low recovery rates. There are also discoveries that have not yet been developed. This means that there are substantial remaining proven resources in the area which constitute a potential for continued production and value creation for decades to come. Investments are being made in new facilities both on Valhall and Ekofisk. This will enable operation and production from the area for the next 40 years. Plans for extensive further development of Eldfisk and Ekofisk Sør have recently been approved, which will lead to major investments in the area in the next few years.

Realising all these possibilities will take time. One of the restrictions for development of the area is gas treatment capacity. For some of these projects, it is most expedient to defer development until capacity becomes available in the existing infrastructure, rather than investing in new capacity. Ekofisk is a hub for the petroleum activity in the area, and many fields are tied in to the infrastructure on Ekofisk for further transport in the Norpipe system.

Valhall receives its power supply from land. The cable to the field from Lista has limited capac-

ity other than the needs on Valhall and Hod. Further electrification of the area has been studied on a number of occasions, most recently in Climate Cure 2020 and in connection with the further development of Ekofisk and Eldfisk.

The large chalk fields are currently produced with water injection, in order to maintain pressure and force the oil out. There is a limit to how much of the oil can be extracted using this method. Therefore, implementation of other methods is being considered in the later phases of the fields' lifetimes. Use of these methods on one or more of the large chalk fields could lead to extended operation, and thus more value creation and employment in the area. CO_2 injection is one method that could be relevant over the longer term. However, there are reservoir-related, technical, regulatory and cost challenges associated with these methods. An additional problem as regards CO_2 injection is obtaining enough of the gas out on the field.

There has been a strong focus on the Ula field on improving recovery using alternating water and gas injection (WAG). This has proven successful. Several satellite fields have been tied in to Ula, bringing gas to the field for injection. The field needs even more gas to realise its potential for improved recovery. Such injection is also being considered on the Gyda field. As a consequence, the field will need access to more gas than it currently has.

The overall potential for improved oil recovery in the southern part of the North Sea is substantial. While the greatest potential is found in the large fields, there are also interesting volumes in smaller fields, with Yme being one such example. Yme was shut down in 2001 after producing for six years, due to low oil prices and production problems. There was still recoverable oil left in the field, which in 2006 led the new field owners to decide to redevelop the field. Yme will be the first shut down field on the Norwegian Shelf that is reopened.

2.6.2 The central part of the North Sea

The central part of the North Sea (between 58 and 60 degrees latitude) has a long history of petroleum activity. Balder, which was proven in 1967, was the first oil discovery on the Norwegian Continental Shelf, although it took 30 years before the field was developed. The first development in the area was the Frigg gas field which produced for nearly 30 years before it was shut down in 2004.

Alvheim and Grane are among the largest oil producers on the Norwegian Shelf, and they are expected to continue to produce for many years. Alvheim is produced using water injection. The fields are also potential tie-in hubs for new discoveries in the area. Vilje and Volund, which produce to Alvheim, are examples.

In spite of declining production, Sleipner can maintain good capacity utilisation and achieve extended lifetime as a consequence of discoveries in the area being tied in to the field. This will also help achieve better exploitation of the Kårstø facilities. Development of fields and discoveries such as Gudrun, Sigrun and Dagny are good examples of this. Sleipner is also an important hub for the Norwegian gas transport system, as both the UK market and the Continental market can be reached from here. Sleipner also has facilities designed to reduce the CO_2 content of the gas. For nearly 15 years, the CO_2 extracted from the Sleipner wellstream has been stored under the seabed, yielding important experience and knowledge about such subsurface storage.

Several discoveries have been made in the Heimdal area, although they are too small to release independent developments. The gas in the discoveries must either be tied in to an oil development in the area, or as a subsea solution to Heimdal or to fields on the UK shelf for further processing. The costs associated with maintaining process activity on Heimdal are relatively high. Gassco is considering solutions for the facility that can result in lower operating costs.

The area is characterised by varied geology, with discoveries in many different types of petroleum reservoirs. The Utsira High is another interesting area in the central part of the North Sea, with mainly oil being discovered here. Exploration activity has taken place since 1967 and the geology is well-known. Like the southern part of the North Sea, the likelihood of making very large new discoveries in the Central North Sea is considered to be small. Although the Utsira High is considered to be a mature area, new types of reservoirs have been discovered here in the last five years. A total of 32 exploration and appraisal wells have been drilled in the area, where exploration activity remains at a high level. Plans are in place to drill about 20 exploration and appraisal wells over the next four years. Interesting discoveries have been made, including Luno, Draupne and Avaldsnes.

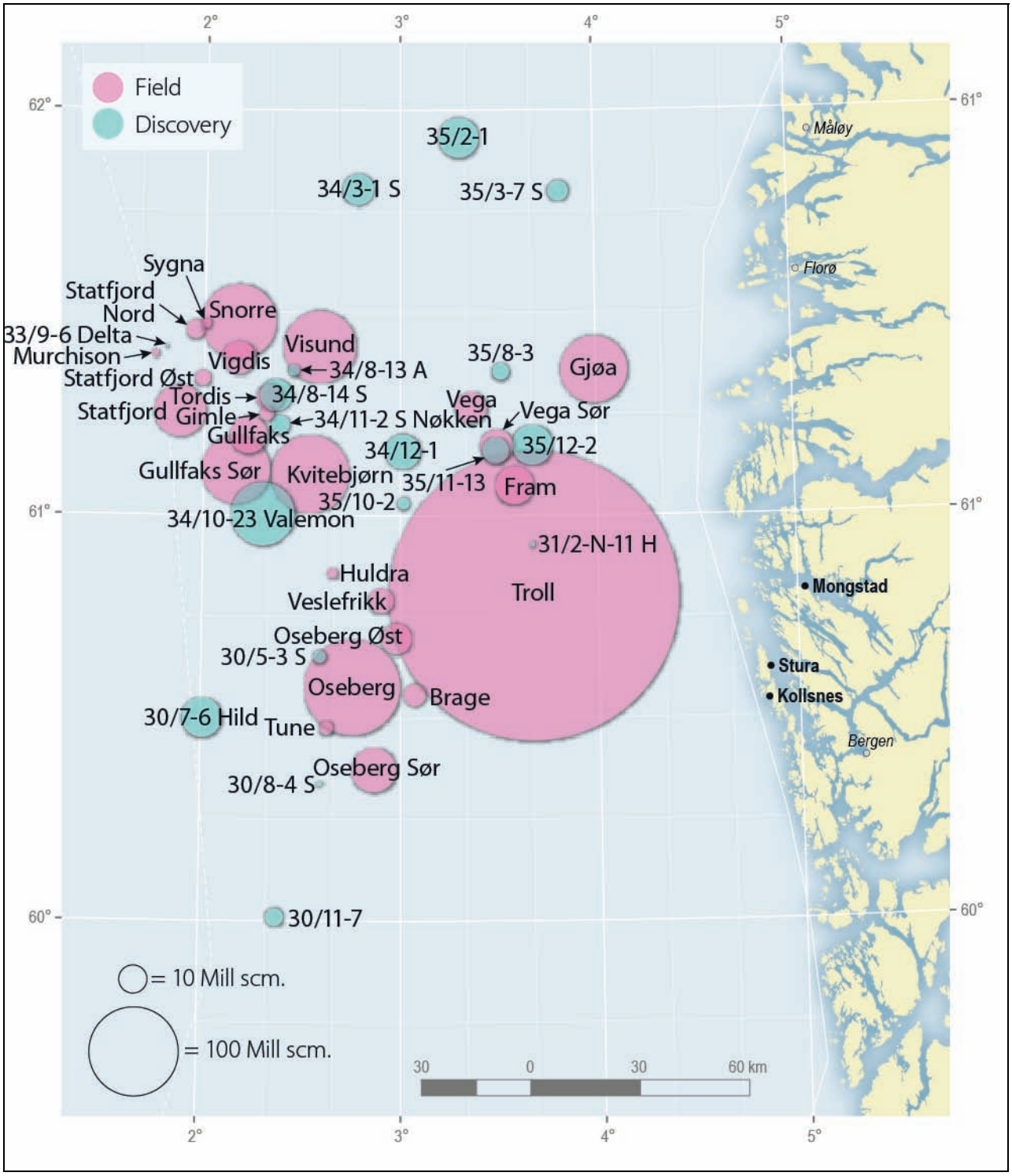

Figure 2.27 Fields and discoveries in the northern part of the North Sea. The size of the circle indicates the total remaining resource volume.

Source: Norwegian Petroleum Directorate.

2.6.3 The northern part of the North Sea

Oil and gas have been produced in the northern part of the North Sea (between 60 – 62 degrees latitude) since the late 1970s. There are significant remaining reserves and resources in the area, both in fields and discoveries. Many late-phase fields combined with aging infrastructure, highlight the importance of making decisions early enough to extract the considerable resource potential in the area. At the same time, it is important that the preconditions of prudent operations

and safe lifetime extension form the basis for such activity.

The northern part of the North Sea consists of two main areas: Tampen and Oseberg/Troll. Oil and gas from the fields in the northern North Sea are transported in part by ship and in part through pipelines to land facilities in Norway and the United Kingdom. Statfjord is now a late-phase field with production of remaining gas being exported to the UK. Troll has a very important function for gas supply from the Norwegian Continental Shelf, and will remain the main source of Norwegian gas exports in the future. Oil production is falling in the Oseberg area, although the fields here will continue to produce for many years. The last development, Gjøa with its satellites, will help maintain production in the area.

Maintaining sufficient flexibility is important in order to safeguard maximum value creation in new discoveries. By considering multiple fields and areas together, one can coordinate solutions so that costs per produced unit are as low as possible. Coordination across fields and production licenses can yield considerable rewards. There is a need to renew and streamline the extensive infrastructure to facilitate resource utilisation and value creation in a long-term perspective. The work being done on the «Snorre 2040» project is important for further development of the Tampen area. Use of existing/new facilities, future oil export solutions, flexible gas export/import solutions, efficient energy solutions and safe lifetime extension are important topics in this work.

A challenge faced by several fields in the area is the ratio between gas extraction and oil production. This is particularly important in the Troll-Oseberg area where more wells are needed. To achieve this, the area's general challenges related to depressurisation in the reservoir must be resolved in a sound manner, and good solutions must be developed to handle the overpressure in the Shetland formation, which complicates the completion of new wells on the Gullfaks field. Ongoing and planned drilling rig upgrade projects, including on Snorre, Gullfaks and Oseberg, are necessary measures. Another issue in the area is injection of gas to recover more oil. This is already applied on several fields and studies indicate that gas injection could be a good solution for even more fields, including fields that do not have their own gas.

2.6.4 The Norwegian Sea

The Norwegian Sea was opened for exploration activity in 1980. The first field to commence production in the area was Draugen in 1993. Draugen is the only facility resting on the seabed in the area. A number of floating installations have since been established, including Åsgard and Norne. Several smaller fields around existing infrastructure have been put into production in recent years.

Today, Haltenbanken and Ormen Lange are mature areas with considerable oil and gas production, along with well-developed infrastructure. There are also areas in the Norwegian Sea that have not yet been developed or even opened up for exploration activity. Oil production from the major fields in the area is declining. The gas export capacity from Haltenbanken, through the Åsgard transport system (ÅTS), is fully utilised for several decades into the future. This could affect the timing for phase-in of new discoveries on Haltenbanken. The timing for production of gas that up to now has been used as pressure support for oil production will affect how long the current capacity is fully utilised. Gas injection has been used for the Åsgard fields, and will continue to be a key factor in maintaining reservoir pressure and oil production.

It has been proven that the Norwegian Sea contains a lot of gas. Produced gas from the fields is transported in the ÅTS pipeline to Kårstø in Rogaland, and in Haltenpipe to Tjeldbergodden in Møre og Romsdal. The gas from Ormen Lange runs in a pipeline to Nyhamna, and from there on to the United Kingdom. The CO_2 content of the gas produced from several of these fields is relatively high, which is also the case for several of the discoveries in the area. Gas from these fields is therefore blended with other gas with lower CO_2 content to achieve compliance with gas quality requirements. This blending takes place from fields both in the Norwegian Sea and from fields located further south. This creates interdependence between the fields in the Norwegian Sea, and affects how the individual fields are produced.

Two fields are being developed: Marulk, which will be tied in to Norne, and Skarv, which is being developed with its own process facility. Work is underway on a further development of Ormen Lange. The Vøring area in the Norwegian Sea is currently an area without infrastructure. Several gas discoveries have been made in the area. The planned development of Luva could create a foundation for further exploration activity

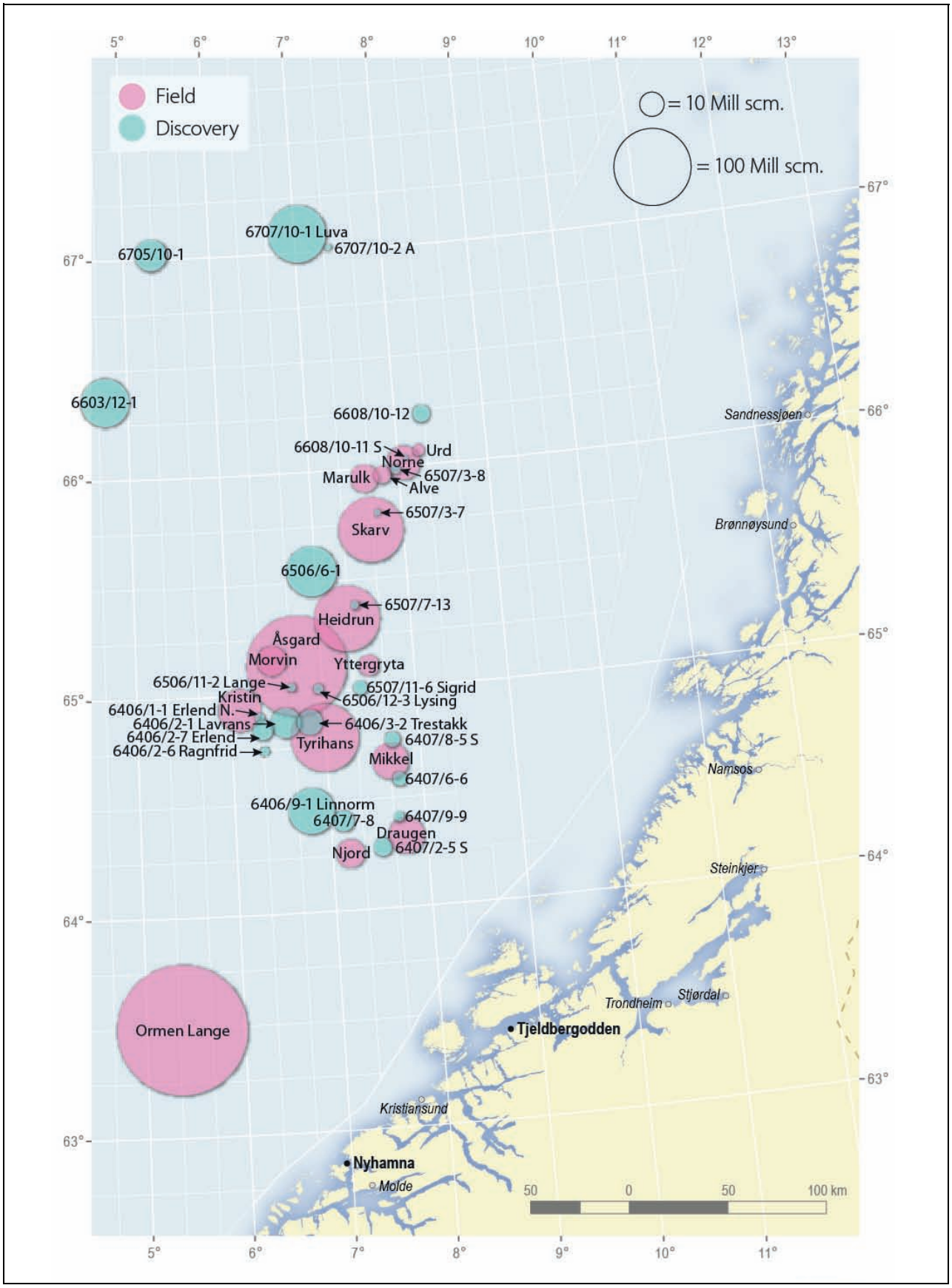

Figure 2.28 Fields and discoveries in the Norwegian Sea. The size of the circle indicates total remaining resource volume.

Source: Norwegian Petroleum Directorate.

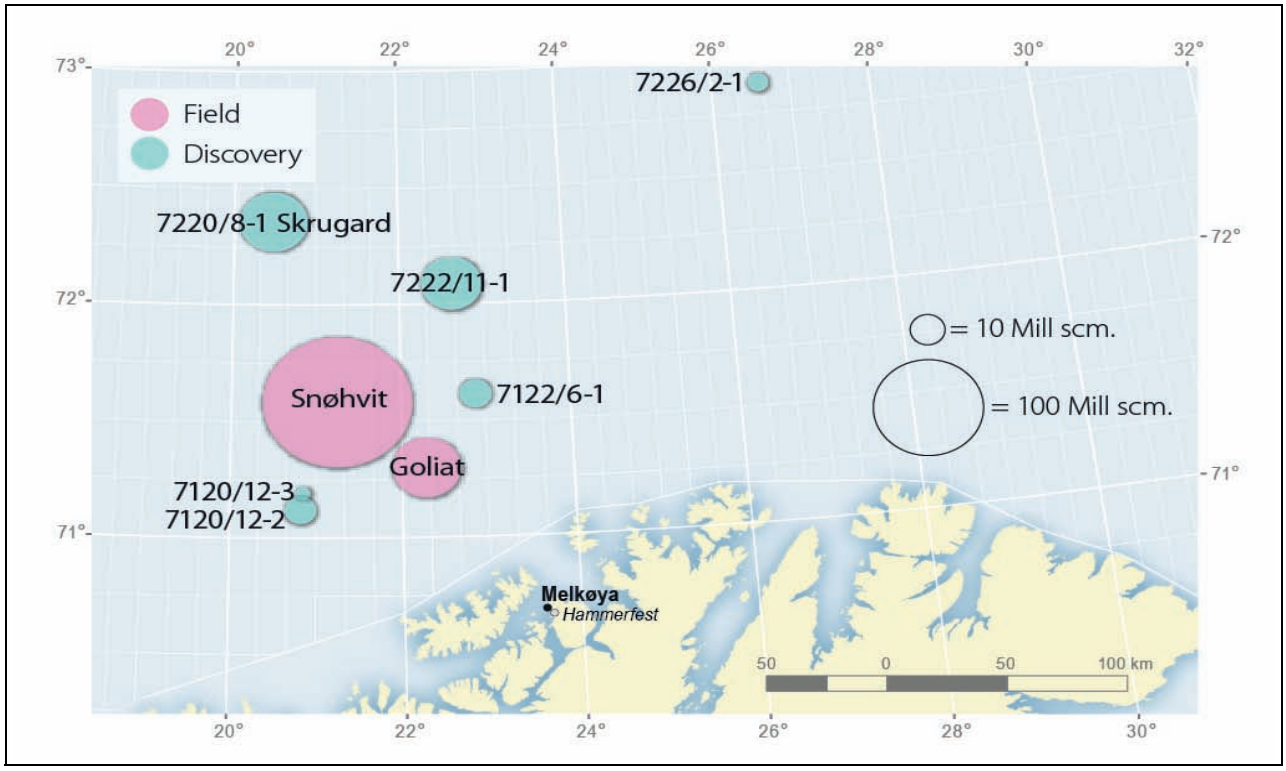

Figure 2.29 Fields and discoveries in the Barents Sea. The size of the circle indicates the total remaining resource volume.

Source: Norwegian Petroleum Directorate.

and new developments in the area. The operator's plan calls for gas from the discoveries to be transported to Nyhamna where the gas from Ormen Lange is already processed.

2.6.5 The Barents Sea

The Barents Sea is currently the least explored part of the Norwegian Continental Shelf. Together with the deep-water areas in the Norwegian Sea, the Barents Sea is considered to be the area with the greatest probability of making large new discoveries. Eleven exploration wells are planned in the Barents Sea in 2011.

The first exploration well in the Norwegian sector of the Barents Sea was drilled in 1980, and Askeladd, the first gas discovery, was made the following year. Snøhvit started production in 2007 and is produced via the LNG facility at Melkøya. This development includes the Snøhvit, Albatross and Askeladd gas discoveries.

The Goliat oil field was proven in 2000 and development and operation was approved by the authorities in 2009. The plan calls for reinjecting the gas from Goliat, but gas export solutions are also being studied. Based on Goliat's gas evacuation needs, Gassco has initiated an area study with the objective of mapping future needs and gas transport alternatives from the area. The study will cover both gas export by pipeline and ship, as well as domestic use of gas from the area.

In the spring of 2011, Statoil made a significant oil discovery on the Skrugard prospect in the Barents Sea. This discovery is a breakthrough in this unexplored area, and an important exploration event for the Norwegian Shelf and the Barents Sea. The discovery is located about 100 kilometres north of the Snøhvit field, and the resource estimate is so positive that it could release a new independent development. This discovery opens up new opportunities for further activity in the Barents Sea.

Box 2.2 The land facilities

Kårstø – larger gas volumes are needed by 2020

The gas processing facility at Kårstø is a central facility for processing gas volumes from the North Sea and the Norwegian Sea. Estimates for the gas processing plant at Kårstø show a significantly reduced supply of gas feed from 2020. These forecasts are based on the gas producers' reported capacity needs at the facility.

The Kårstø facility is densely integrated, with dependencies that entail that any reduction of capacity will force the newest parts of the facility to close first. This means that maintenance and other work to ensure the robustness of the oldest parts of the plant will still be needed when the plant's capacity is adjusted downward. As the petrochemical industry in the Grenland area uses ethane from Kårstø as one of its most important raw materials, the future of this industry will be linked to the future feed situation at Kårstø.

Kollsnes – will maintain two-thirds capacity utilisation until 2030

Natural gas from the Troll, Kvitebjørn, Visund and Fram fields will be delivered to the gas processing facility at Kollsnes. Nearly 40 per cent of all Norwegian gas exports run through this facility, which has a total capacity of 143 million Sm^3 dry gas to Europe per day. Gas from Kollsnes is also an important blending gas due to its low CO_2 content. The feed gas supply to Kollsnes will be reduced as we move towards 2020. Capacity utilisation of about two-thirds can be maintained until 2030, even if new discoveries are not tied in to the gas processing plant.

The Kollsnes facility has been constructed with six independent gas processing lines which enable stepwise downscaling when it becomes necessary to reduce the processing capacity at the facility.

Nyhamna – needs new access to natural gas from the Norwegian Sea

The Ormen Lange field delivers natural gas to Nyhamna, and about 70 million Sm^3 of dry gas is processed per day. This gas is mainly exported to the UK. With failing decisions to develop ongoing maturing fields in the Norwegian Sea (such as Luva and Linnorm) with tie-in to Nyhamna, capacity exploitation will experience a significant drop around 2020. The gas processing facility was built for the Ormen Lange field, and will be forced to close if new fields are not tied in to Nyhamna during the field's lifetime.

Tjeldbergodden – Heidrun's gas injection needs are important

Tjeldbergodden receives gas from the Heidrun field via Haltenpipe. The gas volumes in Haltenpipe go exclusively to industrial use at Tjeldbergodden. Today, Tjeldbergodden utilises less than one-third of the available gas capacity in Haltenpipe, but there are several other fields that could potentially deliver gas via this pipeline, given reasonable facilitation. Heidrun can deliver gas to Tjeldbergodden for quite a long time, but the need for gas injection on the field could limit gas extraction, and thus also potential gas transport to Tjeldbergodden.

3 Oil and gas prices support profitable activity

Oil and gas prices are key elements in the effort to achieve our petroleum policy goals. The sales value of oil and gas forms the foundation and determines the level of value creation and state revenues from the industry. This Chapter provides a review of the outlook for the oil and gas markets.

The world will need more energy in the future. Economic growth and improved standards of living, population growth and increased urbanisation, along with energy and environmental policy, will drive the development in energy consumption. This growth will be particularly significant in emerging economies and in developing countries where energy consumption per capita is low and energy poverty is extensive.

Not only does the world need more energy, it needs cleaner energy. Fossil energy sources currently make up 80 per cent of total energy access and will continue to supply most of the energy need for decades to come. In many countries, the transition in energy supply from carbon-intensive coal to cleaner gas can yield substantial greenhouse gas reductions. The world faces a sobering challenge in obtaining both more and cleaner energy. Development in energy consumption will be affected by many factors, including both global and regional climate policy.

Energy security will also be an important objective in energy policy, in addition to more and cleaner energy. Producer and consumer nations share a common interest in reliable energy supply. Efficient and well-functioning oil and gas markets, along with good energy dialogues between producer and consumer nations, are important factors in achieving this objective.

Reliable access to energy is a key factor in the development of the world economy, and is closely connected to national prosperity and development. Access to energy can free up labour currently used on low-productive manual labour, resulting in increased production, higher wages and less physically demanding work situations. Large parts of the world's population consume very little energy. 1.5 billion people are without access to electricity. Improved access to modern forms of energy is needed in order to lift these people out of poverty. The time currently spent gathering fuel can be used for other purposes. The time, energy and resources can instead be devoted to producing, obtaining and preparing food. Light will facilitate better education.

3.1 The oil market

3.1.1 Development trends

Oil market developments are affected by a number of different factors: economic growth, energy and environmental policy, geopolitical factors and developments in the Middle East, technological development, changes in consumer behavior, etc. The market is in constant development, and the factors driving this development may change over time. Some development trends can be noted if we look at the oil market over the last five years:

High, rising and fluctuating oil prices

The average price during the last five-year period is 70 USD per barrel, while the price in the 1990s was less than 20 USD per barrel, cf. Figure 3.1. While prices have generally been higher, abnormally large fluctuations have also occurred. During this period, the price of oil has varied from 30 to 140 USD per barrel.

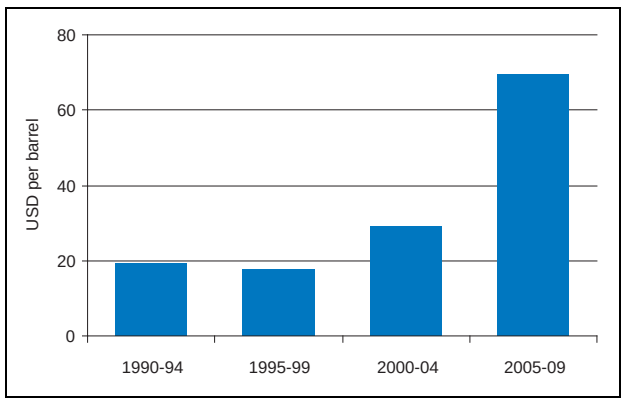

Figure 3.1 Oil price, 5-year average.

Source: PIRA.

OPEC has played an important role in price trends

Ever since it was established 50 years ago, OPEC has attempted to influence the price of oil. From the year 2000, OPEC sought to maintain the price within a price band of 22–28 USD per year, but abandoned this effort in 2005. OPEC has not had an official price target since that time, but in practice has tried to maintain an oil price of 70–90 USD per barrel.

Importance of financial markets

The financial markets have become more important for price formation. Trading in futures and other financial instruments has grown considerably in recent years, both on the regulated commodity exchanges and in the OTC[1] markets. To an increasing degree, we see capital being placed in oil for purely financial investment purposes. This development has impacted price formation in the market. Oil is priced in US dollars in the international market. We note that the price of oil is more strongly correlated with the dollar exchange rate and share indices, and that financial market trends have a greater impact on short-term development in crude oil prices than was the case previously.

Growth outside OECD

The growth in demand has come exclusively from developing countries and emerging economies, with China being particularly important in this respect.

Higher production costs

The cost of producing oil has risen sharply, nearly doubling over the last five years. The financial crisis in 2008 contributed to a temporary drop in costs, with the rising trend resuming in 2010. The cost increase is related in part to the fact that remaining resources are gradually becoming technologically more difficult to recover. However, the higher costs are also linked to the high level of activity in the international petroleum industry and rising prices for input factors in the oil and gas activity.

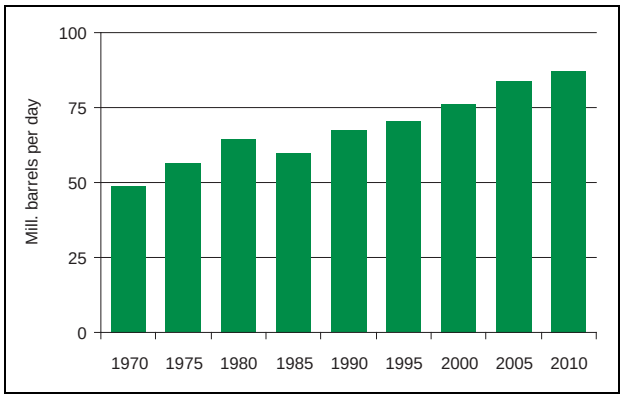

Figure 3.2 Historical oil consumption.

Source: PIRA.

3.1.2 Demand

Oil has been one of the most important commodities in the world economy for a very long time. Demand for oil has grown steadily in recent decades, driven in particular by higher global production, population growth, increased transport activity and urbanisation.

Periods of declining demand have also been experienced, such as in the early 1980s when the real price of crude oil skyrocketed over a short period of time. The financial crisis in 2008–2009 caused a sharp drop in the demand for oil, while demand grew again in 2010.

Consumption of oil will most likely continue to grow, both over the short and longer terms. Growth in oil use could be particularly evident in emerging economies and in the transport sector. There is a need for oil in China, India and other emerging economies where oil consumption per capita is a mere fraction of the consumption in the

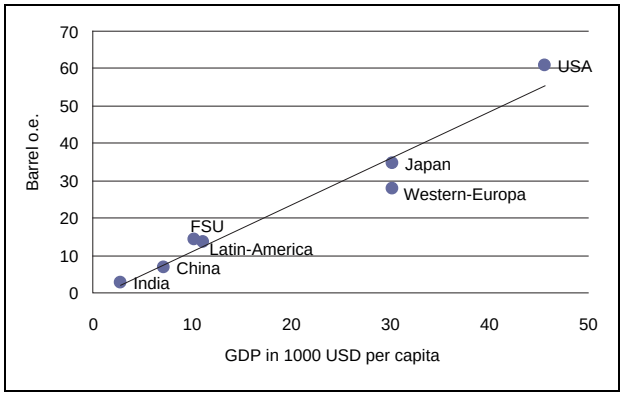

Figure 3.3 Oil consumption and gross domestic product per capita.

Source: PIRA.

[1] OTC – over the counter, direct trade between two parties outside the exchange/marketplace.

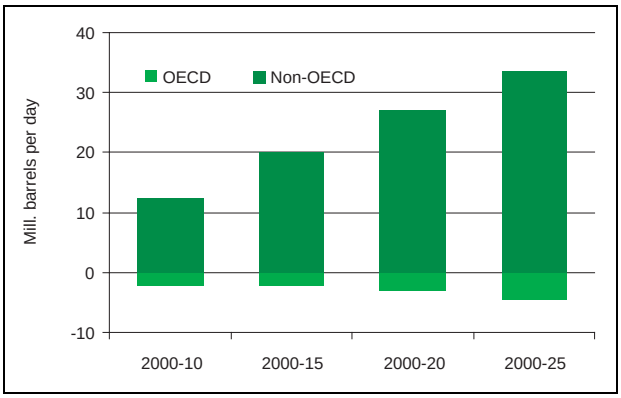

Figure 3.4 Cumulative growth in oil demand (basis year 2000).

Source: PIRA.

OECD countries cf. Figure 3.3. Both total value creation and per capita income are growing rapidly in these countries. In addition to higher energy consumption, higher income levels are often accompanied by a transition from traditional energy forms such as biomass to «modern» energy forms such as electricity and oil products.

Oil consumption may have already peaked in the traditional OECD area. Current consumption is about ten per cent lower than five years ago. This is due in part to the economic downturn in 2008–2009. In the years to come, oil consumption will most likely be further curtailed as a consequence of measures initiated to reduce CO_2 emissions and promote renewable fuels. This is particularly the case e.g. in the US and in the EU countries.

Analyses from sources such as the IEA and the consultant firm PIRA indicate that all growth in oil demand over the next 10–20 years will come from developing countries and emerging economies cf. Figure 3.4.

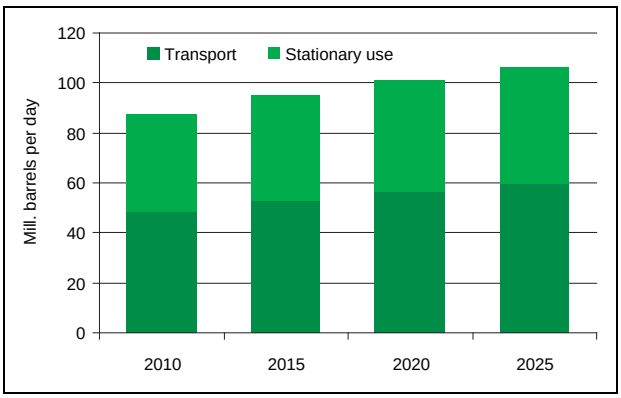

Figure 3.5 Demand trends distributed by area of application.

Source: PIRA.

Growth in consumption will vary widely, depending on use. The transport sector is the most important element for the oil market. More than half of all oil consumption takes place in this sector, and oil accounts for nearly all the energy used there. There is reason to expect that most of the energy consumption in the transport sector will still be from oil-based fuels for quite a long time. Other oil consumption includes stationary applications such as power generation, the petrochemical industry and oil for heating purposes, cf. Figure 3.5.

At the same time, other energy sources such as biofuels and electricity may gain greater acceptance in the transport sector, driven by energy security, climate and environmental considerations. Both the EU and the US have targets for greater use of biofuels, primarily in road transport which accounts for most of the energy consumed in the transport sector. There are also expectations for increased use of electricity in the transport sector through the development of more efficient batteries in automobiles and plug-in hybrid cars. Replacing the automobile fleet will take time, which will in turn affect the timing for when new technologies can result in reduced oil consumption.

Demand for oil may increase by as much as one million barrels per day annually, reaching 100 million barrels per day in 2020, cf. Figure 3.5. Large, new oil resources must be developed; not just to meet the expected growth in demand, but also to replace declining production from existing fields. According to IEA estimates, production from fields that are currently on stream could fall by nearly three-quarters over the next 25 years. This is equivalent to an annual production loss of 2 million barrels per day, or nearly Norway's entire oil production.

3.1.3 Supply

Whether or not global oil resources are sufficient to meet the increased need for oil in the future has been a recurring question. Estimates of the world's oil resources are uncertain, and it is impossible to accurately predict the size of the oil resources, or how much of these resources can actually be produced, based on technical and economic factors. This will also depend on factors such as oil price development, as higher prices will mean that more resources will be economically interesting.

A pessimistic resource assessment points out that, for more than 30 years, oil consumption has

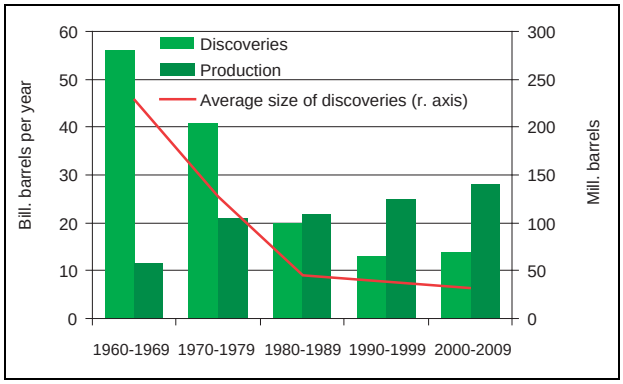

Figure 3.6 Oil discoveries and oil production.

Source: IEA, WEO 2010.

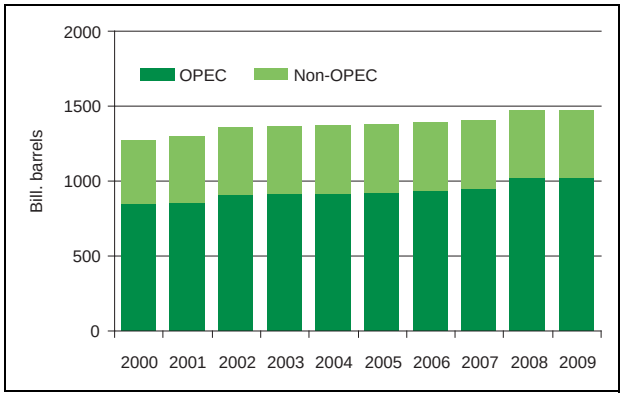

Figure 3.8 Proven global oil reserves.

Source: BP.

been greater than the growth in reserves through exploration, cf. Figure 3.6. However, this could partly be due to the fact that there has been little exploration in parts of the world, for a number of different reasons. This is true, for example, in the Middle East, in spite of the fact that the region holds a significant potential for new discoveries.

Remaining reserves have grown, in spite of the fact that oil consumption has been greater than the volume of resources proven through exploration. This is due to more efficient production methods resulting in higher recovery rates. Remaining proven reserves are estimated at nearly 1500 billion barrels, which is more than all of the oil that has been produced to date. With the current withdrawal rate, the oil will last for more than 40 years. The world's total recoverable oil volumes could be more than 6000 billion barrels, according to estimates from sources such as the IEA.

A more pressing question than the size of world oil resources is whether the oil producers will be able to increase production in step with the growth in demand, and what oil price level will be needed to achieve this. Many of the producers outside OPEC are in decline, such as Norway, Mexico and the United Kingdom. As regards the two largest producers, Russia and the US, production is expected to remain stable or increase slightly in the years to come. Significant production growth could occur in Brazil where a number of major oil discoveries have been made in recent years. Canada could also significantly increase production, if it continues to develop its oil sand resources. Estimates indicate that production outside OPEC could rise in the years to come, but not nearly as much as the expected growth in demand.

This means that the OPEC countries will have to meet most of the growth in demand. It is assumed that two-thirds of the world's oil resources are found in OPEC member countries. These countries currently represent about 40 per cent of the oil production, and the resource base in these countries could support considerable production increases above the current level. However, ample access to resources is no guarantee for stable production growth. Several of the resource countries in OPEC have been, or are currently, politically unstable. Historically, the Middle East has been characterised by frequent wars and conflicts, leading to periods of unstable or declining oil production and thus affecting these countries' ability to build up new production capacity. Budget restrictions can also affect the countries' opportunity to develop new capacity, as capital for investments in oil production must compete with the countries' other needs. The extensive unrest in the region this year has lead to a halt in oil exports from Libya and a sharp rise in oil prices.

Iraq is an example of an OPEC country with significant unexploited oil resources. The country has now entered into agreements with the interna-

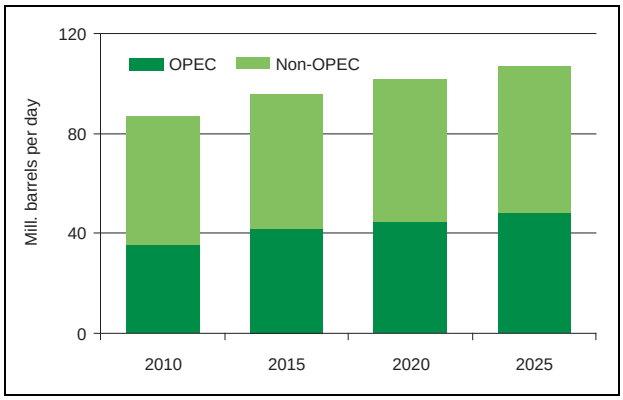

Figure 3.7 Future development in oil supply

Source: PIRA.

tional oil industry that could result in rapidly growing production in the years to come. However, political instability and lack of security in the country could mean that such a development cannot be fully realised.

3.1.4 Oil price

The price of oil is the single most important factor for Norway's petroleum activity. The price of oil has exhibited considerable historical variation from year to year, and issuing accurate price development forecasts has proven to be difficult.

In 2010, the spot price for oil was in the range of 70–90 USD per barrel (Brent Blend), which is a relatively high level in a historical perspective. Prices have risen steadily in 2011 to more than 120 USD per barrel, on the background of unrest and diminished oil deliveries from Northern Africa and the Middle East. The development in this region now represents a considerable element of uncertainty for the oil market. A normalisation of the situation could lead to a drop in oil prices, while there is also the chance that the unrest could spread, which could lead to even higher prices.

There are many factors in the market that could contribute to maintaining high oil prices in the years to come:

- Increasing demand from China, India and other emerging countries
- Weak growth in oil production from non-OPEC countries
- Higher market share for the OPEC countries
- OPECs market regulation
- Geopolitical factors, risk and instability in major resource countries
- High production costs in many important production areas

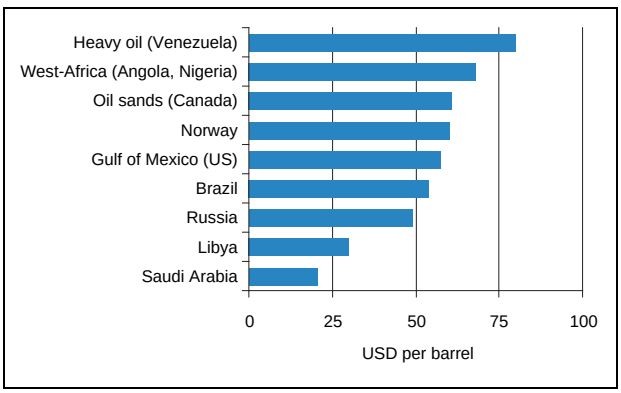

Figure 3.9 Production costs for oil.

Source: IHS CERA.

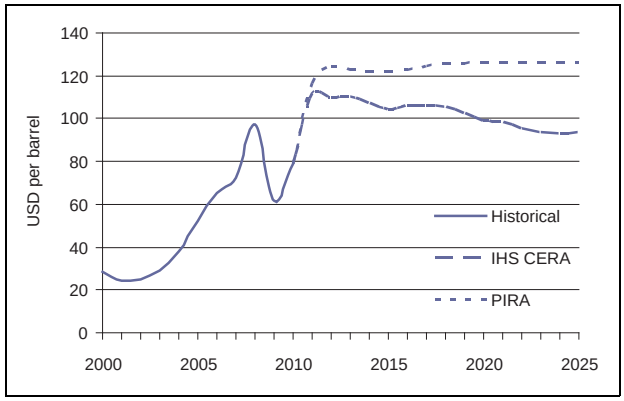

Figure 3.10 Oil price development, historical and future (fixed dollar).

Source: IHS CERA, PIRA.

Over time, we do not expect that the price of oil will be lower than the costs associated with developing new oil fields, or increasing recovery from existing fields. Costs have risen substantially over the last ten years. It is not reasonable to expect that costs will fall much over the longer term. Marginal oil production is occurring in increasingly deeper water and at a greater distance from the markets, which contributes to higher costs. Nor is there reason to believe that the costs associated with unconventional oil, such as oil sand, will be much lower than the current level.

The cost level, as illustrated in Figure 3.9, indicates that an oil price of 60–80 USD per barrel is necessary in many areas in order to ensure that is it profitable to utilise the resource base. Production costs in many OPEC countries, such as Saudi Arabia, are much lower. However, there is no reason to believe that these countries will be interested in or capable of increasing their capacity so rapidly that it will not be necessary to develop new resources in high-cost areas outside the Middle East. The OPEC countries will also have an interest in working against the oil price becoming so high that it undermines the long-term position of oil in the energy markets. By keeping spare production capacity, OPEC has a means of preventing an excessively high oil price.

There are some differences of opinion between various analyst environments when it comes to oil price trends in the years to come, cf. Figure 3.10. For example, PIRA assumes a gradually increasing real price for oil up to about 125 USD per barrel in 2025, equivalent to a nominal market price of about 175 USD per barrel. IHS CERA, on the other hand, assumes a real price for

oil of between 100 and 110 USD per barrel up to 2020, with a declining trend from 2015.

The Ministry is of the opinion that an oil price development approximately at the level of these estimates is possible over the next 10–20 years. At this level, oil prices can make it profitable to produce large parts of the Norwegian petroleum resources, assuming that we can control costs. High oil and energy prices are also important for development of renewable energy generation and to promote energy efficiency.

3.2 Gas markets

There is considerable global growth in renewable energy generation from sources such as wind, solar and biomass. However, these sources are growing from a low level, and they are still expected to account for just a small percentage of world energy sources for many years to come. It is important that we turn world consumption of fossil energy carriers towards the most climate-friendly sources. Coal is the most carbon-intensive energy source, and many countries could achieve significant cuts in their CO_2 emissions by replacing coal and oil with gas.

3.2.1 Development in the gas market

Natural gas, coal and oil are the world's most important sources of energy. In 2008, demand for gas accounted for more than 20 per cent of the world's total energy demand. The most important markets for gas are North America, Europe, Central Asia and Asia. Gas demand is expected to experience strong growth in the years to come, cf. Figure 3.11. In Asia, for example, gas demand is expected to grow by 225 per cent toward 2035. Economic growth and population growth are the most important drivers of this development.

Globalisation

A key development trend in the last decade is the globalisation of the gas market through increased access to gas transported by ship (LNG – Liquefied Natural Gas). This increased flexibility in gas transport has allowed gas to reach new markets. The number of countries importing LNG has tripled over the last ten years. Most of the increase in gas production based on ship transport has come from Qatar. Based on market outlook at the turn of the century, the country undertook an extensive investment program with a view towards supplying the US and European markets with gas.

Unconventional production

Another factor that characterised the gas market was the growth in production of unconventional gas in the US. This production has grown extensively since the mid-1990s, in part as a consequence of reduced production costs and sufficiently high gas prices.

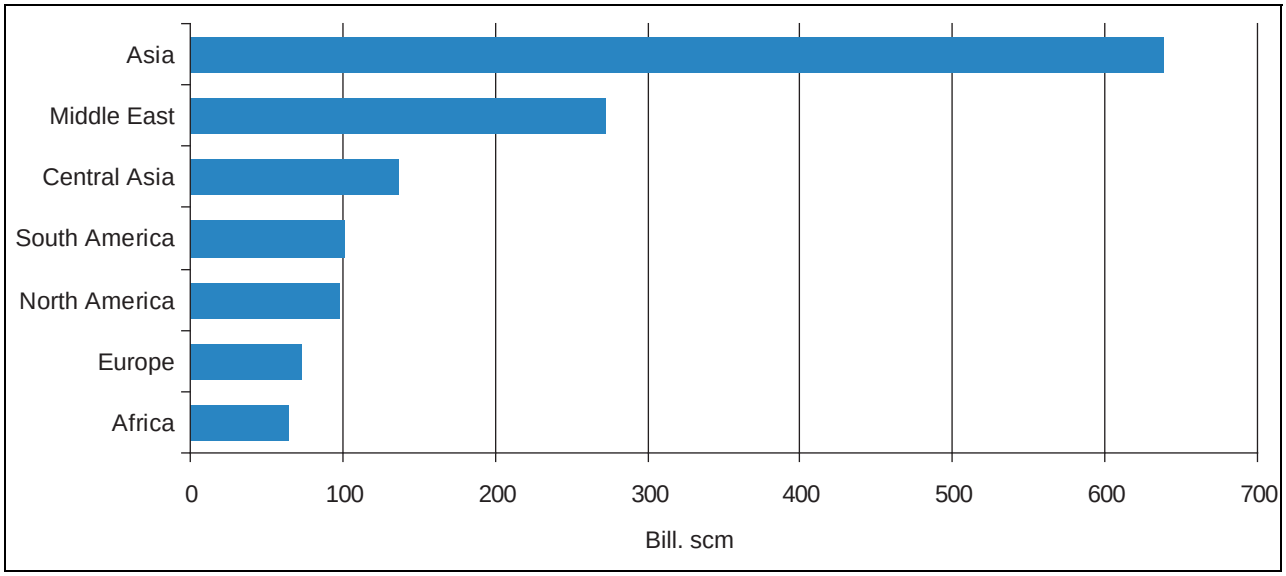

Figure 3.11 Expected growth in demand 2008–2035 (billion scm).

Source: IEA.

Economic downturn

At the end of the previous decade, an international economic downturn lead to reduced demand for gas, both as an input factor in industry and as a consequence of lower energy consumption.

Reduced demand combined with increased supply, both in the US and gas in the form of LNG, lead to an imbalance in global gas supply. Increased gas transport flexibility means that conditions in an individual regional market are more greatly affected than previously by incidents in other regional markets. The consequences of these factors included a drop in spot prices for gas, also in Europe.

In 2010, demand for gas had nearly returned to the same level as before the economic setback in 2008. This demand was driven by cold weather, but also by strong underlying growth in gas demand, which is expected to continue in 2011. Very strong demand for gas is expected from China and India in the next few years due to strong economic growth and a substantial need for energy in general.

The possibilities posed by unconventional gas production have significantly increased world gas reserves and the growth in LNG supply has made gas available to new markets. Overall, this has reinforced the position of gas as a reliable energy source.

3.2.2 European gas demand

The EU countries consume about 500 billion scm gas per year, or about five times the Norwegian production. During the period from 2000 – 2008, average annual demand growth in the EU countries was two per cent. The economic downturn in 2008 and 2009 caused demand for gas to fall by about six per cent. Gas demand is expected to recover to the 2008 level in the course of the next few years.

Gas is used in households, in business and industry, the public sector and the power sector. In the household sector, gas is used for heating and cooking, while it is primarily used for heating in the commercial sector. In the industrial sector, gas is used for heating, in industrial processes and as a raw material in the petrochemical industry. A number of factors affect demand for gas, with the single most important factors being economic growth, the price of gas relative to other energy sources, technological development and energy policy.

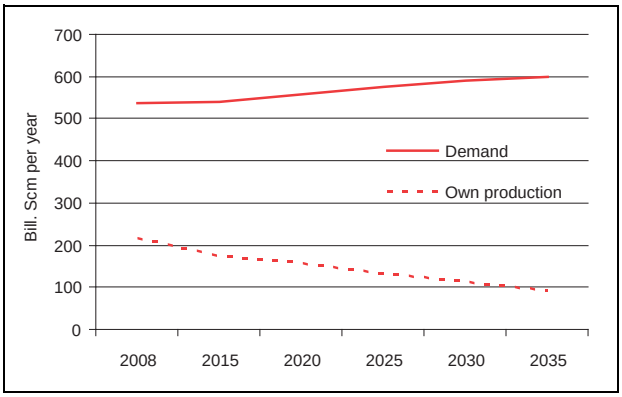

Figure 3.12 EU gas demand and own production.

Source: IEA.

More than 95 per cent of Norwegian gas is sold in the European market, which means that development in European energy consumption is very important for Norway. The EU's energy policy mainly balances three considerations: the environment, security of supply and competitive energy prices. In 2008, the EU adopted principal goals for climate policy, referred to as EU 20–20–20. These targets entail the following achievements towards 2020: a 20 per cent reduction in CO_2 emissions, increase renewable energy sources to 20 per cent and implement energy efficiency measures to help achieve a 20 per cent reduction in energy demand. During the course of 2010, most EU countries launched plans for achieving these goals. Implementation of these plans will have a significant bearing on the future role of gas in the European energy picture.

Energy from renewable sources will help facilitate the EU countries' efforts to reduce greenhouse gas emissions and their need to import energy. Power generation solutions based on wind and solar are considered to be the two alternatives with the greatest potential for growth in renewable energy. Due to the expected and natural variations in wind and sunshine, and since the produced power cannot be stored, these renewable energy sources must be supported by considerable back-up power generation capacity to replace deliveries when the wind doesn't blow or the sun doesn't shine. This back-up capacity is mainly expected to come from gas or coal in the short and medium perspective.

Demand for gas in the EU is expected to grow, while the EU countries' own production of gas will decline, cf. Figure 3.12. This means that the EU will need to increase imports of natural gas in the decades to come.

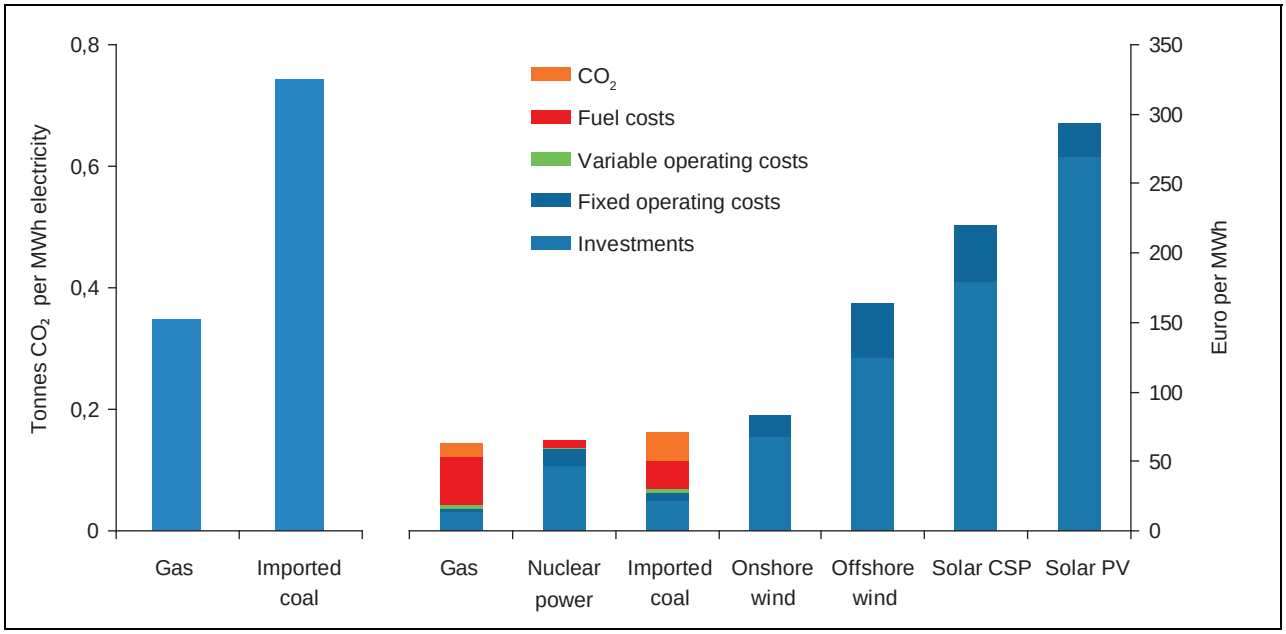

Figure 3.13 CO_2 emissions for gas and coal-based power generation (left), long-term marginal cost for power generation in Europe (right)[1].

1 Assumptions: Gas price: 7.8 $/mmbtu, Brent: 84 $/bbl, coal CIF ARA: 78 $/tonne, coal/lignite: 2 €/GJ, CO_2: 28 €/tonne, USD/EUR=1.44.

Source: CERA.

Most of the growth in gas demand is expected to come in the power sector. This is due to a combination of increased demand for electricity, replacement of old power generation capacity to be phased out and a need for back-up capacity in connection with renewable power generation.

The average age of European coal power plants indicates that a significant number of these must be upgraded or replaced in the near future. A comparison of power generation based on coal and gas reveals a number of advantages for gas. CO_2 emissions from a gas power plant are as much as 70 per cent lower than from the same size existing coal power plant. If gas replaces coal in electricity generation in Europe, this measure alone would be enough to meet Europe's CO_2 targets for 2020. The investments associated with building a new gas power plant are lower than for a coal power plant. Gas power plants also provide more flexible production and take less time to build. Replacing old coal power plants with gas power plants, in addition to the need for back-up capacity for renewable power generation, can form the basis for considerable growth in European gas demand in the decades to come.

Energy efficiency measures can lead to lower growth in gas demand from households as well as business and industry. The economic downturn has also entailed structural changes for parts of the industrial sector. Some of the demand for gas in Europe is expected to disappear permanently as a consequence of industry shutdowns.

3.2.3 Gas supply in Europe

The remaining conventional recoverable gas reserves within the EU[2] are estimated at 2 500 billion scm. The EU countries' own production of gas currently covers about 40 per cent of their consumption, but this number is falling as the resource base is mature.

Production of unconventional gas in the US has also increased substantially in recent years. Unconventional gas resources also exist in Europe, but the volume is uncertain. Moreover, developing these gas resources poses significant challenges, such as high costs compared with conventional gas, access to area, conditions imposed for such recovery and public acceptance. An industrial framework must also be built to enable such production. Most market players do not expect to see commercial development of unconventional gas in Europe until 2020.

60 per cent of the European consumption is imported from various sources. In a historical perspective, the EU has imported gas via pipelines

2 BP, Statistical Review of World Energy 2010

from three sources: Russia, Algeria and Norway. There has been a strong increase in LNG imports since 2000, which has lead to new gas suppliers entering the European market. In 2010, LNG accounted for 30 per cent of the total gas imports to Europe. The actual level of LNG imports in the years to come will depend on the supply balance in the Asian and US gas markets, as well as the level of gas prices in these markets, relative to Europe. Strong demand for gas outside the European market will limit the supply of gas in Europe.

There are significant gas reserves close to the European market. Development of new gas fields and associated infrastructure is capital-intensive. Decisions on new gas development projects are contingent on long-term expectations of sufficiently high gas prices.

Increased gas import to Europe is possible using existing pipelines and LNG terminals, with new infrastructure projects adding to this potential. The «Nord Stream» gas pipeline from Russia to Germany is scheduled for completion in 2011–2012, with an annual capacity of 55 billion scm. A new pipeline from Algeria to Spain («Medgas»), with an annual capacity of about 8 billion scm, was completed in 2010. Other projects being pursued by various players include a new pipeline from Algeria to Italy via Sardinia («Galsi»), a pipeline from Russia to Europe through the Black Sea, Bulgaria and Serbia («South Stream») and a pipeline from Iran and Azerbaijan to Europe through Turkey («Nabucco»).

Recent years have also brought an increase in receiving capacity for LNG in Europe, particularly in the United Kingdom where capacity has increased to about 45 billion scm. There are a number of ongoing and planned projects that will further enhance this capacity. New gas transport pipelines and receiving terminals for LNG increase Europe's opportunities for importing gas, while also diversifying gas supply.

3.2.4 Gas prices

In contrast to the oil market where the price of oil is determined in a global perspective, different regional gas markets have different ways of pricing gas. The US gas price is determined by the supply and demand balance for gas in the region, while the Asian gas price is mainly set in contracts linking the gas price with other energy sources, typically oil.

The European gas market is characterised by two different pricing systems. The United Kingdom has a spot market for gas where price formation is based on the supply and demand balance for gas, while on the Continent, the majority of the gas is still sold under long-term contracts related to oil products.

As a consequence of recent years' changes in the gas market and the strong development in the price of oil, spot prices for gas have, in certain periods, diverged significantly from the price level in oil-related contracts. Because the demand for gas is starting to recover after the crisis and due to continued growth in global gas demand, spot prices for gas are expected to rise in the next few years.

3.3 Summary

The world will need more energy in the future. Economic growth and improved standards of living, along with population growth, increased urbanisation and energy and environmental poli-

Box 3.1 Unconventional gas

Gas resources traditionally believed to be too complex or too expensive to produce are often called "unconventional" gas resources. The three most common types of such unconventional gas resources are gas in tight sands, coalbed methane (CBM) and shale gas. These types of gas resources are found around the globe, although production has so far been limited to just a few countries. North America is currently the leading producer region.

Technological development has helped increase the production of unconventional gas, while simultaneously reducing costs. Production of unconventional gas represented about 45 per cent of total gas production in the US in 2009.

The size of these unconventional gas resources is uncertain. The IEA (WEO 2009) indicates that remaining recoverable resources of unconventional gas are approximately as large as conventional resources. With the current level of gas demand, this is equivalent to potential future supplies for 130 years for conventional gas, and about the same for unconventional gas.

cies, will drive development in energy consumption. This growth will be particularly high in the emerging economies and in developing countries where energy consumption per capita is low and energy poverty is extensive.

Not only does the world need more energy, it needs cleaner energy. Fossil energy sources currently make up 80 per cent of total energy access and will continue to supply most of the energy need for decades to come. In many countries, the transition in energy supply from carbon-intensive coal to cleaner gas can yield substantial greenhouse gas reductions. The world faces a sobering challenge in obtaining both more and cleaner energy. Development in energy consumption will be affected by many factors, including both global and regional climate policy.

Energy security will also be an important objective in energy policy, in addition to more and cleaner energy. Producer and consumer nations share a common interest in reliable energy supply.

The growing need for more and cleaner energy, for oil and gas, along with an emphasis on energy security, all point to good prospects for Norway's export of oil and gas. Norway has always been, and will remain, a stable and predictable supplier of oil and gas. This is a competitive advantage for Norway as an energy supplier.

Rising demand, higher oil production costs and OPEC's market regulation also point to long-term oil prices remaining high, seen in a historical perspective. Most price forecasts suggest that the price of oil will remain high enough to ensure profitable exploration, development and production of the remaining oil resources on the Norwegian Shelf, if costs are kept under control.

The gas market is changing. There is ample supply of gas and prices have come under pressure in recent years, but demand is expected to increase and contribute to an improved gas market balance over time. With growing globalisation of the gas markets, gas will also gradually reach new countries and new markets. Climate policy could also provide an additional stimulus for gas demand, as gas to replace coal is an effective measure in reducing CO_2 emissions.

Gas production in the EU countries is declining, and they will need to increase gas imports in the years to come. Norwegian gas will help meet the European gas demand, and will be an attractive and valued energy source for many decades to come. This means there will be a basis for profitable exploration, development and production of the gas resources on the Norwegian Continental Shelf.

The Government will:

- Work to promote efficient and well-functioning oil and gas markets.
- Through dialogue with the authorities in other countries and participation in international forums, work to ensure that the advantages of natural gas over the use of coal are taken into consideration when setting the framework for Europe's energy structure.
- Work to expand and enhance the energy dialogue between producers and consumers, in part through the framework provided by the IEA and the International Energy Forum (IEF).

4 Recovery of proven resources

A significant part of expected production over the next ten years will come from proven fields and discoveries. Sound utilisation of resources in fields and discoveries is very important for the activity level and the State's income in a short and medium-term perspective. Several fields on the Norwegian Shelf have produced for a long time. Measures to improve recovery on these fields are urgent. Measures must be carried out quickly, before the operation of established infrastructure becomes unprofitable or technically unsuitable. Many measures could be described as time critical. Decisions need to be made quickly.

For discoveries that are not developed, the goal is to find development solutions that achieve the best resource management and create the most value for society. Many current discoveries are small, need to utilise existing infrastructure and be developed quickly in order to be profitable. It is important to carry out active preventive maintenance on existing infrastructure, as well as for modifications connecting new and old infrastructure to be carried out in a prudent manner.

The goal for exploitation of producing fields is to create the greatest possible value for society. This is achieved through evaluating and imple-

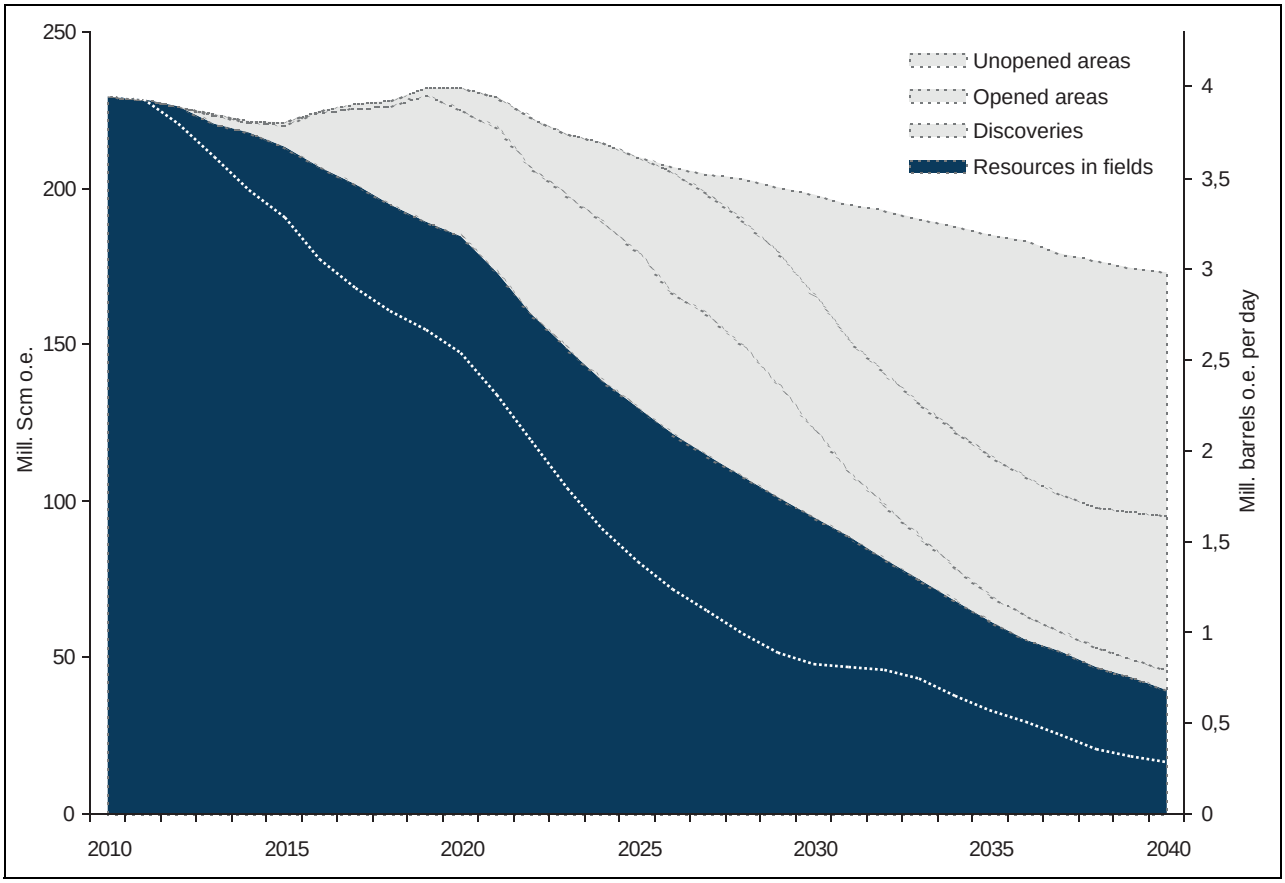

Figure 4.1 Possible production course on the Norwegian Shelf. Volumes from existing fields are highlighted. Production from approved measures is shown below the dashed line. Production that can be realised through planned measures, as well as increased efforts in improved recovery, is shown above the same line.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

menting measures that can improve recovery while also controlling costs. Phase-in of third-party resources to existing fields could contribute to prolonging the profitable production period, while also being an efficient development solution for minor discoveries. Some of the fields on the Norwegian Shelf have been producing for decades, and are currently in a phase where parts of the facilities must be replaced or supplemented. For example, investments are being made in new facilities both on Ekofisk and Eldfisk this year, and new compression capacity for gas is being considered on Troll and Åsgard.

4.1 Potential and technology to recover more

Recovering more entails measures that contribute to maintain production in and around existing fields. Phase-in of new fields can also contribute to extended lifetimes for existing fields. Thus, measures to improve recovery also encompass measures that support rapid development of small discoveries.

In February 2010, the Ministry appointed an expert committee[1] with the mandate to assess measures to improve recovery from existing fields on the Norwegian Continental Shelf. The Committee submitted its report in September 2010 and it was then submitted for public consultation. The Ministry received a considerable amount of input during the consultation round. The problems addressed by the Committee, and the main suggestions emphasised, are addressed in this Chapter.

4.1.1 Potential from higher recovery rate

The development on Ekofisk is a good example of the potential for improved recovery. When the field came on stream in 1971, the plan was to produce 17 per cent of the resources in the field. Today, the plan is to produce more than 50 per cent of the resources in place. The improved recovery rate constitutes several hundred million scm o.e. of oil. The challenge is that, based on current plans, nearly half of the oil originally in the field will remain in the reservoirs.

Fields on the Norwegian Continental Shelf have, on average, increased their oil reserves by a factor of 1.68 from the original development plan

[1] Also called the Åm Committee

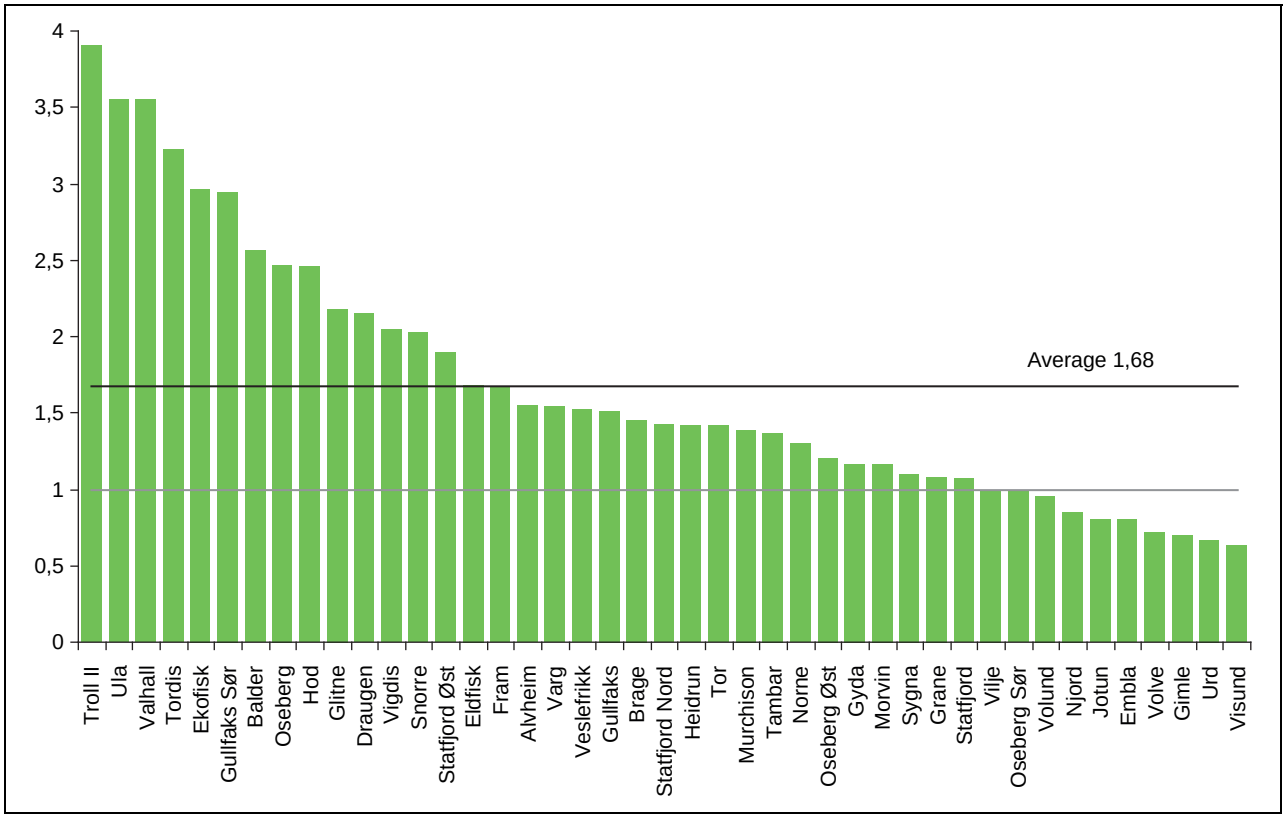

Figure 4.2 Oil reserve increase compared with estimates in the original PDO.

Source: Norwegian Petroleum Directorate.

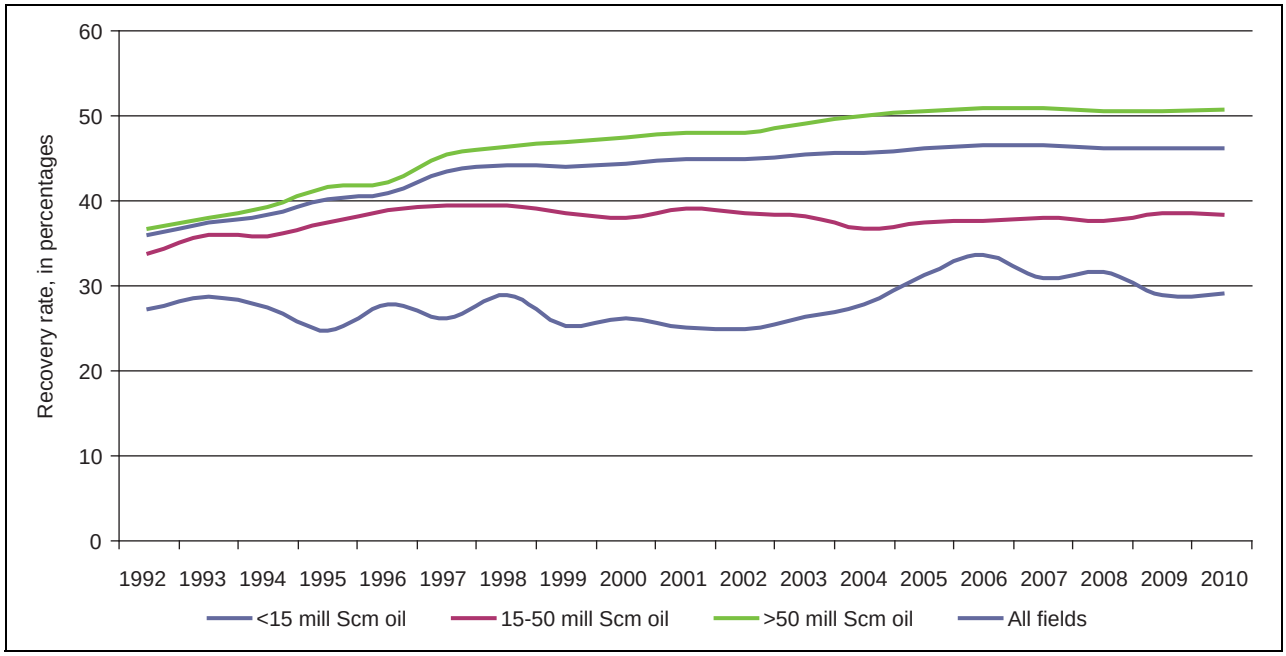

Figure 4.3 Development of expected recovery rate on the Norwegian Shelf.

Source: Norwegian Petroleum Directorate.

and up to 2010, cf. Figure 4.2. There are many reasons for this. Recovery has been better than expected and measures have been implemented which have contributed to an improved recovery rate and increased reserves because more oil (from new parts of the reservoir) is depleted.

The current adopted plans provide an average expected recovery rate of 46 per cent for oil and 70 per cent for gas on the Norwegian Shelf. In

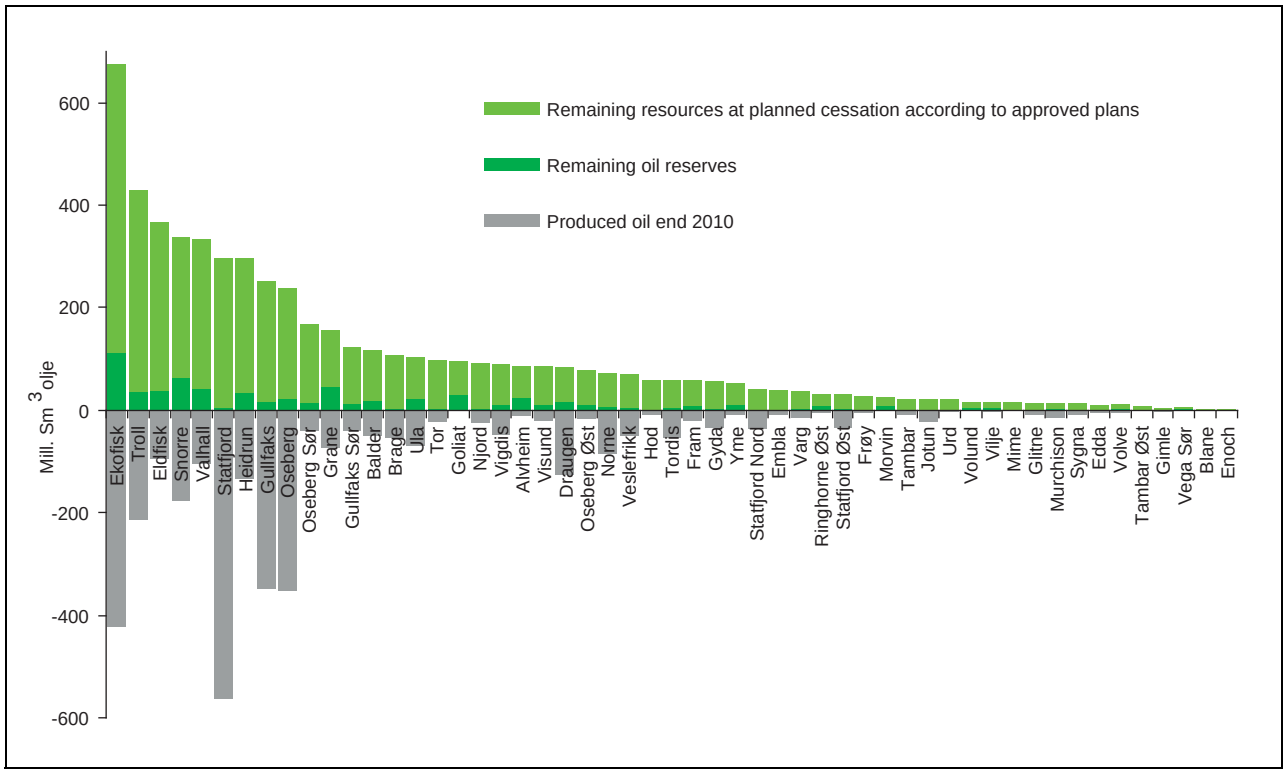

Figure 4.4 Distribution of produced oil, remaining oil reserves and resources.

Source: Norwegian Petroleum Directorate.

comparison, the global oil recovery rate is about 22 per cent. The recovery rate varies from field to field, and depends on factors such as reservoir properties, recovery strategy and technology development. The recovery rate also correlates to the size of the field, cf. Figure 4.3. It is easier to achieve high recovery in major fields because, for instance, they normally have fixed platforms with drilling rigs which can carry out well work throughout their lifetime.

According to the current plans, and with the existing technology, about 30 billion barrels of oil will remain when Norwegian fields are shut down. Improvement of the recovery rate thus has a significant upside, for example, a one per cent increase of the recovery rate for fields that are currently operating will increase oil production by approximately 570 million barrels of oil. The gross sales income from such an oil volume is approximately NOK 325 billion[2]. The cost of producing the resources, as well as when the resources are produced, will determine the size of the values for this potential.

The remaining oil resources in the fields are considerable, cf. Figure 4.4. The resources are already proven, infrastructure exists and many wells are already in place. However, recovery of significant parts of these resources is technically challenging and costly. In order to recover some of this oil, multiple decisions need to be made by the licensee groups over the next several years.

When fields are shut down, it could impact the possibility for third-party use of infrastructure in the relevant area. Use of existing infrastructure can be crucial for the profitability of new and existing discoveries. This means that the window of opportunity for exploration and development of discoveries in mature areas is limited. It is therefore important to facilitate development of time-critical resources and discoveries near existing infrastructure.

The expert group for improved recovery has a vision that about 2.5 billion scm o.e., (or about 15.7 billion barrels) of oil can be produced from fields on the Norwegian Shelf, beyond the current plans. They believe that exploitation of this potential requires a high oil price and use of both existing and new technology. Furthermore, the Committee suggested measures must be implemented on both producing and future fields. The gross sales income from such a resource volume is nearly NOK 9000 billion. The costs associated with recovering the resources, as well as when they will potentially be produced, are crucial as regards the size of values that can be realised from this potential.

4.1.2 Solutions that could improve the recovery rate

Technology development has contributed to high recovery rates from many fields, cf. Figure 4.5. Water injection has been important on the Norwegian Shelf since the 1980s and was, for instance, crucial in improving the recovery rate on Ekofisk. Gas injection has taken place since the 1970s, and is currently used by about 20 fields. In the 1990s, recovery of oil from very thin oil zones was made possible by horizontal drilling on Troll. Several other technology breakthroughs, e.g. within 3D and 4D seismic[3], have also been crucial in improving recovery.

The remaining oil can be divided into two categories: mobile and immobile oil. Oil which is mobile with the applicable recovery method on a field can be recovered using multiple wells and more, long-term use of water and/or gas injection. The recovery rate from many fields can be increased relatively quickly using these measures.

Oil which cannot currently be squeezed out of the pores in the reservoirs using injection of water or gas, as currently done on the fields, is called immobile oil. This applies to large volumes of oil. Production of this oil requires considerable effort, for example in the form of injection of miscible gas and/or CO_2 or chemicals added to the injection water.

Various technologies that could contribute to improved recovery can be grouped in the following manner:
- Drilling and well
- Injection techniques
- Reservoir mapping
- Integrated operations
- Subsea solutions

Drilling and well

The oil companies carry out a number of measures to improve the recovery rate on their fields. Most projects currently carried out are within the drilling and well discipline. Drilling new development wells and maintenance of existing wells is a precondition for future production. How many,

[2] Oil price assumption: NOK 570 per barrel.

[3] 4D seismic is 3D seismic taken in the same place several times. Time is considered the fourth dimension.

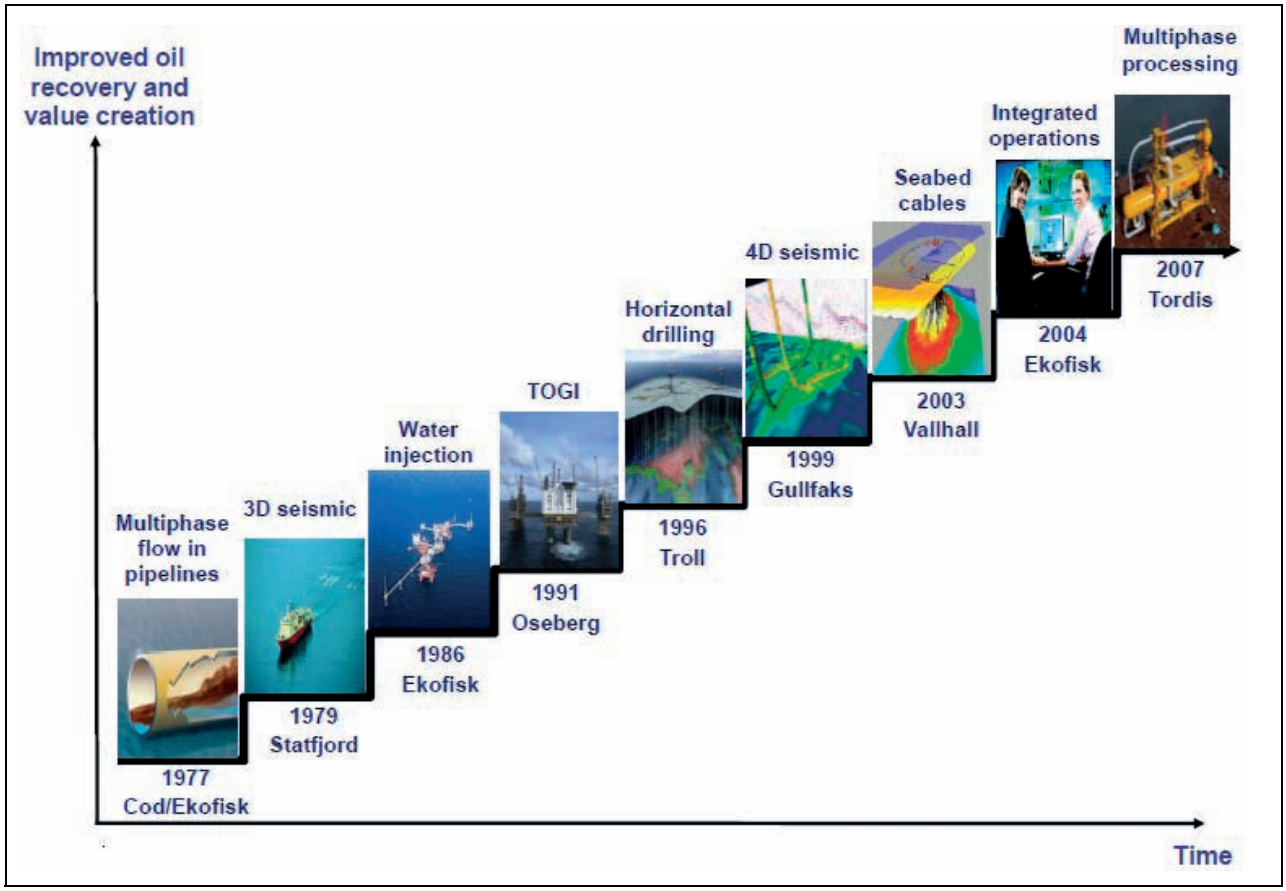

Figure 4.5 Recovery solutions over time for Norwegian fields.

Source: Expert committee for improved recovery.

and where, wells are drilled form the basis for which possibilities will be available for further reserve growth and measures to improve the recovery rate. The least demanding oil resources are the first to be recovered from a field. On several fields these resources have already been recovered. It could therefore be challenging to recover the remaining resources. Complex pressure conditions and unclear barrier conditions in existing wells to be drilled are examples of challenges that must be resolved.

The number of new production and injection wells has declined since the record year 2000. On many fields, the licensees have not been able to carry out the planned drilling programs in recent years. Over time, a considerable lag has built up, and some of the planned wells cannot be completed without updating the drilling equipment.

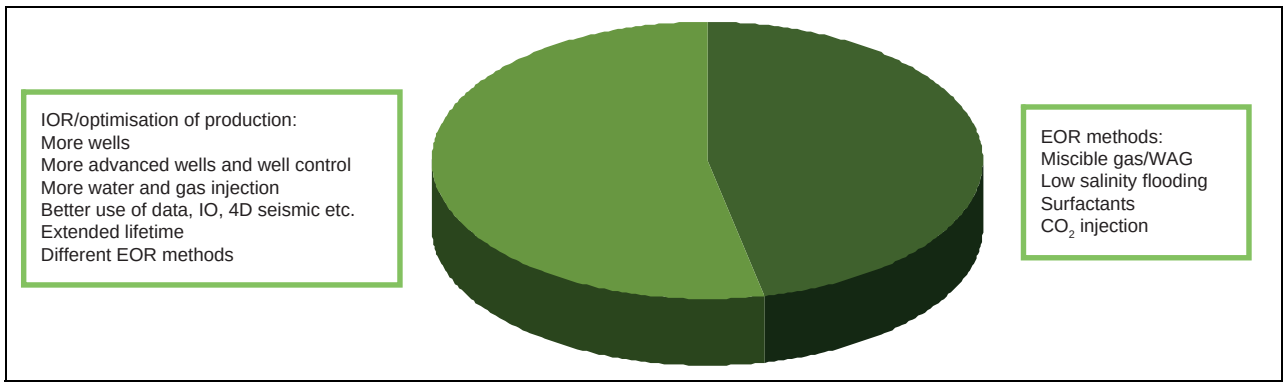

Figure 4.6 Mobile and immobile oil and recovery methods.

Source: Norwegian Petroleum Directorate.

This has also contributed to many fields not reaching their production goals in recent years. In the future, the number and quality of wells drilled will also be crucial for what production is achieved. Wells can be drilled and maintained both from mobile and fixed facilities. Drilling from fixed rigs is particularly important to realise the resources in the large oil fields.

Injection techniques

More oil can be produced using known injection techniques and through development of new injection methods. On the Norwegian Shelf, water and gas injection has been used on many fields. Currently, more than 30 fields on the Norwegian Shelf utilise water injection and more than 20 fields utilise gas injection in some form or another. To date, gas injection is considered to have contributed up to 300 million scm of extra oil and condensate on the Norwegian Shelf. This is nearly as much as has been produced from Gullfaks or Oseberg up to now. By following the companies' current adopted plans for gas injection, this could provide 60–100 million scm of oil that would not otherwise have been produced. Further development of existing technologies has great potential. In addition, there is a considerable potential for improved recovery of the immobile oil in particular, using more advanced recovery methods, such as:

- Injecting water with added chemicals
- Injecting water with a tailored salt content
- Water-alternating gas injection (WAG) / Foam-assisted water-alternating gas injection (SAWAG)
- Injection of CO_2 gas
- Gas injection with miscible conditions

A study carried out by the Norwegian Petroleum Directorate (NPD) in 2005, indicated additional oil recovery with CO_2 in the order of 3–7 percentage points from certain fields. The NPD estimated the technical potential from 20 fields that could use CO_2, to 150–300 million scm of oil. There are several challenges associated with this. In addition, the fields must have access to sufficient amounts of CO_2.

In order to use these methods, a long-term perspective must be used for decisions as regards costs, technology, expected oil prices and willingness to take risks. A precondition for all methods is that the consideration for health, safety and the external environment is safeguarded in a good manner. The various injection techniques must be seen in connection with each other.

Reservoir mapping

Seismic surveys are an important prerequisite for recovering oil and gas deposits. The development has progressed from 2D seismic to 3D and 4D seismic. This has been important both to optimise production and to increase the likelihood of discoveries. The technology development has been headed by Norwegian and international seismic companies and in close cooperation with the oil companies on the Norwegian Shelf.

3D and 4D seismic contribute to a better understanding of the reservoir and reservoir fluid streams. Multiple wells are important as a data basis. Together, this contributes to better reservoir models, which can lead to more accurate drilling and optimal production.

Statoil has estimated that the use of 4D seismic on the Gullfaks field alone has provided value creation equalling about NOK 6 billion. The value creation from 4D seismic over the last ten years has been estimated at more than NOK 22 billion.

Integrated operations

Integrated operations involve using information technology to change work processes to achieve better decisions. Technology allows for equipment and processes to be remote-controlled. Functions and personnel can therefore also be moved onshore. This could improve recovery on fields through more energy efficient operations and better decisions. In 2007, the Norwegian Oil Industry Association (OLF) estimated the resource potential from integrated operations at about 1.9 billion barrels.

Subsea solutions

The development solutions on the Norwegian Continental Shelf have progressed from mainly fixed platforms to more use of subsea solutions. The seabed solutions have contributed to making more discoveries (more) profitable. This particularly applies to minor discoveries and discoveries in deep water. Currently, one-third of production on the Norwegian Shelf comes from subsea wells, and this percentage is rising.

Fields developed with seabed wells generally have a lower recovery rate than fields with wellheads that are above the sea surface (dry wellheads). This is e.g. due to higher maintenance

Box 4.1 Gas in tight reservoir formations on Linnorm

Linnorm is a Shell-operated gas discovery in the Norwegian Sea which was proven in 2005. It is challenging to find profitable methods to produce the gas in Linnorm. The discovery has complicated geology with six stacked reservoirs. There are high pressures and high temperatures here, a mixture of tight and conventional reservoir formations, a wellstream that becomes very corrosive, and which easily forms wax and hydrates. This requires several innovative solutions that challenge the limits for what has been possible or has been carried out so far. In the event of a potential development of Linnorm, a considerable amount of new technology will be developed, which could become very valuable for developments of other gas discoveries in tight formations.

The plan is to develop Linnorm with up to eight wells, a pipeline to the processing facility on a host platform and tie-in to a new pipeline which is planned to run to the existing gas processing facility for Ormen Lange at Nyhamna. A coordinated development could be relevant with Luva, which is located 300 kilometres north of Linnorm.

The operator is working with the Norwegian supply industry to find the limits of what is technically possible with the current technology and to push the limits where needed to achieve a development solution. This includes production technology for recovering gas from tight formations. More than half of the gas volumes in the Linnorm reservoirs are in so-called tight formations where the recoverable gas volumes from conventional production methods are too small to be profitable. Such reservoirs are often defined as "non-reservoir" and are thus excluded from volume calculations and development plans.

Up to the present, production from most tight gas reservoirs has taken place on land, where drilling costs are relatively low and many wells can be drilled. Thus the possibility for a good learning curve and optimisation of the technical solutions also increases. The oil industry is now moving technology from recovery of gas and oil from tight reservoirs onshore to offshore, and the first attempts have been made in the North Sea in the Dutch sector from installations resting on the seabed. The next step will involve doing this at greater water depths, in higher pressure and temperature areas, as well as recovery from floating platforms and/or subsea installations. Offshore wells are significantly more costly, and will require other solutions.

Tight gas can increase the potential for production in Norway; however, this will likely take place with considerably higher development and production costs than from fields with conventional reservoir types, i.e. a form of improved recovery of gas.

costs. It is therefore challenging to prolong production and improve recovery cost-efficiently through more wells and interventions from seabed fields. Access to less costly vessels and methods to implement well operations are therefore important to improve recovery from fields with subsea wells.

4.2 Measures – the legal framework

Petroleum activity on the Norwegian Continental Shelf is regulated through an extensive legal framework based on cooperation between authorities and licensees. Within this framework, the following is an assessment of measures in connection with voting rules, policy for extending production licenses and following up mature fields.

4.2.1 Voting rules

According to the expert committee, the current voting rules may make it difficult to make decisions in the partnership as small owner groups could stop profitable development projects proposed by the majority owners. For mature fields, the voting rules could also hinder improved recovery by companies focusing on production in the late phase not achieving an operations model that is necessary for this type of production, even though they have a high ownership interest in the partnership. The committee therefore suggests that the voting rules are changed so the majority principle can be applied to all production licenses.

Petroleum activities must be carried out in accordance with a production license, which gives the oil companies (licensees) an exclusive right to explore and produce petroleum in the area included in the license. A condition for awarding a

production license is that the licensees must come to an agreement. By signing the agreement, the licensees form a partnership. This agreement is formulated by the Ministry, and contains e.g. a voting rule for the partnership's decisions pursuant to the production license. The voting rules are stipulated by the Ministry. All subsequent changes are contingent upon the Ministry's approval.

The voting rules form the basis for most decisions made within each partnership. They thus play an important role for resource management on the Norwegian Continental Shelf. Since the start of the petroleum activities on the Norwegian Shelf, Norwegian authorities have wanted a diverse selection of qualified companies to contribute expertise to the work in a production license. Broad-based technical input will increase the level of expertise in the production license and will contribute to the other licensees assessing the operator and checking the operator's work. In order to give the companies an incentive to participate in the technical work, the voting rules have been designed so that all companies in each partnership, including the companies with small ownership interests, will have an actual possibility to influence decisions that are made. The voting rules on the Norwegian Shelf have therefore been designed differently from the voting rules in the company legislation, where more decisions require a joint owner majority of the votes cast (straight majority), but some decisions require a larger majority.

Since the mid-80s, the principle for designing the voting rules has been that decisions are made by a combination of a number of licensees (a majority) and their ownership interests (a majority). In a production license with three licensees the normal voting rule will thus be determined such that decisions are made if at least two of the licensees, which jointly represent at least 50 per cent of the ownership interest, have voted for a proposal. Similarly, decisions in production licensees with four licensees are made when at least three licensees that normally jointly represent at least 50 per cent of the ownership interest have voted for a proposal.

In some instances, the Ministry has seen that licensees with small ownership interests in a production license can have too much influence compared with licensees with considerable ownership interests. The desire to ensure that licensees with small ownership interests have influence – and thus an interest in contributing expertise – should therefore, in certain instances, be balanced somewhat better vis-à-vis the significance of interest majority. The size of ownership interests reflects the financial realities in the production license.

In the future, the voting rules will also mostly be based on a combination of majority in the number of licensees and ownership interests. However, the Ministry will to a larger degree emphasise interest majorities when stipulating new voting rules. In licenses with many small ownership interests you can, for instance, choose to design a voting rule which stipulates that they cannot block decisions that participants with more than two-thirds of the ownership interest want to make. With new awards, the Ministry will also be able to stipulate a voting rule based on a principle of pure interest majority if this is considered reasonable based on the composition of the partnership and the consideration for making it as easy to form a quorum as possible.

In the event of changes to the number of licensees or changes to licensees' ownership interests in existing production licenses, the partnership, pursuant to the joint operating agreement, must propose new voting rules. The new voting rule is contingent upon the Ministry's approval. If no proposals are made, the Ministry can determine new voting rules for the partnership. The new voting rules must be designed so that each party's voting power is impacted as little as possible.

If special reasons so indicate, the Ministry can extend a production license beyond the license period determined upon the award. The Ministry will stipulate the conditions of such a special extension. In the future, the Ministry will in such instances assess the voting rule in the relevant license, and potentially set requirements for a new voting rule if there is a need to change the existing voting rule. A new voting rule will to a greater degree be based on a principle of interest majority.

The Government will:

- To a greater degree emphasise interest majority when determining voting rules for awarding new production licenses.

4.2.2 Predictable extension of license period for production licenses

The expert committee proposes that the authorities must clarify the question of a new extension of the license period at an early point in time, when the need arises. The assessment regarding a new extension should be made on the basis of achieved results and long-term plans to increase the field's value creation.

Investments in projects for improved recovery on the fields require the licensees to have a long-term perspective. A production license is first awarded for an initial period. During this period, the licensees must explore the awarded area. Following the expiry of this period, the licensees have a right to require an extension of the license period, as long as the mandatory work obligation is fulfilled. This period is nearing the end for many fields on the Norwegian Shelf.

Investment decisions made on fields that are currently nearing the end of the license period will also have financial effects in the years following the license period. The Ministry may extend the license period beyond the originally determined period, if the licensees apply for this – so-called new extension. Since it could be relevant for several licensees to apply for such a new extension of the license period, the Ministry believes it is important to determine a predictable policy to prevent under-investment in such fields.

A limited license period could result in the licensees under-investing in e.g., improved oil recovery, exploration, technology development and environmental technology towards the end of the duration of the license. This is because, in their investment decisions, licensees will not give full consideration to the value of activity that takes place after the expiry of the license period. This will then lead to socio-economically unfortunate decisions, and the squandering of resources. The result will be reduced value creation and lower State income, both due to lower returns on a potential State ownership interest and through lower tax revenues from the licensees.

This effect can be met with a new extension of the production licenses to the same licensee group, and on the same conditions. With a new extension, the State will also be able to change the conditions – for example by reserving the right to (increased) State participation in the license. This will, by itself, move in the direction of increasing the percentage of value creation from the field which falls to the State. The Ministry still assumes, however, that the value of an increased State ownership interest in licenses that are in a late phase normally will not offset the loss of State income that could result from lower value creation due to uncertainty about whether a new extension will be granted, and in such case, on what conditions. This is due to the State's strong exposure in the activity through the tax system and direct ownership.

For some fields with significant remaining resources at the end of the license period and/or with low State participation, it could be appropriate to use the opportunity to increase the State ownership interest with a new extension of the production license. Ekofisk and Troll are examples of two fields where new extensions of the license period were contingent upon an increased SDFI interest.

In its application to extend a production license, the licensee group must provide a reason for why the license period is a limitation as regards good resource management in the field, and thus also a hindrance to the highest possible value creation.

According to the Petroleum Act, the licensees may apply for a new extension at any time during the license period, when they themselves believe the need arises. It is up to the Ministry to make a decision on such a new extension, and the conditions for the activity in the license can in such cases be changed, adapted or continued along the lines of the plans that are submitted.

In certain cases, the Ministry could make a new extension contingent upon, e.g., that a new or changed plan for development and operation is submitted by a certain deadline. If the stipulated condition(s) is not met, the original license period will still apply.

The Ministry sees that there could be good reasons for the licensees needing, at a certain stage, a degree of security that a project that will increase the field's value creation can actually be implemented. There can be many directions and decisions that need to be made well before a final plan for the further operation of a field can be submitted to the authorities. However, the Ministry still presumes that the regulations already contain the instruments needed to determine a new extension.

The Government will:

- Approve applications for new extensions of the license period for a production license with the same ownership structure if the application substantiates improved utilisation of reserves, unless special conditions call for something else. For some licenses, special factors such as low State ownership interest and/or significant remaining reserves, could require the SDFI interest to be increased, or other conditions to be renegotiated when extending the production license.

4.2.3 Follow-up of late-phase fields

The expert committee sees a need to formalise the production licenses' work with measures for improved recovery. The committee has suggested that the licensees submit a simplified, revised development plan, when 80 per cent of the planned volume is produced, at the latest. The argument is that such a measure will advance the improved recovery work to a greater extent in the companies' governing bodies. This will promote greater discipline in the companies' work. At the same time, the Ministry will to a greater degree be involved in the companies' work to achieve a higher recovery rate. The committee states that such a process will not entail significant additional work for the companies as the necessary information is currently already reported to the authorities.

Currently, the authorities have an impact on the companies' plans for a field through the processing of development plans. This process is an important tool for the authorities to ensure good resource management on the fields. Approval of production schedules takes place when approving the development plan and through annual production licenses. The authorities can also, at their discretion, after the development plan and production schedule have been approved, require the licensees to carry out assessments of the resource utilisation in a field. This could become relevant, for instance if new information about the reservoir calls for a different recovery strategy. If necessary, the Ministry can, pursuant to applicable statutes and regulations, require the licensees to prepare a report on field-related factors, including alternative production and injection schemes and the total recovery rate for various production schedules.

Through the authorities' general follow-up work as regards resource management, fields requiring special follow-up from the authorities may emerge. In addition to this follow-up, the authorities carry out an annual review of all fields on the shelf with the objective of identifying fields which require special attention.

The Ministry is concerned with ensuring sufficient attention to sound resource management from the licensees. This could be particularly important for fields in the tail phase. The Ministry agrees with the expert committee that it is important to elevate the work on improved recovery into the licensees' governing bodies and furthermore, that this must not be done in a manner which entails unnecessary additional work for the companies. The Ministry will, based on these assessments, further consider the need for additional enhancement of the regulations to ensure sufficient attention to improved recovery and good resource management.

The Government will:

- Intensify the follow-up of fields in the late phase.
- Require new plans for recovery in late phase fields, where this is considered suitable.
- Assess the need for further enhancement of the regulations to ensure sufficient attention to improved recovery and sound resource management.

4.3 Measures – cost level and profitability

The costs on the Norwegian Shelf have increased significantly in recent years and are higher than in other petroleum provinces, cf. Chapter 2.4. The high cost level has a direct effect on the profitability of measures for improved recovery and influences the lifetime of existing fields. The cost level development is paramount for the possibility of achieving improved recovery.

The challenges associated with costs are discussed by the expert committee and concern is expressed that a high cost level could impede investment decisions regarding improved recovery. The committee acknowledges that a cost reduction on the Norwegian Shelf is completely necessary to reach the potential within improved recovery. Furthermore, the committee emphasises that this requires joint efforts from authorities and the industry.

4.3.1 Drilling and wells

The expert committee proposes several measures to alleviate a pressured rig market on the Norwegian Shelf. To ensure sufficient drilling capacity, the committee suggests that long-term drilling and intervention contracts are used to a greater extent, so capacity will increase quickly enough on mature fields. The committee believes that the rig fleet must be improved by establishing international standards and requirements with joint interpretation and application. The committee believes that it should be investigated whether it is possible to take the initiative for such standardisation through the EU or EEA. This could reduce

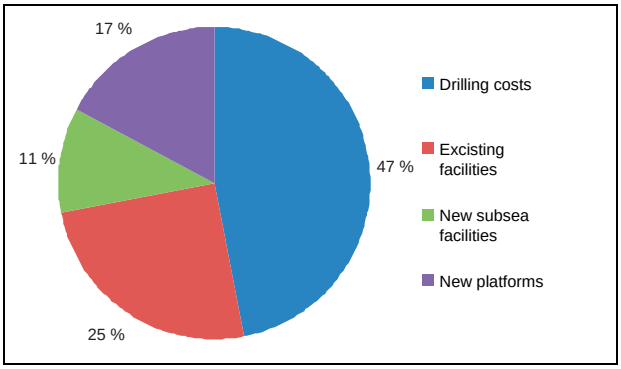

Figure 4.7 Distribution of investments in discoveries and fields in 2010.

Source: Ministry of Petroleum and Energy / Norwegian Petroleum Directorate.

the rig rates, which make up a significant part of drilling costs on the Norwegian Shelf. According to the committee, the rig costs for development and operations amounted to more than NOK 15 billion in 2009.

Drilling new development wells and maintenance of existing wells is a prerequisite for future production. The number of wells and the condition of the wells form the basis for possibilities for reserve growth and measures to improve the recovery rate from fields. In the short term, drilling and wells are crucial in order to recover as much as possible of the remaining oil in existing fields. At the same time, it has become more challenging and time-demanding to drill and complete new wells from the fields. The reasons for this are complex, but are both due to factors relating to the condition of existing wells to be drilled from and other factors in the subsurface, for example pressure changes.

Drilling wells is the largest cost component in petroleum activities, cf. Figure 4.7. Drilling costs make up a large part of the costs in improved recovery measures, development and exploration. There is a great value potential in identifying and implementing cost-reducing measures associated with drilling on the Norwegian Shelf.

Increased rig rates are an important cause of the considerable growth in cost levels on the Norwegian Shelf in recent years. Econ Pöyry estimates that the cost level on the Norwegian Shelf has nearly tripled from 2004-2008. Even though the rig rates have declined somewhat after the peak towards the end of 2008, the level at the end of 2010 was still high. A comparison with the UK shelf carried out by Wood Mackenzie shows that the drilling cost per recoverable barrel is still more than 15 per cent higher on the Norwegian Shelf. No changes have been carried out in the HSE Regulations during this period that could have contributed to this development. The increase in rig rates is primarily considered to be caused by other factors in the rig market.

The number of new production and injection wells has declined since the year 2000. The companies have not been able to carry out their planned drilling programs in recent years. The consequence is that a significant lag has built up in the drilling activity. Well maintenance – which is important for achieving established production plans, is also delayed because it takes longer to drill than expected, and few platforms can drill and carry out well maintenance simultaneously. It is important that the companies consider the possibility for using alternative methods for monitoring and maintenance of wells (well intervention) which do not require use of the fixed drilling equipment. For intervention in seabed wells, designated well intervention vessels have been built. The Ministry considers it important that more such vessels are built as it will free mobile drilling facilities for drilling development wells.

During the autumn of 2010, a total of 930 planned production and injection wells were reported for the period 2011-2020. Of these, about 310 will be drilled from fixed facilities. Drilling using the drilling facilities on the fixed installations is particularly important in realising the resources in the major oil fields. This is because most major oil fields are equipped with dedicated drilling rigs. Several of the fixed drilling rigs require upgrades and maintenance for the sufficient number of wells to be drilled. When upgrading and during maintenance of existing drilling facilities, it is important that the need for future wells is considered, both as regards challenges and number. In this connection, alternative drilling methods and new drilling technology must be considered, and necessary equipment must be installed in order to meet the challenges that are expected as the fields mature.

The Norwegian Petroleum Directorate, oil companies, consulting companies and other players point out that sufficient rig capacity will be a challenge on the Norwegian Shelf in the future. Many players point out that it is demanding to bring mobile rigs onto the Norwegian Shelf. Currently, about 30 mobile rigs operate on the Norwegian Shelf. In 2-3 years, many of the contracts will expire. Whether the rigs will then remain on the shelf remains unknown. A tight rig market, particularly after 2004, has led to several highly specific rigs being brought to the Norwegian Shelf. Of 21

semi-submersible rigs on the Norwegian Shelf, seven are equipped for drilling at water depths over 1000 metres. These are often not particularly suited for existing fields.

By increasing drilling capacity, costs can be reduced and the activity level can increase. Gains will be achieved directly through reduced rig rates and cheaper wells. At the same time, increased drilling capacity will mean more wells, and thus improved resource utilisation. The lack of the correct type rig could lead to fewer wells being drilled and/or that the drilling costs become unnecessarily high. This is particularly relevant for fields with long lifetimes and a significant need for wells.

The Ministry believes there is a need for more measures to improve the access to rigs and to limit the costs of drilling so the potential for improved recovery is realised. The exploration profitability will also increase through such measures. This is a task which requires measures mostly from the industry, but the authorities must also contribute.

The Ministry agrees with the committee that the capacity and efficiency of drilling activities will increase if the licensees to a greater extent agree to enter into contracts with more rigs on a more long-term basis. Within improved recovery, the potential for long-term contracts is particularly great. Players with wide portfolios of operating fields are especially suited for entering into such contracts. The Ministry therefore encourages such licensees to establish rig cooperation schemes, where rigs are contracted by several players on a long-term basis. The Ministry expects the industry to ensure access to sufficient vessels so the desired drilling can take place on the Norwegian Continental Shelf.

The Ministry believes that the Norwegian Shelf needs high rig capacity in order to realise the great potential in the existing fields. The future need for drilling on the fields is great. There should therefore be a basis for placing rigs adapted to Norwegian regulations on key fields that are adapted to the needs of these fields. The Ministry expects that the owners of the major fields will carry out such organisation. Many additional resources are time-critical and drilling must take place soon so as not to lose significant resources.

The Ministry agrees with the expert committee that it is desirable to increase the rig capacity on the Norwegian Shelf and to reduce costs. Improved flow of vessels involved in petroleum activities in the North-Atlantic onto the Norwegian Shelf is a measure that could contribute to this. The authorities will appoint an expert group in order to highlight and identify potential financial, industrial, regulatory or other obstacles to increasing rig capacity on the Norwegian Shelf and reducing costs. Through a comprehensive approach, the expert group will propose measures that could improve the flow of vessels involved in drilling on the Norwegian Shelf. A safety level equal to or higher than the current level will be used as a basis by the expert group.

In connection with developing fields, development and production with a fixed rig will be an alternative to hiring a mobile facility at moderate sea depths. Choosing a drilling solution depends on many factors. The number of wells and well interventions used as a basis has great significance. The geographical placement of the well as regards the production facility is another important Chapter, which is associated with the size and complexity of the reservoir. The cost picture also differs. Installation of fixed rigs requires considerable investments, while for mobile facilities the entire cost is continuous rig rent. It is important that these alternatives are considered by the licensees.

The Government will:

- Appoint an expert group to highlight and identify obstacles that limit the rig capacity on the Norwegian Shelf and propose measures that could improve the flow of vessels involved in drilling on the Norwegian Shelf.
- Encourage the licensees on the Norwegian Shelf to establish rig cooperation schemes, where rigs are contracted on a long-term basis.
- Ensure installation of fixed rigs is considered by the licensees in connection with relevant, new developments.

4.3.2 Coordination

The expert committee proposes that the authorities, in cooperation with the petroleum industry, should carry out a thorough evaluation of the rewards associated with better coordination of fields on the Norwegian Shelf. The evaluation should emphasise the effect of coordination on profitability, including operating costs and the recovery rate on existing and surrounding fields. The analysis will form the basis for possible measures for better coordination on the Norwegian Continental Shelf.

There is extensive experience on the Norwegian Shelf with developing discoveries jointly, when this is most profitable. This type of solution is most manageable when the relevant discoveries have the same ownership. This could either be the case from the start or could be achieved through unitisation.

The Norwegian Petroleum Directorate has an important task in looking at development of new discoveries in an area context. Similarly, Gassco plays a part in looking at gas evacuation from new discoveries in a shelf perspective. When there could be advantages associated with a coordinated development of multiple discoveries, initiatives are made vis-à-vis the owners of the relevant discoveries to also evaluate the consequences of such a solution. Coordination could trigger major operational advantages that could provide both financial rewards and other benefits, such as making measures like power from shore more realistic.

The Government will:

- Contribute to developments and fields being coordinated when this is the best solution as regards resource management.

4.3.3 Cost/benefit analyses in the event of new regulations/stricter practice

The expert committee has suggested that the authorities to a larger degree should highlight costs and benefits associated with changes in requirements and how they are put into practice for HSE and environmental measures, by establishing a transparent methodology along the lines of the Ministry of Finance's guidelines for cost and benefit analyses. In this way, it will be easier to achieve a more comprehensive approach. The committee further suggests that, for late phase fields, the authorities must be cautious in stipulating new, costly and extensive requirements for HSE and the external environment, as this shortens a field's lifetime and results in loss of values.

The Norwegian petroleum activities have shown good results both as regards safety and safeguarding the external environment. This is a result of targeted efforts over many years. As regards safety, functional risk-based regulations have been developed which emphasise prevention, safety and continuous improvement. National and international authority cooperation emphasising experience exchange and learning from accidents has also been an important factor. The activities are subject to strict requirements and instruments for both emissions to air and discharges to sea and for emergency preparedness for acute spills.

The considerations for health, safety and the external environment are important for all activity on the shelf. The stringent requirements for the safety level and safeguarding the external environment must be further developed. The safety regulations are an important reason why the Norwegian Shelf currently has facilities with high technical integrity and has had a positive development as regards safety. The Norwegian Shelf will continue to be a leader within safety. The extensive regulations established are a main reason for the activity having low emissions to air and discharges to sea compared with most other petroleum-producing countries.

In order to ensure a good basis for making decisions, e.g. in connection with regulatory amendments, the Instructions for Official Studies and Reports have been established. According to the Instructions for Official Studies and Reports, measures must be impact-assessed and the consequences must be quantified as far as possible. This applies for the petroleum sector in the same manner as for all other sectors. The overall effect of the factors included must be addressed. The consequences must be considered in relation to all overall or general considerations that could be of significance when assessing whether the measure should be implemented. Affected authorities should be included in the decision process before a decision is made.

The Ministry is concerned with good goal management in the sector, and is therefore concerned with ensuring that sound processes, pursuant to the Instructions for Official Studies and Reports, are implemented. It is important that cost/benefit analyses are used. These are important issues that the Ministry will continue to work on.

The Government will:

- Further develop stringent requirements for the safety level and safeguarding the external environment on the Norwegian Shelf, also for fields in the late phase.

4.3.4 Joint effort to reduce operating costs

The cost level within Norwegian petroleum activities has grown significantly in recent years, and has reached such a high level that it could threaten the long-term development of the indus-

try if the oil and gas price falls back to historic levels. Many profitable business opportunities could be lost if we do not achieve better cost control. The cost development experienced in recent years has a very complicated background and encompasses both international and domestic factors.

The expert committee directs several proposals to the industry. This includes a proposal for joint efforts to reduce operating costs on the Norwegian Shelf. Many of the other proposals directed at the industry also focus on reducing costs, including the need for standardising processes, solutions and adjustments in the contract regime. Controlling the cost level is mainly the industry's responsibility. There are many different issues associated with market conditions, organisation of the activity and other factors that contribute to an unfavourable cost development.

The industry has established the KonKraft agency, where they cooperate on factors that are crucial to the further development of the Norwegian Shelf. Trade unions, suppliers and oil companies participate in the agency. An important part of the work in KonKraft involves directing focus to the oil and gas industry's possibilities and challenges.

Improved recovery is an area in which the Ministry believes that KonKraft can make a positive contribution. Through its participants and composition, KonKraft is well-positioned to establish appropriate follow-up of the various areas where the industry is challenged by the expert committee to improve recovery. The Ministry has therefore requested that KonKraft prepare a proposal for processing/follow-up of the various proposals the expert committee has presented, as well as considering if, and potentially how, joint efforts to reduce operating costs on the Norwegian Continental Shelf can be organised. In total, KonKraft's assignment encompasses 16 different proposals from the expert committee. This work is already underway in KonKraft.

The Government will:

- Follow-up KonKraft's work on following up the expert committee's measures directed at the industry.

4.4 Measures – player composition and competition situation

The player scenario on the shelf has changed considerably over the last 15 years. This is partially the result of active policies from the authorities to bring in more and different players on the shelf, and partially an effect of consolidation in the industry. The development is described in more detail in Chapter 2.6 of the report.

4.4.1 Petoro and SDFI

The player composition and competitive situation is also a topic in the expert committee's report. The majority of the committee suggests that Petoro should be strengthened through changes in the company's current financing scheme. Furthermore, the committee believes that the authorities and licensees should to a greater extent carry out portfolio adaptations so that decisions that are crucial for improved recovery and value creation are more likely to be made, and also that the authorities must facilitate increased activity in the field transaction market.

On behalf of the State, Petoro is the administrator of the State's direct financial involvement in the petroleum activities (SDFI). As a licensee, Petoro plays an important role as a licensee in the fields where the State has direct ownership.

The large mature fields make up the core of SDFI's value creation. In 2009 and 2010, the company has increased its efforts to contribute to improved recovery from the mature fields. The Ministry finds it very important that this work be continued. An amplified effort from Petoro will also contribute to more measures for improved recovery being identified and implemented. Implementation of measures for improved recovery will have great significance as regards value for the State's ownership interests. The financial lifetimes of the facilities are challenged through uncertainty in reserve bases and increasing costs. It is therefore important that the correct decisions are made at the right time to ensure maximum recovery and the best possible utilisation of existing infrastructure. The issues faced by the partnerships are complex, which requires Petoro to carry out considerable work for the contributions to be relevant. Petoro has pointed out certain fields which they will follow-up in particular. This is discussed in more detail in Chapter 9.

The Ministry is concerned with providing Petoro with sufficient resources so the company can contribute increased value creation to the

State. The Ministry furthermore believes that the State's budgeting system ensures a unified and comprehensive assessment of the State's expenses for different purposes. The financing of Petoro should, along the lines of other purposes in the State budget, be subject to this important principle. The State budget system is not an obstacle for strengthening Petoro for the future through increased allocations or by varying the allocations from year to year as needed.

The Ministry believes that a well-functioning second-hand market for field interests will contribute to ensuring that companies which see the greatest value creation potential in a field become owners. The company that sees the greatest potential in a field will be willing to pay the most for an interest in the field. A functioning second-hand market is therefore positive and desirable from a resource management perspective.

Along with the tax and fee system, SDFI will secure the State a high percentage of value creation on the Norwegian Shelf. SDFI is not an instrument for facilitating increased activity in the second-hand market. Certain adjustments in the SDFI portfolio could become relevant, e.g. to promote cost-effective coordinated solutions for fields.

The Government will:

- Strengthen Petoro's expertise for following up mature fields.

4.4.2 Tax treatment of exploration costs

The expert committee notes that the increase in new companies focusing on exploration may have resulted in a weakened focus on operating fields/ improved recovery. They suggest a review of the scheme whereby companies can apply for reimbursement of the tax value of exploration costs, to examine the effect it has had on operating fields.

The petroleum taxation system is built on the rules for normal company taxation. It is designed to have a neutral effect on the companies' decisions regarding development and operation. This means that decisions that are profitable for the companies before tax must also be profitable after tax. Due to the extraordinary profitability in the recovery activities, the activity has also been subject to an additional special tax. The ordinary tax rate is, as on land, 28 per cent. The special tax rate is 50 per cent. In the basis for ordinary tax and special tax, depreciation and all relevant costs[4] are deducted from the taxable income. In order to shield the average rate of return from special tax, an extra investment-related deduction is provided (so-called uplift) in the calculation basis for special tax. There is fiscal consolidation between different fields. Companies that are not in a tax position can carry forward deficits and uplift with interest. In the event of cessation, these elements can be transferred.

From the 2005 income year, a change was implemented in the tax treatment of exploration costs for companies that are not in a tax position. The scheme is based on the companies, instead of carrying forward deficits with interest, can demand reimbursement of the tax value of exploration costs in connection with the tax assessment. This means that companies in and outside tax positions are treated equally as regards exploration costs. The scheme makes it easier for companies that are not in tax position to finance exploration activity.

The Ministry believes that a reimbursement scheme for the tax value of exploration costs has been very important, especially to stimulate timely exploration in mature areas. The equal tax treatment of players in and outside tax positions as regards exploration costs is a policy the Ministry wishes to continue.

4.5 Measures – technology development

The expert committee has proposed several measures within technology areas such as drilling and wells, advanced injection methods, subsea solutions and reservoir mapping. The committee e.g. recommends that the companies should to a greater extent test advanced recovery methods such as injection of surfactants[5], low-saline water and CO_2. These technologies are particularly important to recover the significant amount of immobile oil, and can contribute significantly to improved recovery on the Norwegian Shelf. Many of the methods have shown a great potential for improved oil recovery from onshore fields in the US and China, for example, but have not been widely used offshore. Several promising technologies have also been developed through laboratory studies and simulations, but they remain to be

[4] Including exploration costs, expenses for research and development, financing, operation and removal.

[5] A surfactant is a substance which is added to a reservoir to reduce the interface tension between oil and water. Detergents also contain surfactants.

tested at a larger scale on the fields. CO_2 for improved recovery will, in the long-term, be significant for resource utilisation on the Norwegian Shelf. It will therefore be natural to see CO_2 storage from Norwegian sources in connection with possible future use of the gas as a recovery measure.

The committee recommends, for instance, that the authorities should establish a forum for cooperating on pilot projects with participation from the most important players and decision-makers on the shelf. The committee also recommends strengthening DEMO2000. In the submissions to the recovery committee's report, there is general agreement on the need for more pilot testing and technology development on the Norwegian Shelf.

New technology and new solutions will be necessary in many cases to mature new profitable reserves and to realise the great potential from improved recovery on the Norwegian Shelf. The State, as resource owner, has an important role to play as an initiator and facilitator to ensure that all possibilities for improved recovery and increased value creation are considered before the fields are shut down. Through SDFI and the tax system, the State assumes considerable risks, costs and value creation from improved recovery measures.

Since the fields and infrastructure have limited lifetimes, it is crucial that pilot testing starts quickly. Reports from the companies to the Norwegian Petroleum Directorate indicate that a significant number of pilots have been delayed or will not be carried out. There could be several reasons for the downgrade of pilots. For example, the companies seem to prioritise ordinary operations over pilot testing, which often entails higher technical and financial risk. Furthermore, the current development projects are smaller than before, and are not as financially equipped to carry out development and testing of new technology.

State co-financing of pilots could contribute to acceleration and realisation of several socio-economically profitable projects. There is often a transfer value from a pilot on one field to other fields. The owners of individual fields will not take this into account when deciding whether or not to carry out a pilot. Significant resources are at stake for the State as resource owner. If the market is unable to bring about sufficient new technology or pilots, the authorities should implement various measures.

The Ministry agrees with the committee that more production licenses/companies should jointly plan pilots. With more small players and discoveries on the Norwegian Shelf, coordination of new technology testing across the licenses will be even more important than before. Through FORCE, the Norwegian Petroleum Directorate has taken an initiative to facilitate such cooperation. The agency currently consists of 35 oil and gas companies that are willing to explore the possibilities for sharing costs and results in connection with field pilots. Through FORCE, the Ministry will continue to bring forth more pilots and, along with key players on the Norwegian Shelf, work for increased efforts regarding testing new technology on the Norwegian Shelf.

As there are considerable volumes of oil that are difficult to recover with conventional technology, advanced technology that can retrieve these resources must be prioritised and advanced. There will therefore be a special need to propose pilot tests within advanced injection methods to recover more of the difficult oil. These issues are discussed in more detail in Chapter 8.7.

The Government will:

- Work for increased efforts on testing new technology together with key players on the Norwegian Shelf.
- Consider establishing a research centre within improved recovery.

4.6 Infrastructure – use and further development

This Chapter addresses two elements of the infrastructure on the continental shelf. The first Chapter addresses use and further development of the gas transport system. The other element addressed here is the regulations associated with conditions for using others' facilities.

4.6.1 The Norwegian gas transport system – organisation and regulation

The Norwegian gas transport system consists of a network of pipelines with a total length of about 8000 km, six landing points in four countries (the UK, Germany, Belgium and France), as well as four Norwegian onshore gas treatment facilities (Kårstø, Kollsnes, Nyhamna and Melkøya). Gas export in the form of liquefied natural gas (LNG) on ships from Melkøya enables Norwegian dry gas to reach markets outside Europe. To date, more than NOK 260 billion has been invested in the network, calculated at current value.

The transport capacity in the Norwegian gas transport system depends on a number of factors, such as pressure and temperature. The total available capacity for Norwegian export of dry gas through pipelines is about 370 million scm per day. This amounts to 120 billion scm per year. In addition, LNG amounting to more than 10 million scm per day is exported from Melkøya. An additional 9 million scm is used per day in this country for power and heating, for methanol production at Tjeldbergodden or transported to the Grane or Tyrihans fields as injection gas to increase oil production. Gas is also used for injection on other fields on the Norwegian Shelf to increase oil production.

The operator of the gas transport system, Gassco, prepares a transport plan every year which analyses the total need for gas transport up to 15 years into the future. Future production is uncertain. Unlike previous years, last year's transport plan represented a clear change in that new discoveries are not replacing reduced production from existing fields, even when prognoses from all discoveries on the shelf are included. Part of the reason for this is that the resource estimates in certain discoveries and fields have been reduced.

The infrastructure for gas transportation from the Norwegian Shelf has been gradually further developed in connection with development of new fields. These have been fields with significant amounts of gas which have warranted major investments in dedicated transport solutions. Building pipelines is a costly endeavour, and investments in the transport system provide considerable scale advantages. The gas transport system can be characterised as a natural monopoly with major basic investments. There is need for regulated access and tariffs in the system to ensure equal access to the system for everyone with gas transport needs.

The gas infrastructure is utilised by multiple users and organised in an integrated manner with a joint ownership structure through Gassled. The operating responsibility for the gas pipelines and transport-related gas treatment facilities lies with Gassco, a limited company wholly-owned by the State. This organisation results in efficient use of the gas transport system and reduces operating costs. The goal is efficient utilisation of the gas transport capacity, as well as ensuring easy access to available capacity for the users and at the tariffs stipulated by the authorities.

The gas transport system is neutral for all players with a need to transport natural gas. Natural gas companies and qualified users have a right to access on non-discriminating, objective and transparent conditions. These users have access to capacity in the system based on their need for gas transport. Gassco is responsible for capacity allocations and for ensuring that transport rights are transferred between users as needs change.

The returns from the gas transport infrastructure are regulated by the authorities. This ensures the earnings are extracted on the fields and not in the transport system. Tariffs in newer pipelines are stipulated so the owners can expect real returns of about seven per cent before tax on the total capital, with a possibility of minor additional income to stimulate increased utilisation and cost-effective operations. The tariffs provide the owners with reasonable returns while also preventing additional profits from being taken out in pipelines and treatment facilities.

The Ministry determines the main principles for access to the transport system and stipulates tariffs for its utilisation. In 2008, the Ministry initiated an extensive review of the access regime. So-called interruptible capacity will be introduced. The current rules giving pipeline owners priority when reserving available capacity will be revoked. This will ensure more efficient utilisation of the gas transport system and equal treatment of all companies that produce natural gas on the Norwegian Shelf. The Ministry will establish an expert board to independently resolve disputes in individual cases where there is disagreement regarding access to the gas transport system.

The majority of the gas transport system on the Norwegian Shelf is owned by the Gassled partnership. The Gassled owners have traditionally been companies that produce gas on the Norwegian Shelf. As an operator, Gassco carries out activities on behalf of the partnership at the participants' cost and risk. Thus, Gassco has no earnings. Companies wishing to transport gas pay transport tariffs designed to cover the direct costs of operating the transport system, as well as provide the owners with reasonable returns on the transport system investments.

The authorities' goal is for third-party use of gas pipelines and associated facilities to take place based on tariffs and conditions stipulated by the Ministry and laid down in the tariff regulations. In instances where third-party use of gas pipelines and associated facilities that are not already included in the tariff regulations is considered, the Ministry will include these facilities in the regulations. The issue of operator responsibility for

the relevant facility will also be considered in such cases.

Gassled includes all rich and dry gas infrastructure currently in use, as well as so-called third-party use, i.e. where plans include transport of gas in the infrastructure by a party other than the owner. The system accommodates incorporation of new pipelines and transport-related facilities in Gassled from the time third-party use becomes relevant, and new facilities can thus become a part of the central upstream gas transport system. Joint ownership of the entire transport system ensures the gas is transported as efficiently as possible, thus providing maximum value creation. This is due, in part, to the fact that it allows to avoid conflicts of interest as regards which pipeline the gas will be transported through.

The users pay for the operation of the transport system through tariffs. The users also make a significant contribution to further development of the transport system through participation in various investment groups. There has been a need to strengthen the users' opportunities for voicing their views on how the system should be operated and developed. The Ministry has therefore asked Gassco to strengthen the existing user forum in the system. The forum will provide recommendations to Gassco in matters related to technical operation, use and further development of the system. The user forum will also endorse the part of Gassco's budget which deals with operations and further development. The forum does not have a mandate to make decisions.

Through introduction of regulated tariffs, third party access and establishment of an independent operator, the owners' influence over the

Box 4.2 New gas infrastructure in the Norwegian Sea

Due to the responsibility for comprehensive further development of the gas transport system, Gassco has the authority to finance studies on new infrastructure until the relevant concept is defined and found feasible. Then Gassco must promote the project to find companies willing to invest in further realisation of the project. The final investment decision is made at a later time during the process.

The rich gas pipeline from Åsgard to Kårstø (Åsgard transport) will for a period in the future be a bottleneck for gas transport out of the Norwegian Sea. So far, new discoveries have not been made in the Norwegian Sea of a size which would justify a new, larger infrastructure development consisting of a landing pipeline, gas treatment facility and export pipeline. However, multiple discoveries in the Norwegian Sea could require transport solutions as early as 2016-2017, depending on a development decision. Åsgard transport does not have the capacity to transport new gas until after 2021. If these discoveries are to be developed according to the licensees' plans, existing infrastructure must be used, or new infrastructure must be developed.

Gassco has worked on studies regarding increased transport capacity for new volumes out of the Norwegian Sea. These studies have been carried out in close cooperation with Statoil and Shell, who are the operators of Luva and Linnorm, respectively. These two discoveries form the primary basis, but other possible gas volumes in the Norwegian Sea have been considered.

The main topic of the studies has been to research a new pipeline for Nyhamna, as well as consider how to increase the capacity in Langeled and Nyhamna. Furthermore, possibilities for a pipeline connection between existing infrastructure around Åsgard transport and a new pipeline for Nyhamna have been considered. Gassco has also researched landing to Nordland and LNG transport, but these alternatives have been rejected due to high costs.

There are several challenges associated with a gas evacuation solution from the Norwegian Sea. In addition to technological challenges associated with e.g. deep water, wave height, high temperatures and pressure in the reservoirs, there are significant distances between the gas discoveries. Some of the discoveries also have a higher CO_2 content than the prevailing specification requirements for the gas recipients. This means that the CO_2-rich gas must be mixed with more CO_2-poor gas and/or dedicated technical solutions to separate CO_2 must be established.

Several companies with shut-in gas volumes in the Norwegian Sea have reported an interest in financing further studies of gas transport capacity out of the Norwegian Sea.

transport system has been reduced. This has led to a reduced interest in participation in Gassled on the part of some of the traditional owners. ExxonMobil recently sold out of Gassled. Several other owners have started sales processes. The company which ExxonMobil sold its share to, Njord Infrastructure AS, represents a new type of owner in Gassled because this company is primarily entering the owner side for financial reasons. The Ministry has consented to this transfer, but has stipulated requirements as regards certain aspects of the buyer's financing and organisation. It is important to the Ministry to have a diversified ownership in Gassled in the years to come, e.g. to distribute the financial responsibility among more participants.

Licensees must have the necessary qualifications to carry out their tasks in a responsible manner. Which specific qualifications are necessary depends on what type of tasks will be carried out. Different qualifications are required for owners in a transport system such as Gassled than for owners in production licenses. The fact that Gassled has a competent and independent operator (Gassco), that the activity regulates returns, that new infrastructure can be developed and financed outside Gassled and that there is open, non-discriminatory access to the system, all contribute to define the role and tasks of an owner in Gassled. This framework will be reflected when determining the necessary qualifications and financial capacity for an owner of the system.

Considerable investments have been made in the gas infrastructure on the Norwegian Shelf. Significant gas volumes are needed for new gas infrastructure to be realised. Given the large investments required to build new gas infrastructure and the relatively low transportation costs in existing systems, the oil and gas companies will have incentives to use existing gas infrastructure when considering different transport alternatives for new gas. In the event of full capacity utilisation in transport and/or gas treatment facilities, the companies will face the choice of delaying gas evacuation until capacity becomes available in the existing infrastructure, injecting gas in reservoirs which could contribute to improving oil recovery, or building new gas infrastructure. The most important elements in such an analysis are:

1. When capacity will become available in the existing infrastructure
2. Costs of new gas infrastructure
3. How the gas evacuation solution impacts oil production

It is therefore advantageous for the development of the gas transport system to have a regular activity level on the shelf, continuously adding resources both from improved recovery, development of new discoveries and new resources from the exploration activity.

There are two characteristics of the Norwegian Shelf that will impact the development of the gas infrastructure in the future. Development of new areas located north of existing pipeline grids will require new gas infrastructure, while production from existing gas fields is also declining.

The trend towards smaller discoveries will make it more challenging to justify strengthening and further development of existing infrastructure. It could also be necessary to consider phase-out of the infrastructure unless new major discoveries are made within a reasonable time. When dismantling and phasing out parts of the gas infrastructure have started, this will make a potential need for transport capacity for subsequent discoveries more expensive. It could be challenging to reinstate pipelines and process facilities that have not been operating for a period of time due to lack of competence, deficient maintenance and technically-outdated equipment.

A comprehensive further development of the gas infrastructure is an important tool to ensure efficient resource management on the Norwegian Shelf. Various forms of market failure could lead to a disparity between the companies' view on efficient infrastructure development and the authorities' view. Sources of market failure could include coordination problems between the different partnerships and the licensees or different strategic interests.

As the shelf matures and fields being developed become smaller, coordinating infrastructure projects across production licenses will become increasingly important. The authorities have therefore emphasised playing an active role in the development of gas infrastructure on the Norwegian Shelf. Gassco is a key player in this effort. The company possesses extensive knowledge about gas transport and unique familiarity with the system the company is operating. This, in combination with Gassco's position as an independent player without ownership in production licenses or transport systems, makes the company suited to coordinate interests across production licenses and thus safeguard overall shelf considerations. Since its start in 2001, Gassco has had a regulatory responsibility to further develop the gas transport system on the Norwegian Shelf.

This responsibility has been clarified further through regulatory amendments.

The Ministry receives sufficient information regarding new infrastructure projects early on. The Ministry is then able to ensure that the studies deemed necessary by the authorities are carried out. This ensures the best possible basis for making decisions when the authorities process plans for installation and operation of new infrastructure projects. Gassco's assessments will be one of several important contributions to the authorities' comprehensive assessment of a submitted plan for installation and operation. The decision to apply for permission for installation and operation, and choice of the development solution to be included in such an application, must still be made by the licensees.

In the years to come, further development of infrastructure will consist of smaller, but still relatively extensive projects, such as removing bottlenecks in the gas transport system and making it more robust. In addition, the infrastructure must be able to receive gas with a different composition than before, for instance, with higher H_2S and CO_2 content.

Gassco will contribute to a comprehensive further development of Norwegian gas infrastructure. In instances where larger developments are considered, it is therefore important to have an area perspective so that smaller discoveries are also included in the assessments. A further development of the gas infrastructure must also take place in a manner which serves the existing gas infrastructure.

Norwegian gas activities make up an important part of the petroleum sector and generate considerable value for the Norwegian society. It is important that the infrastructure operation is cost-effective, as this could contribute to ensuring that new discoveries are attractive.

The Government will:

- Regulate access to and tariffs in the gas transport system and ensure equal access for everyone with gas transport needs.
- Establish an expert board to resolve disputes in individual cases where there is disagreement regarding access to the gas transport system.
- Strengthen the existing Gassled user forum to ensure that the users' views on how the system is operated and developed are voiced.

4.6.2 Third-party use of facilities

A more mature continental shelf sets strict requirements for efficient use of infrastructure as regards resource management. It is the authorities' responsibility to facilitate predictable and reasonable conditions for use of facilities by others, as well as contributing to efficient negotiations. The Ministry laid down the Regulations relating to use of facilities by others (TPA Regulations) in 2005. Based on the consideration for good resource management, the purpose of the regulations is to ensure good incentives for exploration, new field development and improved recovery through efficient negotiation processes and appropriate profit sharing in connection with use of existing facilities. The introduction of the regulations has contributed to easier realisation of time-critical resources near planned and existing infrastructure.

This will be achieved through providing a clear framework for the negotiation process and the design of tariffs and conditions in agreements relating to the use of facilities by others. With smaller developments, use of existing facilities will often be a prerequisite in order to achieve acceptable profitability. In this phase, it is very important that the infrastructure owners allow third-party use of available capacity.

Both for licensees in the field with established infrastructure (owner field) and the licensees in the field that wants to use existing infrastructure (user field), tariffs and conditions for use will be very important for whether such third-party use is actually realised. Mainly, the parties themselves will determine the commercial conditions for such use through negotiations. The regulations implement the principle that earnings from recovery must mainly be taken out on the user field. Other tariffs and conditions related to the use of facilities by others must be at a reasonable level and calculated with a basis in the services offered. The owner field is entitled to reasonable earnings for such use, also taking into account the risk it assumes as a result of the third-party use.

In the current regulations, the companies have a duty to report vis-à-vis the Ministry, which will contribute to efficient negotiation processes. The Ministry will consider which amendments need to be made to the regulations to ensure that the duty of disclosure assumed by the companies functions as intended.

With a basis in the agreements signed after the TPA regulations entered into force and the Ministry's experiences with the regulations up to

now, the Ministry intends to make amendments to the regulations. A key topic will be whether the regulations result in the best possible balance between the consideration for efficient resource utilisation and the goal that as much of the earnings as possible must be taken out through recovery in fields, not through ownership of existing infrastructure.

The Government will:

- Amend the Regulations relating to use of facilities by others (TPA Regulations) with the goal of more efficient resource utilisation, and that the maximum amount of earnings are taken out in the new fields.

4.7 Development of discoveries

At the end of 2010, 100 discoveries on the Norwegian Shelf were not developed. The overall resource estimate for these was 700 million scm o.e., which amounts to about 15 per cent of the remaining proven resources.

For discoveries that have not been developed, the goal is to find development solutions that provide the best resource management and create the most value for society, while also safeguarding environmental and safety considerations. Many of the current discoveries are small, and thus need to utilise existing infrastructure and be developed quickly in order to be profitable, cf. Figure 4.9. Most development candidates can be developed with a subsea template tied in to existing infrastructure.

4.7.1 Discoveries approaching a development decision

Estimates indicate record-high development activity on the Norwegian Shelf in 2011. Beyond the projects where development has already been approved, decisions regarding several projects connected to existing fields are expected, as well as a number of new developments.

Ekofisk Sør and Eldfisk II are the largest projects connected to existing fields that were processed by the authorities in 2011. The compression projects on Åsgard and Troll are also large projects underway on existing fields. In total,

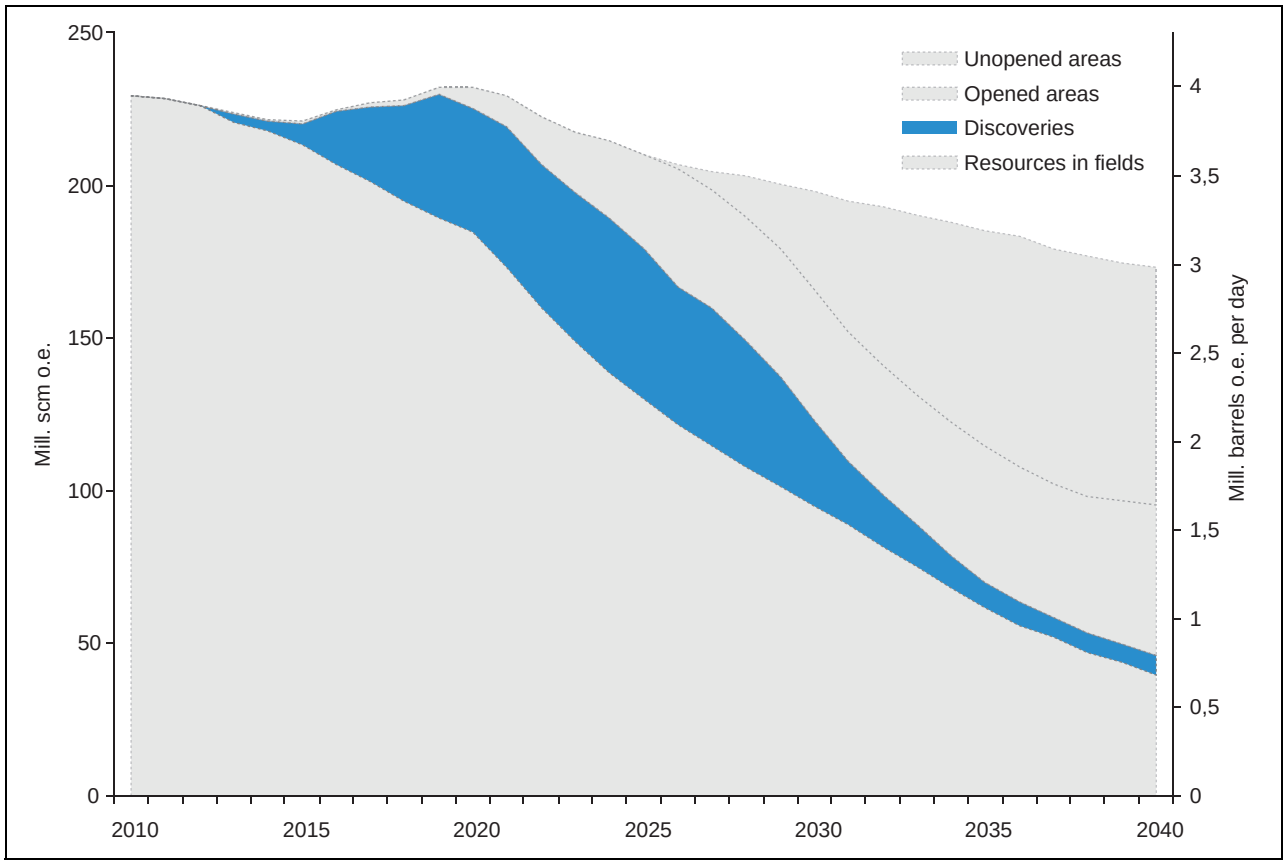

Figure 4.8 Possible production course on the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

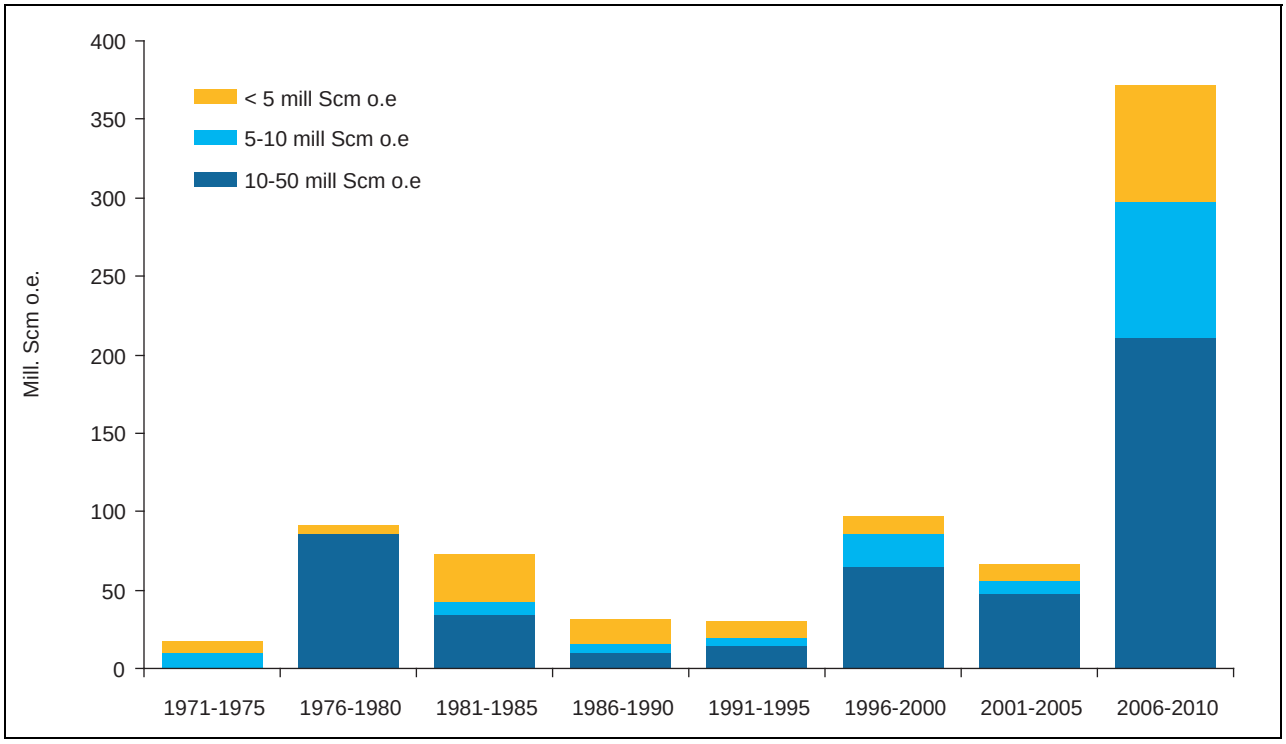

Figure 4.9 Size of discoveries and discovery year for non-developed discoveries.

Source: Norwegian Petroleum Directorate.

investments of more than NOK 80 billion are planned in these projects.

Hild, Luno, Draupne, Bream and Skuld are all new, major projects which the companies are working to propose in 2011. All of these projects have an investment scope exceeding NOK 10 billion, and will be submitted to the Storting (Norwegian Parliament). Development of the Valemon and Knarr fields has also been subject to authority processing in 2011. The total investments in these projects have been estimated at more than NOK 105 billion.

Hyme, Visund Sør, Stjerne and Vigdis Nordøst are the working names for projects with estimated investments of less than NOK 10 billion that have been proposed thus far in 2011. In total, the investments associated with these projects have been estimated at about NOK 20 billion.

The overall investments over time associated with projects that are expected to be proposed in 2011, have been estimated at more than NOK 200 billion. The reserve growth due to the new fields amounts to about 200 million scm o.e. The independent developments will be hubs that will make profitable development of nearby minor fields possible. The small fields tied in to existing fields will contribute to extended lifetimes and improved recovery from the parent fields. Development of the fields will entail considerable deliveries from the Norwegian supply industry.

4.7.2 Other discoveries

As part of its follow-up of activity on the shelf, the Norwegian Petroleum Directorate annually maps factors that delay the progress of developing discoveries. The follow-up shows that socio-economically profitable discoveries are developed, but that the process takes time because the development solution must await access to processing and transport infrastructure, commercial agreements and maturing of the resource base.

There are several causes for why discoveries have not yet been developed. According to reports received by the Norwegian Petroleum Directorate, a lack of infrastructure capacity or gas solution is the reason behind about one-third of the stalled projects. Uncertainty as regards the resource base and reservoir conditions is the reported reason for halting more than another third of such projects.

Small discoveries can either be developed through phase-in to existing fields or through a coordinated development of multiple discoveries. In the North Sea, there are many cases where phase-in to established infrastructure and utilisa-

tion of available capacity in late phase fields, must compete with establishment of new and independent field centres. Such centres can be realised through a coordinated development of multiple deposits. These challenges may also apply to the Norwegian Sea and Barents Sea. The concept solution will be considered based on e.g. the discovery potential in the area and costs associated with lifetime extension on existing facilities that are relevant for tie-in.

The review confirms the impression from previous studies that profitable discoveries are developed, but this may take time as a profitable development solution must wait for access to processing and/or transport infrastructure, or the resource base must mature. At the same time, many small discoveries are made which are not profitable with the work processes and cost level established on the continental shelf. Standardisation and quicker project implementation could contribute to making more discoveries profitable.

4.7.3 Profitability for small discoveries – standardisation

Profitable development of more small discoveries will require a different approach than the development solutions and work methods that have dominated the industry up to this point. Not least, a review of work processes and decision processes in the industry will be important.

Both a larger degree of standardisation of development solutions and effective coordination of developments can contribute positively to profitability. This applies both to coordinated development of discoveries across ownership, as well as coordination through use of existing infrastructure. Standardised development solutions seem to be most relevant for discoveries where the plan calls for development with subsea solutions, where production with few wells is planned, and where the upside potential for resources is assumed to be limited. Gas discoveries are considered to represent fewer challenges than minor oil discoveries, which could involve issues as regards depletion strategy, number and placement of wells, in addition to the need for gas or water injection.

Developments with an independent facility will always have greater flexibility as regards production forms, depletion strategy and phase-in of new resources. Therefore, it must be considered in each case whether the resources are of such a scope and nature that they facilitate simple or standardised developments.

Important factors when developing small discoveries include:

- Efficient phase-in of new discoveries as capacity becomes available.
- Rapid development and lower costs.
- Good coordination across different licensee groups.
- Improving the efficiency of operation and coordination of activities to achieve lower costs on the large, mature fields.

An increased need to carry out early investments could be a consequence of rapid, standardised development solutions. Furthermore, it could become more challenging to establish sufficient flexibility as regards potential subsequent measures to improve the recovery rate from the fields, and to have a facility that can develop a possible upside potential in the relevant area. For many of these discoveries, a simplified process will be based on drilling only one well before development is determined. The resource potential will then often be less clarified than for previously completed developments. Coordination with other minor discoveries in an area could also be an issue in areas where this potential has not been well-researched.

Simplified developments with standardised, well-documented solutions could be a good way of securing profitable production of more marginal resources. This must be carried out in a manner which adheres to applicable safety and environmental requirements. The alternative to such a new approach could be that the resources remain in the ground because they are not profitable with traditional solutions and work processes.

The current authority practice also facilitates rapid project implementation and standardised solutions. Development projects with an investment framework less than NOK 10 billion will not normally require processing by the Storting. This means that the official processing of the projects can be carried out in eight to ten weeks from when the Ministry receives a development plan until approval is granted. This assumes the impact assessment obligation has been clarified before the plan is submitted to the Ministry. The impact assessment obligation could be fulfilled through previous impact assessments and/or a regional impact assessment.

The Ministry will determine whether the impact assessment obligation is considered fulfilled. Establishing that the impact assessment duty is fulfilled through previous impact assessments takes place by the operator submitting an application for this to the Ministry. In most cases,

the Ministry will often consult with other ministries, usually the Ministry of Fisheries and Coastal Affairs and the Ministry of the Environment, before a decision is made. All projects must be sufficiently impact-assessed in order for the impact assessment duty to be considered fulfilled.

In 2010, the Ministry updated the PDO/PIO guidelines[6] in cooperation with the Ministry of Labour. The objective of the guidelines is to e.g. show how the authorities' need for documentation may be adapted to the size and complexity of the projects. Small, simple projects require simpler documentation than large, complicated projects. Another important factor addressed by the new guidelines is the necessity of good contact with the authorities before important directions are made in the projects, i.e. in reasonable time before the plans are submitted to the authorities. Such early contact will, for instance, help determine whether the projects are suited for fast-track development. By involving the authorities at an early stage, the need for processing time is reduced when the plans are submitted to the authorities for approval, and the risk of choosing development solutions that are not acceptable to the authorities is also reduced.

With the current pattern for the licensees' preparation of and decisions regarding plans for development and operation, fast-track developments will often require entering into important contracts before authority approval is granted. This is because some of the equipment has a long delivery period, or because purchasing early results in lower costs. The Petroleum Act and the current authority practice provide a possibility for this. A precondition for allowing companies to enter into contracts early is that it does not impede the authorities' ability to exert influence on development solutions. Applications for early contract awards are therefore subjected to thorough scrutiny. Important elements of such processing will include whether standardised equipment will be used which can alternatively be used in other projects, whether the solution provides good coordination across licensee groups and whether suitable environmental solutions are chosen.

For small developments where the conditions are otherwise suited for rapid project progress, it could also be appropriate to submit the development plan to the Ministry at an earlier time than with the current practice. The official processing of the development will then better correspond with the licensees' decision process. This will facilitate obtaining necessary clarifications associated with the projects at a suitable time. The need to enter into contracts before the development is approved will be reduced.

With earlier submission of the development plan, there will be greater uncertainty associated with resources and costs. As long as the decision basis is good enough for the licensees to make their investment decisions, this will normally be good enough to prepare a development plan. The disadvantage of such a model could be that a development plan might more often be withdrawn after being submitted. The disadvantages of this are considered to be limited.

The Government will:

- Introduce a practice of earlier submittal of plans for development and operation (PDOs) in fast-track developments.

4.7.4 Naming petroleum deposits

Names are important symbols. The names given to new fields in new areas should reflect the importance of the activity to regions and to the country as a whole. Many fields have names taken from Norse mythology. This practice has provided many good field names with deep Norwegian roots.

Naming petroleum deposits, in this case fields, is regulated through the Regulations relating to the Act relating to petroleum activities and the Resource Management Regulations, respectively. The Regulations relating to the Act relating to petroleum activities stipulate that naming petroleum deposits, fixed facilities and wells, as well as using proper names when naming fields, must be approved by the Norwegian Petroleum Directorate (NPD) and that the NPD can stipulate further provisions to supplement this Chapter. The Resource Management Regulations stipulate:

> «The licensee shall, no later than the time of submission of the Plan for Development and Operation (PDO) or an application for exemption in respect of such plan, forward to the Norwegian Petroleum Directorate an application for consent to naming of the field. The field name shall be applicable as from the time when the Plan for Development and Operation has been approved or when the Ministry has decided not to require such plan to be submitted for approval.»

[6] Guidelines for plans for development and operation of a petroleum deposit and plans for installation and operation of facilities (PIO).

A final decision regarding the name is stipulated by the Norwegian Petroleum Directorate.

On behalf of the licensees, the operator applies for approval of a field name to the NPD. Emphasis has been placed on the new field name being compatible with other field names in the same area. For example, a small field, with the working name Pi, was named Gaupe (lynx) in June 2007, because the same area contained fields with names such as Rev (fox) and Varg (wolf). Before approval, the NPD submits the proposed name to the Norwegian Language Council for comment.

The Ministry intends to implement an adjustment as regards naming petroleum deposits. The current practice will be continued for small, new fields developed using existing facilities. Such fields must be named in accordance with the established name practices in the relevant area.

Larger, independent developments, however, have a greater symbolic effect than smaller satellite fields. This is particularly the case in new/frontier areas such as the Barents Sea. It is important that the chosen name reflects the significance of the project and activity for such developments. The names from Norse mythology with the strongest symbolic effect have already been used. Discoveries that represent a significant leap or great progress for the industry, the region or country, must have names reflecting this. A good name must capture the context. The Ministry will therefore review the current system to ensure that it contributes to field names for major, independent developments with a national context and historical significance.

The Government will:

- Review the current naming system to ensure that it contributes to major, independent developments receiving field names that have a national context and historical significance.

4.7.5 Ownership and taxation of facilities

Most production facilities used in petroleum activities are owned by the licensees on the fields so that all income and fees are included in the licensees' tax accounts according to the Petroleum Taxation Act. How these revenue streams are internally priced will thus not be of tax significance to the licensees.

There are several examples of production facilities, such as a production ship, being owned and hired by owner companies that operate outside the petroleum taxation system. In such instances, the price paid by the licensees to rent the facility will be very significant to the overall tax payment from the field.

If the parties that own and hire the production facility are completely independent of the relevant licensees, the licensees have a significant interest in keeping the hiring costs as low as possible. Every NOK spent "over-paying" for rent, will mean lower profit, both before and after tax, for the licensees.

If companies that own and hire production facilities are taxed outside the petroleum taxation system, while the licensees also have financial interests in the production facility, there is a risk of tax-motivated decisions. This could entail unfavourable decisions for the State as resource owner. This is because the rent income from the facility will be subject to a lower tax rate than the marginal rate in the petroleum taxation regime. The licensees' rent expenses will, however, be a deduction in the basis for petroleum tax. If the licensees have financial exposure in the production facility, they will no longer have the same financial incentives to establish low rental prices. Maintaining high rental prices will be a great advantage for them. The tax aspects of this are handled by the tax authorities when processing the licensees' tax assessment.

This could result in challenges for the resource authorities as it could also impact which development solution is chosen. The possibilities for tax optimisation through renting a facility could lead to a socio-economic loss if the development solution is influenced. The resource authorities are concerned with regulating the activity so that socio-economic losses are avoided. On this basis, the Government will amend the petroleum regulations so the licensees cannot rent production facilities from companies/players where they already have a financial interest.

The Government will:

- Amend the petroleum regulations so licensees cannot rent production facilities from affiliated companies.

4.7.6 Development of discoveries results in spin-off effects

One of the Government's goals is for development of new discoveries to create the greatest possible value for society and to result in local and regional spin-off effects. According to the EEA agreement, Norway is part of the EU's internal market, which

is founded on certain basic principles regarding free movement of goods and services, free competition, prohibition against discrimination based on nationality, etc. The EEA agreement thus restricts a country's ability to stipulate conditions for economic activity based on national considerations. The ESA has determined that Section 10-2 of the Petroleum Act has not been designed in a manner in which it can be considered to comply with Norway's commitments under the EEA agreement. This relates to provisions associated with the organisation of licensees' petroleum activity in Norway and base use. The Ministry therefore submitted a proposal, cf. Prop. 102 L (2010–2011), regarding certain amendments to the Act. The objective of the amendments is to ensure better compliance between the wording of the Act and Norway's commitments under the EEA agreement. The text will also better reflect the practice that has been established pursuant to the provision.

The proposed amendments will not weaken the possibilities to create spin-off effects through further development of the Norwegian petroleum activities. The central precondition to achieve spin-off effects is further development of profitable activity. The framework and authority involvement in connection with the activity will ensure that the possibility for achieving favourable local and regional spin-off effects will be continued to the degree the activity forms a basis for it.

It is important to find socio-economically sound development and operation solutions when developing discoveries. Experiences from developments such as Skarv, Ormen Lange, Snøhvit and Goliat show that new major developments lead to significant local and regional spin-off effects, independent of the development solution. In most cases, a landing solution will provide more workplaces locally and regionally during the operations phase than a purely offshore development. An important premise for achieving good spin-off effects is that local and regional businesses exploit the commercial possibilities provided by a development in the nearby area. Many small discoveries made now will be operated via existing facilities and will not result in increased staffing on the parent facility. However, such developments still entail a considerable potential for deliveries during the development and operations phase.

The dialogue and interaction between local and regional authorities and businesses are important when preparing a plan for development and operation. At the same time as the Ministry works to strengthen the spin-off effects, different interests must be balanced. It is important for the value of a project to largely fall to the community in the form of taxes and fees. These contribute to financing our welfare.

The authorities will be an active facilitator in ensuring regional and local spin-off effects. Their work in connection with processing development plans is designed to help identify good solutions. When the authorities approve a plan for development and operation, emphasis is placed on facilitating participation by regional and local companies in the competition for assignments associated with the activity to be established.

The guidelines for preparing development plans (PDO/PIO guidelines) state which expectations the authorities have for developments that could result in local and regional spin-off effects. It is assumed that the operator has extensive contact with local and regional authorities when preparing a major development case, and must, insofar as possible, facilitate local and regional business development from the project. The Ministry maintains a dialogue with the operator regarding how this should take place. This applies to all independent developments of a certain size.

The operator must analyse the local and regional businesses' competence and capacity as regards the need for goods and services during the development and operations phase. The operator will analyse various types of workforces in relation to its own needs, both during the development and operations phase, and will present measures to meet the workforce need. The expected local, regional and central employment effect must also be described. The operator should research which measures to implement in order to enhance expertise in the businesses, e.g. through supplier networks and information regarding work routines. The operator should also describe the possibilities for using local and regional workforces and indicate potential cooperation possibilities with other players. The operator will also assess the need for involvement from public authorities.

The clarification of this practice in the guidelines ensures that the operator, through its work with the impact assessment, is made familiar with the local and regional businesses and contacts local and regional authorities early on. This also ensures that all involved parties receive good information and an overview of the consequences of a development. In most developments, we have seen that good contact early on between the operator and regional players yields good results.

The Government will:

- Ensure that new discoveries create the greatest possible value for society and facilitate positive local and regional spin-off effects.
- Ensure early contact between the operator and local/regional businesses and relevant authorities.
- Stipulate requirements for societal factors to be researched in connection with plans for development and operation, including regional and local spin-off effects.
- Facilitate qualification of relevant local/regional suppliers during the development and operations phase.
- Facilitate establishment of new tendering processes for new developments that enable participation by companies from the region where the development is located.
- Ensure an effective base and operations structure, which contributes to local and regional business and competence development.
- Operators of new, independent developments must, no later than two years after the field starts producing, carry out an analysis of regional and local spin-off effects of the development.

5 Discovering more in opened areas

The objective of Norwegian exploration policy is to make new discoveries that are necessary to ensure a stable activity level, the highest possible value creation and State income over the medium and long term. This can best be achieved through an efficient and timely exploration of the Norwegian Shelf.

The areas of the Norwegian Shelf that are opened for petroleum activity include large parts of the North Sea, the Norwegian Sea and the southern part of the Barents Sea. Significant undiscovered resources are still expected in the unopened areas, which could provide a basis for activity for years to come. New area has not been opened to the petroleum industry since 1994. What were initially considered to be the most promising parts of the opened area have now been mapped.

Activity has been underway on large parts of the Norwegian Shelf for many years. These areas contain familiar geology and well-developed infrastructure, and the areas are deemed mature. Other parts of the shelf are characterised by less knowledge of the geology, a greater degree of technical challenges and a lack of infrastructure. These areas are called frontier areas. To achieve a suitable exploration of both mature and frontier areas, two equal licensing rounds have been established: awards in predefined areas (APA) for mature areas and numbered rounds for frontier areas.

As a petroleum province matures, the challenges and opportunities change. To ensure effi-

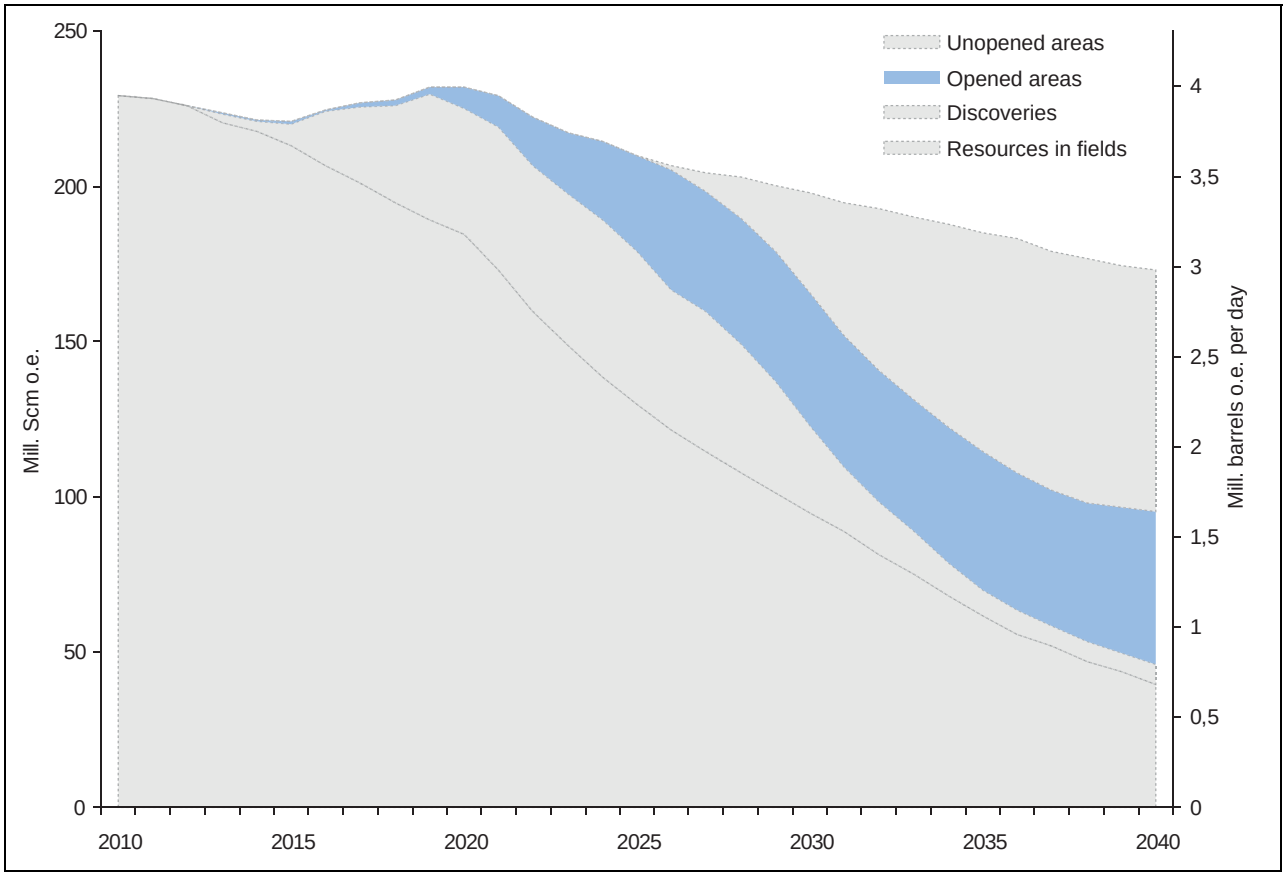

Figure 5.1 Possible production course on the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate.

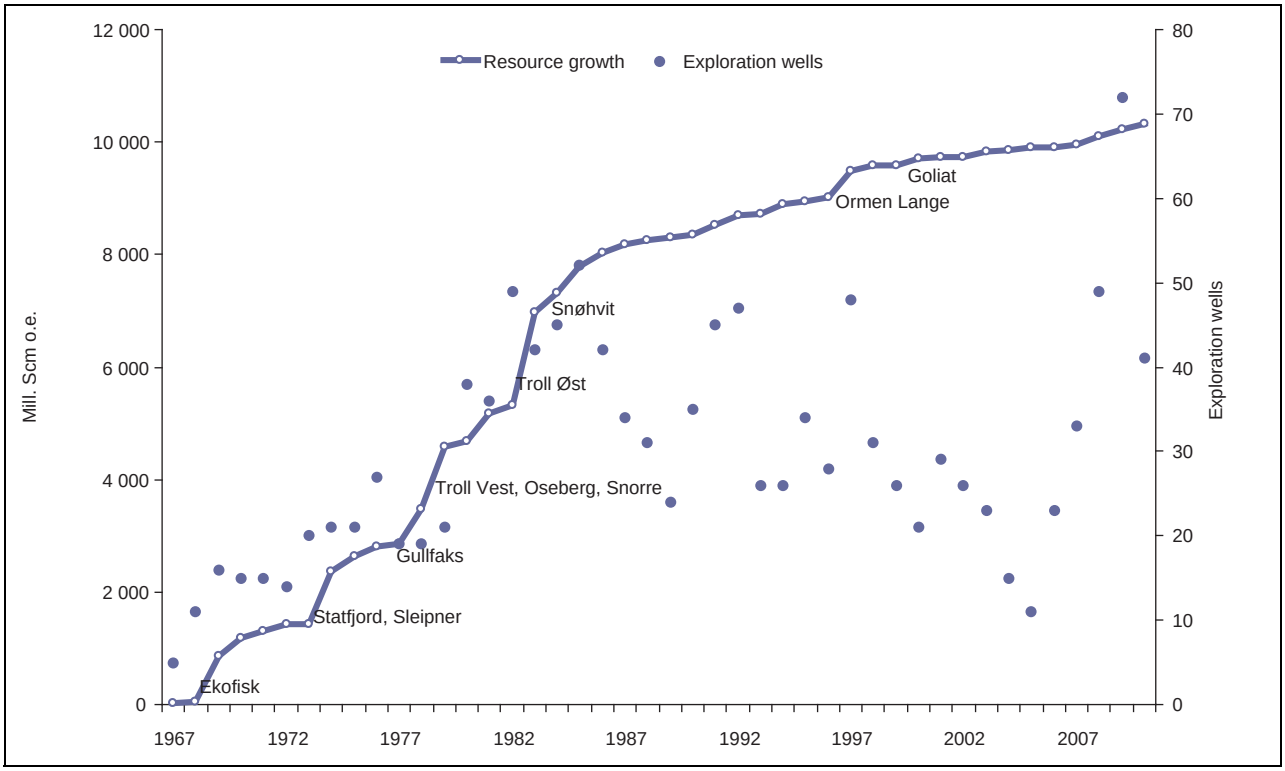

Figure 5.2 Cumulative resource growth over time, and the number of exploration wells drilled per year.
Source: Norwegian Petroleum Directorate.

cient exploration and development of potential discoveries, changes were undertaken in the petroleum policy ten years ago to attract players with a strong focus on the more mature areas of the Norwegian Shelf. The current player scenario is well-balanced, and consists of companies that focus on new, larger and more risky projects and companies that focus on smaller projects with lower risk.

The Government wants to maintain exploration activity. The most important instrument for achieving this is awarding area in licensing rounds. Extensive awards both in mature and frontier areas are important in maintaining a high level of exploration activity. It is necessary to maintain exploration activity so as to curb the decline in petroleum production. The Government will therefore continue a predictable award policy in relation to numbered rounds and APA rounds.

The Government will:

- Award production licenses in mature and frontier areas to curtail the decline in petroleum production.

5.1 Undiscovered resources in opened areas

Considerable volumes of recoverable resources are still expected on the Norwegian Shelf. The Norwegian Petroleum Directorate's estimate for the expected undiscovered resources is 2570 million scm o.e. The estimate's range of uncertainty is from 1020 scm o.e. to 4800 scm million o.e. The expected undiscovered resources are distributed between the three marine areas with 33 per cent expected in the North Sea, 30 per cent in the Norwegian Sea and 37 per cent in the Barents Sea.

Average discovery size declines as petroleum provinces mature, and this is also true of the areas on the Norwegian Continental Shelf. During the first 20 years, many particularly large discoveries were made on the Norwegian Shelf, and many of these fields are still producing significant volumes. Since the mid-1980s, reserve growth has not been as large. With the exception of Ormen Lange, the largest discoveries were proven during the period from 1969 to 1984. In the 1990s, discovery size and number of exploration wells decreased, cf. Figure 5.2.

In the 2000s and since, the size of discoveries has been considerably smaller than the largest discoveries made until the mid-1980s, cf. Figures

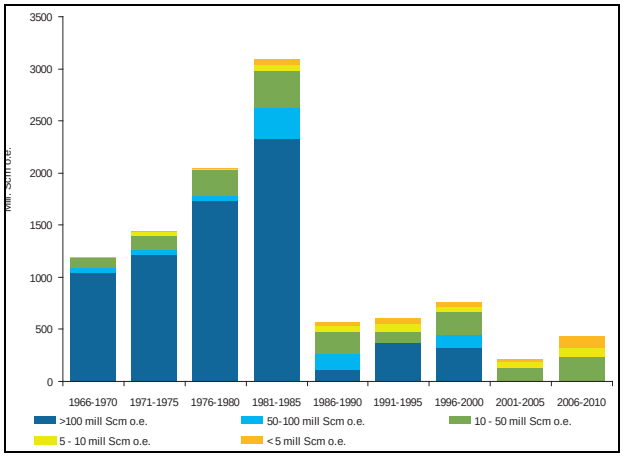

Figure 5.3 Resource growth and discovery size, 1966–2010.

Source: Norwegian Petroleum Directorate.

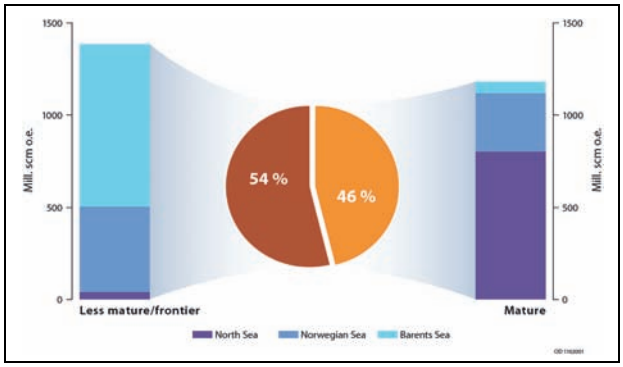

Figure 5.4 Undiscovered resources in mature and frontier areas.

Source: Norwegian Petroleum Directorate.

5.2 and 5.3. This reflects the fact that the opened areas have become more mature. At the same time, the discovery rate has increased during this period and some of the discoveries are still of considerable size, providing good income for the State and the companies. Furthermore, many discoveries are close to infrastructure, which makes them less cost-intensive and quicker to develop.

In the future, large parts of the production are expected to be from discoveries that are not yet proven. As of 2020, the importance of resources that have yet to be found will gradually increase and become dominant. Profitable discoveries are an essential precondition for maintaining the production level. This assumes that we are able to sustain the level of exploration in open areas.

Large volumes and values are still present in mature areas. The Norwegian Petroleum Directorate estimates that nearly half of the undiscovered resources will be found in mature areas, cf. Figure 5.4. Most of these resources are expected to consist of small discoveries in the North Sea. The majority of the North Sea is covered by the APA area and is thus defined as a mature area. The potential in frontier areas of the North Sea is therefore limited. The largest potential in frontier areas is found in the Barents Sea, followed by the Norwegian Sea. This is also reflected in the recently completed 21st licensing round, where all awarded area is in the Norwegian Sea and the Barents Sea.

5.2 Exploration activity within comprehensive marine management

5.2.1 Integrated management plans and exploration policy

Norway's ambitions have always been high as regards environmentally friendly petroleum activities. Joint regulations have been created within health, safety and the environment, and they are administered by, among others, the environmental, petroleum and safety authorities. So as to safe-

Box 5.1 Definition of mature and frontier areas

There is considerable variation in the challenges associated with realising the potential for undiscovered resources on the Norwegian Shelf. The variation coincides with the degree of maturity in the different areas. Mature and frontier petroleum areas were described in Storting White Paper No. 38 (2003–2004), The Petroleum Activities.

Mature areas are characterised by familiar geology, smaller technical challenges and well-developed or planned infrastructure. This results in a relatively high probability of discoveries, but at the same time, the probability of making new, large discoveries is low.

Frontier areas are characterised by little geological knowledge, significant technical challenges and lack of infrastructure. The uncertainty associated with the exploration activity is greater here, but new, large discoveries are still possible.

guard the external environment and maintain consideration for other industries, the relevant management plans are used as a basis in stipulating environmental and fishery terms for both types of licensing rounds.

Storting White Paper No. 12 (2001–2002), Clean and rich seas, established that integrated management plans shall be prepared for Norwegian waters. The purpose of the management plans is to facilitate value creation through sustainable utilisation of resources and ecosystem services in the waters, while also maintaining the ecosystems' structure, function, productivity and biological diversity. The management plans are a tool for both facilitating value creation, and maintaining the environmental values in these waters. The management plans shall contribute to a comprehensive and ecosystem-based management of Norwegian waters.

The first management plan was presented in 2006, and covered the Norwegian part of the Barents Sea and the waters off Lofoten. This management plan was updated and presented to the Storting in the spring of 2011. The management plan for the Norwegian Sea was presented to the Storting in the spring of 2009. The Government is currently working on a management plan for the North Sea and Skagerrak.

The responsible agencies gather extensive knowledge concerning these waters in the work to establish the comprehensive management plans. In addition, views on the technical basis are gathered through involvement of interest groups in public consultations and conferences. Impact assessments of industry activities based on available knowledge are used as a basis for assessments and decisions in the management plans. In connection with updating the plans, new knowledge is gathered where gaps have been identified. The management plans will be updated regularly, normally after 4–5 years. Considerable work is done by the authorities' responsible agencies, as well as consultant and research environments, to maintain and further gather knowledge concerning the sea. This is in agreement with the requirement for knowledge-based management. The management plans ensure both a sound foundation for responsible management, as well as predictability surrounding the framework and conditions for the petroleum activities and other business activities.

The integrated management plans for the various marine areas states where petroleum activity may take place in the open area, and where the activity is prohibited during specific time periods. Area-specific conditions can also be imposed on the petroleum activity. Seasonal restrictions for exploration drilling and acquisition of seismic data are examples of such area-specific restrictions.

All areas that have been opened for petroleum activity and not excluded from petroleum activity in the management plans can be announced in numbered licensing rounds, or included in the APA area. Within the framework of the management plans, an expert petroleum assessment determines when new areas are added to the APA area. The consideration for sequential exploration of frontier areas is important in the numbered rounds, while the need to prove and produce time-critical resources is important in the APA rounds. In connection with the consideration of the management plans for the Norwegian Sea and the Barents Sea-Lofoten, it was determined that, in connection with licensing rounds, the area-specific environmental and fishery requirements for petroleum activity as laid down in the management plans, will be used as a basis. No additional environmental or fishery demands will be made.

However, to clarify whether significant new information has emerged between the revisions and updates of the management plans, a public consultation process will be held in connection with APA rounds and announcement of blocks through the numbered licensing rounds. This consultation will only solicit input connected with significant new information that may have emerged after the relevant management plan was adopted. The Government will thus have a good technical basis for making comprehensive and balanced decisions on the framework for the petroleum industry, also in the period of time between updates of the management plans. This will safeguard the consideration for good resource management, along with considerations for health, safety and the environment and coordination with other industries.

The Government will:

- In areas with established managements plans, use the environmental and fishery requirements from the relevant management plan as a basis. No further environmental or fishery demands will be imposed for new production licenses in the area.
- Within the framework of the management plans, use expert petroleum evaluations as a basis for which areas are included in the APA area and which areas are announced through numbered licensing rounds.

5.2.2 Coordination with the fishery industry

Norwegian maritime areas are rich in natural resources, and they play a very important role in Norway. The resources in the sea and under the seabed must be soundly managed in a way that ensures value creation and welfare in a long-term perspective. Norway's coastal and sea areas are important for commercial activities such as the petroleum sector, fishing, shipping and tourism. Increased activity and more users demand good coordination so that different industries can co-exist.

The fishery industry is important to Norway. Today, fish is the third most important export article after petroleum and metal. More than 10 000 people have fishing as their primary occupation, and there are about 6 800 fishing vessels in Norway.

Ever since the petroleum activities on the shelf started nearly 50 years ago, the authorities have maintained that petroleum activities must be carried out side by side and in cooperation with other industries, particularly the fisheries. This has laid the foundation for value creation based on both oil and gas resources, as well as the fishery resources. The extensive system of impact assessments in all phases of the petroleum activity is an important element in achieving this.

The Petroleum Act requires the authorities to carry out comprehensive impact assessments prior to opening an area. In this connection, evaluations are made of e.g. the environmental, financial and societal consequences for other industries, including the fisheries. The Petroleum Act also requires impact assessments as a part of plans for development and operation, and as a part of plans for disposal of facilities after production ceases.

The management plans are important in the processes to ensure good coordination. Area-specific conditions were established in connection with the consideration of the management plans for the Norwegian Sea and for the Barents Sea – Lofoten in order to protect environmental assets in particularly valuable areas. These conditions replaced the license-specific conditions in the Barents Sea. In the Norwegian Sea, the area-specific conditions from the management plan apply to new licenses. The conditions in the management plan can also be imposed on existing production licenses, subject to application. License-specific requirements apply in the North Sea until a management plan is submitted.

Ever since the 1980s, special environmental and fishery conditions have been stipulated in connection with announcement and award of new areas on the Norwegian Shelf. These conditions entail that consideration must be given to the fisheries and fishery resources, both in connection with seismic data acquisition and with drilling. In the most vulnerable areas, time limitations have been set for acquisition of seismic data and drilling of exploration wells. Prior to exploration drilling and acquisition of seismic data, measures must be implemented to inform affected interested parties.

The Norwegian Petroleum Directorate and the Directorate of Fisheries established a working group in the autumn of 2007 to consider issues related to acquisition of seismic data and electromagnetic surveys. In 2009, the Norwegian Petroleum Directorate, the Directorate of Fisheries and the State Pollution Control Agency, now the Climate and Pollution Agency, presented a report entitled "Report on startle response and other harmful effects from seismic sound waves – recommendations concerning test activity". With regard to the startle response in fish, the report did not reach a conclusion regarding the distance at which such a response occurs. The desire on the part of some for stipulation of a general minimum distance for the startle response was thus not accommodated. This is mainly due to the fact that there was relatively little research on the startle response, and that the viewpoints of the commercial interests were incompatible. In this context, reference can be made to the fact that how and how far the sound waves travel in the sea at any given time depends on the hydrographic conditions, which vary throughout the year as well as from area to area.

In the wake of this work, a cooperative group has been established between the petroleum authorities, the petroleum industry, fishery organisations/fishery authorities and the Climate and Pollution Agency. This work has resulted in a number of measures, with regulatory changes in both the Resource Regulations as well as in the Petroleum Act and Petroleum Regulations. Measures have also been initiated regarding communication, coordination and expertise.

The changes in the Resource Regulations include a requirement for courses for fishery experts regarding seismic data acquisition, with clarification of the fishery expert's role and required expertise, along with requirements for keeping and reporting of log books after end of voyage. The changes also encompass further

coordination of requirements relating to reporting surveys and requirements for tracking equipment for seismic vessels. The Norwegian Petroleum Directorate has established a web-based reporting and announcement system for survey activity, including an option for interactive information searches for information on reported surveys and announcement of surveys. A cooperation agreement has been signed between the Coast Guard, the Directorate of Fisheries and the Norwegian Petroleum Directorate, where the Coast Guard is the primary contact for the fishery expert.

For a number of years, the Norwegian Oil Industry Association has carried out annual "fish and seismic" seminars, a forum for exchanging experience and knowledge between the industry, authorities and the fishery industry. Both the Norwegian Petroleum Directorate and the Directorate of Fisheries have been active participants in these seminars.

Several measures have been implemented to obtain more knowledge about the effect of seismic surveys on the fisheries. While there is general agreement that seismic surveys have little direct harmful effect and do not harm fish at a population level, there is considerably more disagreement as regards behavioural changes in fish in connection with acquisition of seismic data and as regards introduction of a minimum distance from fish.

In connection with the acquisition of seismic data outside Lofoten/Vesterålen in the summer of 2009, a follow-up research project was conducted to obtain better documentation of how the sound from seismic surveys affects certain species of fish that are subject to commercial fishing, and thus potential catches for fishers. The cost frame for the project was NOK 25 million, and it is one of the largest projects ever carried out. The study was financed by the Norwegian Petroleum Directorate and conducted by the Institute of Marine Research.

The main conclusions from this study were that the seismic surveys had no proven harmful effect on marine life, but that the sound affected fish behaviour, and that there was a change in catches (increase or decrease) in the period during which seismic data acquisition took place. Net catches of Greenland halibut and haddock were reduced, but grew in the period after the acquisition activity. The fish exhibited increased swimming activity, which can be symptomatic of a stress reaction. However, the fish showed no clear changes in food intake. Lower density of pollock was measured during the seismic acquisition activity, but no change was proven in the distribution of other species. With regard to direct harm to fish larvae, previous research has revealed that harm only occurs within the very immediate area, maximum five metres around the sound source. On this basis, it was concluded that the seismic surveys do not entail harm at the population level.

In connection with the petroleum activity in the north, the petroleum industry has taken the initiative for vessels in the fishing fleet to be qualified and to secure expertise for operating oil spill equipment. The Maritime Directorate has stipulated new regulations making it easier to utilise fishing vessels and other suitable vessels in oil spill preparedness. In connection with the Goliat development, the licensees and the Norwegian Clean Seas Association for Operating Companies (NOFO), in cooperation with the northern fishermen's association (Fiskarlaget Nord) have drawn up a comprehensive emergency preparedness concept for use of fishing and other vessels in coastal oil spill response. The intention is to establish a permanent emergency preparedness fleet consisting of 30-40 vessels for coastal response in Finnmark county. According to the companies and NOFO, the fleet will make up part of the permanent oil spill preparedness for the Goliat field, but can also safeguard the preparedness needs of other activity in the area.

The cooperation between the two industries is important in strengthening preparedness in coastal waters. Using the fishing fleet will enable the oil companies to benefit from local maritime expertise and increase emergency preparedness capacity. At the same time, the initiative can yield additional financial resources for the involved fishers, and spin-off effects for the local environment. The knowledge and capacity that are built up will also be useful for the Norwegian Coastal Administration as regards oil spill preparedness considerations associated with e.g. discharges from ship traffic.

The petroleum activity also entails significant reinforcement of the general preparedness to respond to potential accidents. This provides security for all users of the sea. The emergency preparedness includes e.g. both land and sea helicopters, as well as upgrading of the fishing fleet with towing capabilities. Establishment of petroleum activities can result in better general preparedness and greater security than would have been the case without the activity. This enhanced preparedness could be very important in connection with various types of accidents at sea and along the coast that are not related to the petroleum

activity. One specific example is when an search and rescue (SAR) helicopter from the Heidrun platform contributed in the rescue work when a chemical tanker collided with a fishing boat off the coast of Fræna municipality in Møre og Romsdal county in October 2007.

Although the authorities have implemented a number of measures to ensure the best possible interaction between the petroleum activity and the fisheries, both through regulatory change, improved communication and enhanced expertise, it will continue to be important in the future to focus on work and processes that can promote cooperation between the fishery and petroleum industries. Research work has brought considerable new knowledge, and constitutes important work that we must continue to build on. The objective is to find balanced solutions that promote long-term, sustainable management of our ocean-based resources, and ensure good cooperation in the years to come.

The Government will:

- Promote good cooperation between the fishery and petroleum industries by placing restrictions on exploration and drilling activity based on knowledge from the work on comprehensive management plans.
- Utilise the fishery industry's resources and expertise in oil spill preparedness.

5.3 Exploration policy

The purpose of the exploration activity is to contribute to resource growth, and thus pave the way for development and production of the undiscovered resources. Exploration activity is designed to achieve this in an efficient manner. The award system for new licenses and the player scenario are key elements in our exploration policy.

It is important that interesting exploration acreage in mature areas is explored in a timely manner so that time-critical resources can be proven and produced. In frontier areas, it is important that regular licensing rounds give access to interesting area while safeguarding the consideration for socio-economic efficiency through stepwise exploration.

The system of awards in predefined areas (APA) is an important measure in achieving our exploration policy objectives. The system is a further development of the numbered licensing round system that facilitates timely exploration through annual awards, and predictable area through the predefined areas. Predictable addition of acreage to mature areas, and which companies can apply for, are important for the efficiency of the APA system. The companies do extensive geological work in these areas when they know that they are available in an annual round of awards. This predictability is a key feature of the APA system.

Table 5.1 Number of awards in APA rounds and the North Sea Awards (NSA).

NSA 1999	14	APA 2003	19
NSA 2000	5	APA 2004	28
NSA 2001	10	APA 2005	45
NSA 2002	11	APA 2006	58
		APA 2007	52
		APA 2008	34
		APA 2009	38
		APA 2010	49

A variety of companies contributes to stronger competition for acreage, and ensures that new ideas emerge and are tested. The increased diversity among the licensees on the shelf has contributed to good exploration results in mature areas in recent years.

The Office of the Auditor General has carried out an administrative audit of administrative practices in connection with license awards[1]. They reviewed the award process in APA 2007 and APA 2008, as well as in the 19th and 20th licensing rounds. No significant deviations were identified in relation to the Storting's resolution and assumptions. The survey reveals that:

> «Overall, the survey shows that administrative practices in connection with the award of production licenses in the petroleum sector consistently complies with all reasonable requirements based on general requirements for sound case processing and generally accepted public administration principles.»

[1] Office of the Auditor General's administrative report 1 2010 "Office of the Auditor General's survey of administrative practices in connection with award of production licenses in the petroleum sector"

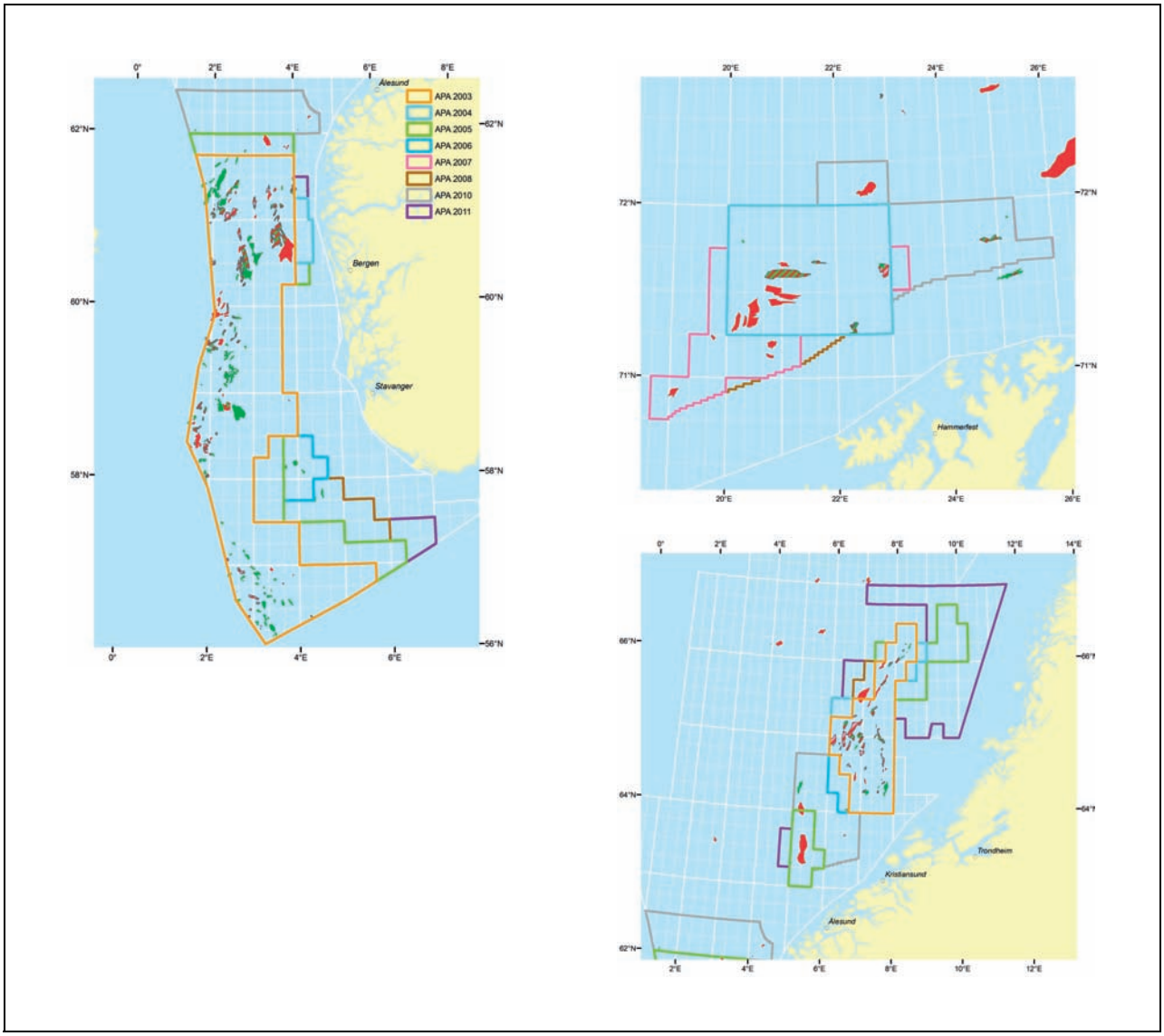

Figure 5.5 Expansion of the APA area since the APA scheme was established.

Source: Norwegian Petroleum Directorate.

5.3.1 Mature areas – APA

The mature areas are characterised by familiar geology and well-developed infrastructure. The likelihood of making discoveries is often relatively high, while at the same time there is less chance of making large discoveries. These areas often include fields in the later stages of their lifetime, or fields that are shut down. Most new projects in mature areas are expected to be relatively small, often necessitating tie-in to existing fields to ensure profitability. At the same time, phasing in these discoveries can help extend the lifetimes of the fields they are tied in to. Central challenges for the mature part of the shelf therefore include achieving rapid project progress for many small discoveries, as well as achieving the highest possible production from established fields within their technical and economic lifetimes. How time-critical these resources actually are depends on the planned shutdown of nearby infrastructure.

Today, the mature areas include large parts of the North Sea, the eastern and southern parts of the Norwegian Sea and most of the Barents Sea South.

Exploration in mature areas

Since their introduction in 2003, the APA rounds have contributed to a considerable number of new licenses on the Norwegian Shelf. A total of 324 production licenses have been awarded since the APA system was established, cf. Table 5.1. This is more than one-third of all production licenses

Table 5.2 Wildcat wells, discoveries and proven resources in area awarded in the North Sea Awards and APA licensing rounds from 2000 to 2010.

Year	Number of wildcat wells completed	No. of discoveries	Resources proven in million scm o.e.
2000	0	0	0
2001	1	0	0
2002	3	0	0
2003	0	0	0
2004	2	0	0
2005	0	0	0
2006	2	0	0
2007	9	6	31.2
2008	12	7	32.7
2009	23	9	45.3
2010	23	10	91.8

awarded since awards commenced in 1965. The North Sea Awards were the predecessor of the APA scheme, and comprised selected mature areas in the North Sea. Forty production licenses were awarded under this scheme from 2000-2003. The awards are and have been necessary in order to curb production decline and maintain activity.

In line with Storting White Paper No. 38 (2003–2004), The petroleum activities, the APA area is gradually expanded as new areas mature. Such a gradual expansion has been carried out since 2003, cf. Figure 5.5. The first APA round, APA 2003, primarily included area in the North Sea and on Haltenbanken in the Norwegian Sea. The areas around Snøhvit in the Barents Sea were included starting with APA 2004. The APA area has been expanded every year since the system was established, with the exception of 2009.

It is important that the awarded acreage is explored quickly and efficiently to ensure maximum utilisation of existing infrastructure. This is also important because it takes time from acreage is awarded until production can start. The average lead time on the Norwegian Shelf is 11 years from discovery to production start-up. Small discoveries made near infrastructure can often be quickly phased in to existing infrastructure, assuming capacity is available. This could result in shorter than average lead time.

Well-developed or planned infrastructure means lower investments for developing new discoveries. Even small discoveries can yield good profitability if they can be phased in to existing infrastructure with available capacity. Infrastructure has a limited lifetime, which is why it is so important to prove and then produce the resources in the area before the existing infrastructure is shut down. If this cannot be done, profitable resources could be left in the ground because the discoveries are too small to justify necessary infrastructure on their own.

It often takes some time before we can see the results of policy changes. The restructuring that has taken place since 2000 is beginning to yield results in the form of number of wildcat wells, discoveries and proven resources in licenses awarded through the North Sea Awards and the APA rounds.

The exploration that has taken place as a consequence of licenses awarded in the North Sea Awards and the APA rounds has yielded results. A total of 32 discoveries have been made in this area over the last four years. Overall, the resources from these discoveries make up more than 200 million scm o.e. Several of the licensees linked to the major discoveries are already planning developments. Proposed plans for development of one of these discoveries, Knarr, have been submitted for the authorities' processing in 2011.

Awards through the APA system

The APA licensing rounds are annual. As a general rule, the acreage that can be applied for is announced in the first quarter of the year, with the application deadline for the companies around 15

September. The award of new production licenses normally takes place right after the new year.

The criteria for award of production licenses are published through the announcement. These criteria form the basis for which companies secure awards in the APA rounds. In these awards, significant emphasis is attached to the understanding of the geology that emerges in the application, and the technical expertise that the companies possess. Other award criteria include financial strength and experience with the individual company. HSE requirements are published in the announcement and are used as a basis when new production licenses are awarded. The Ministry of Labour, represented by the Petroleum Safety Authority Norway, undertakes an HSE assessment of the companies in connection with the applications.

Each year, the Government considers whether the APA area should be expanded. The areas can be expanded within the framework that lies in the management plans for the relevant sea area, but the area cannot be reduced. One possible exception to this rule is the emergence of important new information that is relevant for the decision in the management plan as to where petroleum activity can take place, after the relevant management plan was adopted. It is highly unlikely that this will ever actually occur, as knowledge about the petroleum activity and the sea environment is very well known. Potential new acreage will be included in the announcement of the next APA round.

When expanding the predefined area, the authorities propose acreage that is characterised as mature from a technical petroleum perspective. Using the definition of mature petroleum areas and frontier petroleum areas as a point of departure, the authorities have operationalised this into the following technical petroleum criteria, wherein one or more criteria must form the basis for such a proposal:

Area is close to infrastructure. This includes both existing and planned infrastructure. Potential resources in the areas are regarded as time-critical.

Area with exploration history. This includes area that has previously been awarded and relinquished, area with known plays or play models[2] and area situated between awarded and relinquished area.

Area that borders on existing predefined areas, but that has not been applied for in numbered licensing rounds.

In the Norwegian Sea and the Norwegian part of the Barents Sea there are management plans that ensure balanced consideration for the external environment and the interests of various users of the sea, including the petroleum activity. Before expanding the APA area, the proposal is submitted to other ministries to ensure that potential new and significant information emerges before an expansion decision is made.

The APA areas can be expanded as new areas mature. Predictability regarding which areas can be applied for, along with a regular addition of new area, is important for the efficiency of the system, and is a key characteristic of the scheme. The companies carry out extensive geological work in these areas. It is therefore important that the areas included in the scheme are not subsequently withdrawn.

Experience with the APA scheme

The companies, particularly the new players on the shelf, have shown great interest in the APA scheme. The scheme has been criticised by environmental organisations and environmental agencies. In light of this, and the fact that the scheme had been in effect for five years, the Government decided to evaluate the scheme in 2008. In November 2008, the Government requested input regarding experiences with the APA scheme. A total of 67 submissions were received. A more detailed description of the evaluation is available to the public as an unprinted appendix to this report.[3]

The APA scheme has proven to be an important scheme for efficient exploration of mature areas. It has contributed to strengthen diversity and competition within exploration on the Norwegian Shelf. The scheme contributes to predictability for the industry with regular awards through an annual cycle. At the same time, the scheme contributes to maintain exploration activity in mature areas so resources are proven and produced. In the future, the Ministry will continue to emphasise such assessments when expanding the APA area.

Following a balanced assessment where considerations for petroleum activity, HSE, the exter-

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[2] An exploration play or play model is a geographically and stratigraphically delimited area where a specific set of geological factors is present so that petroleum may be proven in producible quantities. Such geological factors are reservoir rock, trap, mature sourcerocks and migration paths, as well as a trap formed before migration of petroleum ceased. All discoveries and prospects within the same play are characterised by the play model's specific set of geological factors.

[3] www.regjeringen.no/oed

nal environment and fisheries were weighed, the Government has decided to maintain the APA scheme. It is very important for the management of petroleum resources and has contributed to efficient licensing policies and good resource utilisation. The management plans safeguard the considerations for the environment and interaction with other industries along with other regulations. The regulations and management plans are used as a basis for petroleum activity in the APA area in the same manner as for activity in areas awarded in numbered licensing rounds.

The APA scheme will therefore be carried out as an annual licensing round in all mature areas to contribute to maintain activity and production on the continental shelf. All areas opened for petroleum activity, and not exempted from petroleum activity in a management plan, can be included in the APA area. Within the framework of the management plans, a technical petroleum assessment is carried out when new areas are added to the APA area.

For sea areas with an established management plan, the Ministry will use the environmental and fishery conditions from the relevant management plan as a basis in new production licenses. Until the management plan is updated, no further environmental and fishery requirements will be stipulated for petroleum activity in the area.

The Government will introduce public consultations in connection with APA rounds. For areas with a management plan, input is only requested regarding new, significant information that has come to light after the relevant management plan was approved.

Since the establishment of APA, the work programs have been made public. The authorities will continue this practice.

The Government will:

- Carry out the APA scheme as an annual licensing round for all mature area on the Norwegian Shelf to contribute to maintaining activity and production.
- Within the framework of the management plans, use technical petroleum assessments as a basis for which areas are included in the APA area.
- Introduce public consultation in connection with APA rounds. For areas with a management plan, only input regarding new, significant information that has come to light after the relevant management plan was approved is requested.

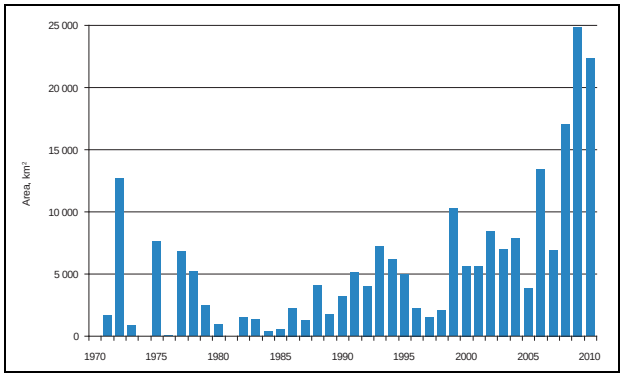

Figure 5.6 Annual relinquished area.

Source: Norwegian Petroleum Directorate.

- Continue to publish the work programs in APA licenses.

Fallow areas

From the resource owner's perspective it is very important that the resources are explored efficiently and in a timely manner, and to prevent area from becoming fallow.

Production licenses can be in an initial period or in the extension period. The Petroleum Act regulates the duration of these periods. The initial period can last a maximum of ten years. The extension period may last up to 50 years. Upon application, the extension period may be extended beyond this.

Currently, strict license conditions and work programs are stipulated to prevent fallow area. In addition, conditions are stipulated for activity though the processing of development plans. Together, this prevents fallow area in newer awards. Therefore, fallow area is mostly a problem in older production licenses. In the early awards there was great uncertainty associated with the resource basis and the framework was not as developed as it is today. Therefore, larger exploration areas were awarded to companies than is the current practice. The companies have retained large areas during the extension period.

The objective of the area fee is to provide companies with incentives to explore and utilise potential resources in the awarded area in an efficient manner. If a company finds that the awarded area does not contain sufficiently interesting commercial possibilities, the area fee will contribute to the area being transferred to others or returned to the State. In 2007, amendments to the Petroleum Regulations' provisions relating to area fees entered into effect. The purpose of the amendment was to

strengthen the fee's function as a policy instrument in resource management. The main rule is that area fees shall not be paid in areas with production and active exploration activity. Areas without activity, however, will be subject to a higher fee.

The NPD has reviewed existing licenses on the Norwegian Shelf to assess the exploration activity. Area included in a development plan is excluded in the evaluation. The following criteria define an area as fallow:

- Exploration drilling has not been carried out and the costs of geophysical or geological surveys are lower than NOK 20 million from 1 January 2008 to 1 January 2010.
- Activity has not been budgeted in the form of drilling exploration wells or geophysical or geological surveys in 2010 or 2011.
- No significant relinquishment of area since the summer of 2008.
- No new licensees since the summer of 2008.
- Nearby infrastructure has available capacity or new capacity is planned.
- It is expected that potential discoveries in the area will be of a size that could justify the costs of upgrading/developing new capacity.

Licenses with very little area where exploration is not realistic in practice, are excluded from the data basis. The same applies to the licenses where the authorities have granted exemptions from conditions in the licenses.

In order for resources to be proven and produced in a profitable manner, it must be possible to transport petroleum out of the area. There must be available infrastructure which a discovery can be phased in to if it is not large enough to warrant stand-alone development. In the Barents Sea and Norwegian Sea, for example, major discoveries are needed to justify a new development.

Technical problems can arise which delay development. Gudrun is a recent example of fields being developed several decades after the discovery was made, e.g. due to a challenging reservoir. In other instances, there might be high CO_2 content in the gas, which could make it difficult to phase-in the resources to existing infrastructure quickly enough.

The NPD's analysis shows that about two per cent of all awarded area is fallow. The scope of fallow area is therefore considered modest. The scope is expected to be reduced further as a result of the area fee. Relinquished area has increased considerably in the last few years, cf. Figure 5.6. This is most likely due to introducing a new area fee in 2007. The authorities want to monitor this development before other potential measures are implemented.

The Norwegian Oil Industry Association (OLF) has issued a statement regarding the need for facilitation for increased circulation of area covered by licenses on the Norwegian Continental Shelf. OLF believes that there is no current need for further initiatives from the authorities to increase the rate of circulation of area covered by licenses on the Norwegian Continental Shelf.

The Government will:

- Prevent idle licenses by following up activity in mature areas and using the area fee to achieve good area management.

5.3.2 Frontier areas – numbered rounds

The frontier areas are characterised by limited knowledge about the geology, lack of infrastructure and often considerable technical challenges. The uncertainty associated with the resource basis is greater than in mature areas. At the same time, it is still possible to make new, large discoveries.

In frontier areas, area is announced and awarded through numbered licensing rounds. In

Table 5.3 Number of blocks announced, awarded and number of production licenses in the 17th – 21st licensing rounds. The number of blocks includes both whole and parts of blocks.

	Announced blocks	Awarded blocks	Number of production licenses
17th round	32	18	6
18th round	95	46	16
19th round	64	33	13
20th round	79	63	21
21st round	94	61	24

Table 5.4 Wildcat wells, discoveries and proven resources in area awarded through numbered licensing rounds from 2000 to 2010[1].

Year	Number of wildcat wells completed	Number of discoveries	Proven resources, million scm o.e.
2000	0	0	0
2001	4	2	4.3
2002	3	1	2.9
2003	3	3	15.3
2004	1	0	0
2005	5	4	52.8
2006	2	0	0
2007	9	2	5.2
2008	4	3	4.7
2009	4	2	30.9
2010	2	0	0

[1] Resource growth from area awarded in numbered licensing rounds before 2000 is not published. There could therefore be a difference in the total reserve growth.

the last ten years, numbered licensing rounds have normally taken place every other year.

The number of announced blocks in the most recent numbered licensing rounds has been varied and reflects the interest from the industry, the need for sequential exploration and expected prospectivity in the available areas. From the 17th to the 19th licensing rounds, the percentage of awarded blocks compared with announced blocks has been about 50 per cent. In the 20th licensing round, about 80 per cent of the announced blocks were awarded, while the percentage was somewhat lower in the 21st licensing round with 65 per cent. In total, 80 production licenses have been awarded in the last five licensing rounds in frontier areas on the Norwegian Shelf.

The nomination process for the 21st licensing round shows that there is still considerable interest in the Norwegian Shelf. The Ministry received nominations from 43 companies. 138 blocks were nominated by two or more companies. 94 blocks or parts of blocks were announced, 51 in the Barents Sea and 43 in the Norwegian Sea. The Ministry received applications from 37 companies. During the spring of 2011, 61 blocks in 24 new production licenses were awarded to 29 different companies.

From the 19th licensing round, the focus has mainly been on the western and northern parts of the Norwegian Sea and the southern part of the Barents Sea. These are areas with less familiar geology and technological challenges such as basalt layers and deep waters. There is no infrastructure in large parts of these areas. This means that relatively large resources must be proven, individually or overall, in order to justify new infrastructure. There is greater financial risk associated with exploring in frontier areas. This is often because the geological conditions are less known, in addition to lack of infrastructure and more technologically demanding drilling operations.

The exploration activity in frontier areas awarded during the period 2000-2010 has varied, cf. Table 5.4. Since 2004, eleven discoveries have been made in production licenses awarded in numbered licensing rounds after the year 2000. In total, about 116 million scm o.e. has been discovered.

The large number of applications in the 20th and 21st licensing rounds shows that there are still great expectations for the Norwegian Shelf. Even though several dry wells have been drilled in frontier areas in recent years, there has also been positive news. During the spring of 2011, Statoil made the largest discovery (Skrugard, 7220/8-1) in the Barents Sea since the Goliat discovery in 2000. The well was drilled about 110 kilometres north of the Snøhvit field and preliminary resource estimates indicate that an independent development could be realistic. Preliminary calculations of the size of the discovery are between 25 and 40 million standard cubic metres of recovera-

ble oil and 2-7 billion standard cubic metres of recoverable gas.

Sequential exploration is still important

The Norwegian Continental Shelf has gradually been opened for petroleum activity. The strategy for licensing rounds in newly opened and frontier areas has mainly adhered to the principle of sequential exploration. This entails that results of wells in certain blocks in an area should be available and evaluated before new blocks are announced in the same area. This approach ensures that large areas can be mapped with relatively few exploration wells. In this manner, available information is used for further exploration and drilling of unnecessary, dry wells can be avoided. Sequential exploration contributes to a rational mapping of areas with less familiar geology. The strategy leads to only announcing and awarding certain key blocks even though large areas are opened. The policy has consisted of opening relatively large areas and then announcing key blocks in subsequent licensing rounds. The announced blocks are considered to be the most prospective and/or to have high information value.

Numbered licensing rounds

Numbered licensing rounds are normally carried out every other year. All areas opened for petroleum activity, and not exempted from petroleum activity in a management plan, can be included in a numbered round[4]. Within the framework of the management plan, a technical petroleum assessment takes place when new areas are to be included in a numbered round. The numbered rounds start with a nomination process. The authorities invite the companies to nominate blocks to be included in the licensing round. Based on the companies' nominations and own assessments, the Norwegian Petroleum Directorate recommends which blocks should be announced. Following an assessment of which blocks should be announced, the Ministry submits a proposal for consultation to relevant parties. After the submissions have been summarised and the Government has made an overall and general decision regarding the scope of the announcement, the relevant blocks are announced with an application deadline. The applications are then processed, negotiations take place with the companies regarding license conditions, and the round is completed by awarding new licenses.

The management plans for the sea areas clarify where petroleum activity can take place in open areas and determine potential area-specific conditions for the petroleum activities. Time restrictions for exploration drilling and seismic acquisition within special areas are examples of such conditions. Where a management plan has been established, the Ministry will use the environmental and fishery conditions in the relevant management plan as a basis for new production licenses. Until a management plan is updated, no further environmental and fishery requirements will be stipulated for petroleum activity in the area.

A public consultation before announcing numbered rounds was introduced in the 20th licensing round. During the consultations in the 20th and 21st licensing rounds, no significant new information has emerged according to the Ministry that has not already been considered either in the work with the management plans or which will be addressed by the authorities' expert agencies.

In the future, the Ministry will continue to carry out public consultations before announcing blocks in numbered licensing rounds. The management plans include an extensive technical process with expert input and involvement of interest groups in consultations and conferences, cf. Chapter 5.2.1. For the sea areas included in a management plan, only input regarding new, significant information that has emerged after the relevant management plan was approved is requested.

A number of smaller new players were applicants in the 20th and 21st licensing rounds. In this connection, a more extensive evaluation of financial strength was carried out before the license awards. The Ministry of Labour, through the

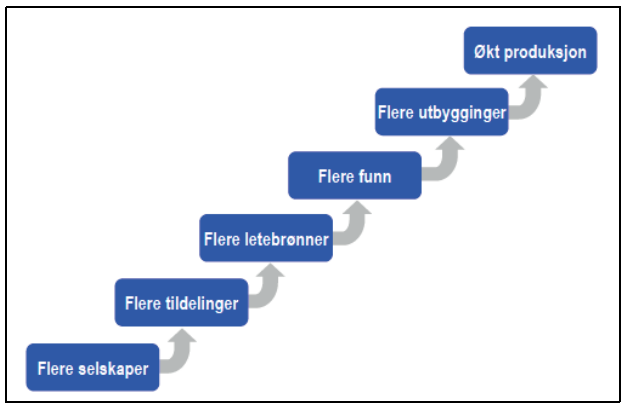

Figure 5.7 Diversity could increase production.

[4] Area included in the APA area will not be relevant for numbered rounds.

Petroleum Safety Authority Norway, carries out an HSE assessment when awarding licenses. The HSE requirements are provided in the announcement and are used as a basis when awarding new production licenses.

During numbered rounds, the work commitments are characterised by being adapted to the production license's geological challenges. At the same time, the Ministry aims for the most efficient exploration of the areas possible, and wants the work commitments to be strict with decision dates/milestones. The background for this is the desire for efficient progress in the production licenses and preventing fallow areas. From and including the 21st licensing round, the Government has decided to make the work programs public in numbered rounds as well, such as in the APA rounds. The work programs from previous numbered rounds will not be made public without consent from the licensees.

The Government will:

- Carry out numbered licensing rounds, usually every other year, on the Norwegian Shelf to contribute to maintaining activity and production.
- Within the framework of the management plans, use technical petroleum assessments as a basis for which areas the companies are invited to nominate blocks in.
- Carry out public consultation when announcing area in numbered licensing rounds. For areas with a management plan, only input regarding new, significant information that has emerged after the relevant management plan was approved is requested.
- Make the work programs public from and including the 21st licensing round to ensure openness in the petroleum activity and equal treatment during the licensing rounds.

5.4 New and different types of companies

One of the measures to increase exploration activity and value creation in petroleum activities was to increase the number and diversity of licensees and operators. In 2000, the shelf was opened so that more oil companies would have access. So far, a considerable number of new companies have entered the shelf. Many licenses have been awarded, and in recent years, many of the new companies have made significant discoveries.

The new companies that are active on the shelf mainly consist of medium-sized international companies (so-called independents), small Norwegian companies, smaller foreign companies and European gas and energy companies. This has resulted in a greater diversity of companies and types of companies than before.

5.4.1 Requirements for companies and prequalification

New companies normally undergo a prequalification process, which includes the stipulation of requirements for companies that want to establish themselves on the Norwegian Continental Shelf. The requirements for a licensee are related to the activity they wish to participate in. What qualifications are necessary depend on what type of tasks will be carried out. Qualifications for owners in a transport system such as Gassled, differ from the qualifications for owners in production licenses. This Chapter addresses participation in production licenses.

The prequalification scheme[5] was established to allow the companies to evaluate their suitability for participation on the Norwegian Continental Shelf before they potentially devote resources to considering concrete business opportunities. A prequalification does not entail that the company can be considered qualified to actually carry out activities, but provides an indication of the authorities' preliminary assessment of the company. In addition, the system is used if the authorities find it necessary to carry out a new review of companies that are currently licensees with a low activity level and that wish to increase activity, or companies that have been prequalified, but have not been active on the shelf for some time.

The paramount requirement for new players is that they must contribute to value creation. This means that the company must be a genuine oil company. During the prequalification process, an assessment of the company is carried out by the Norwegian Petroleum Directorate and by the Ministry of Labour, through the Petroleum Safety Authority Norway, before the Ministry makes an overall assessment and determines whether a company is suited to be prequalified.

In order to be prequalified as a licensee, the companies do not need to have equally good expertise within all relevant disciplines, but must be able to contribute to creating value through

[5] Reported in Storting White Paper No. 39 (1999-2000) Oil and gas activities.

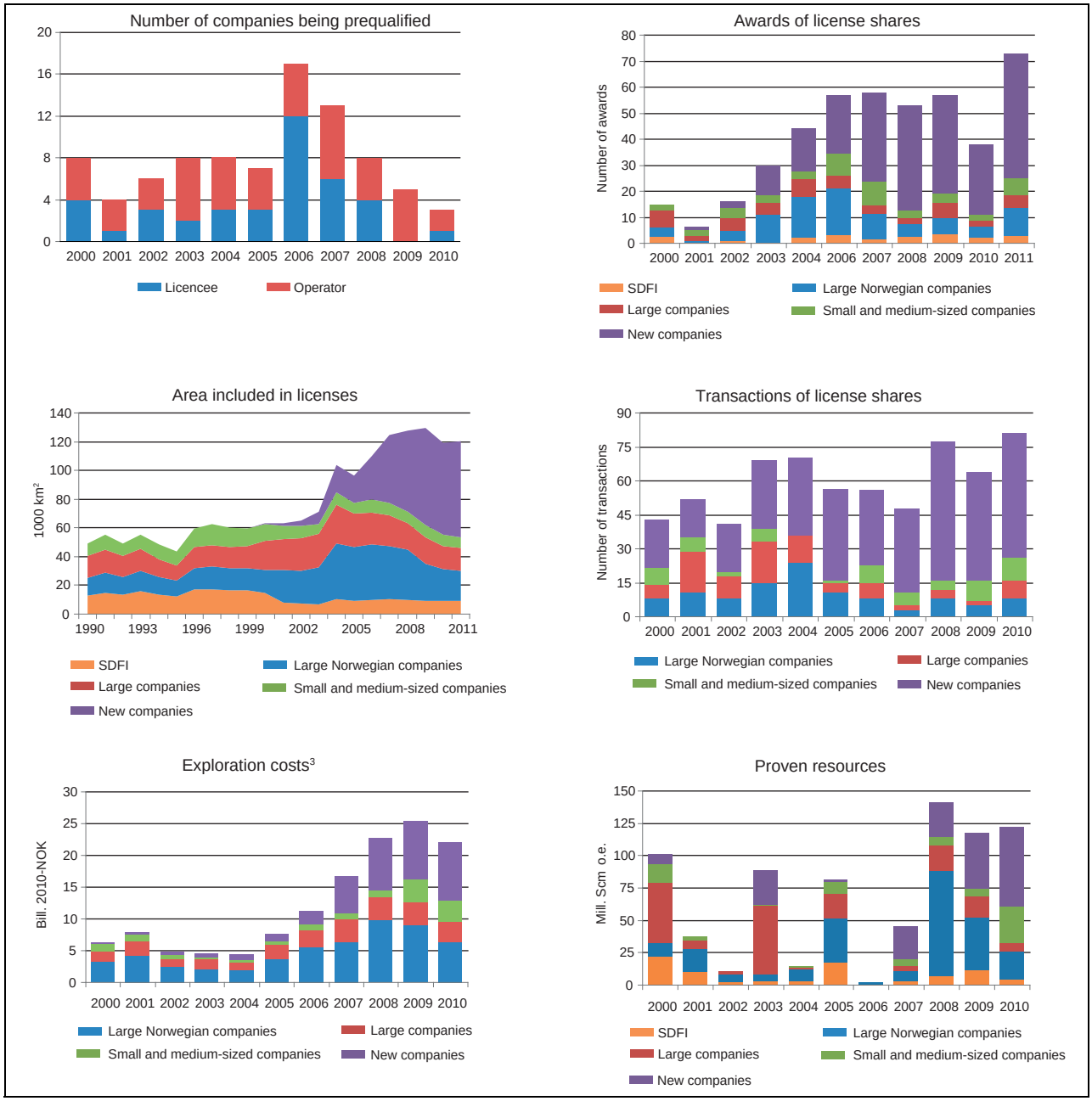

Figure 5.8 Players and exploration activity[1].

1 New companies since 2000: 4Sea Energy, Aker Exploration, Bayerngas Norge, BG Norge, Bridge Energy, Centrica, Concedo, Dana, Det Norske, Discover, DONG, Edison, Endeavour, Faroe, GDF SUEZ, Genesis, Lotos, Lundin, Mærsk, Marathon, Nexen, Noreco, North Energy, PGNIG, Premier, Repsol, Rocksource, E.ON Ruhrgas, Sagex, Skagen 44, Skeie Energy, Spring, Talisman, VNG, Wintershall, Agora Oil & Gas; small and medium-sized companies: AEDC, Hess Norge, Idemitsu, OMV, Petro-Canada, RWE-DEA, Svenska Petroleum; large, international companies: BP, Chevron, ConocoPhillips, Eni, ExxonMobil, Shell and Total; large, Norwegian companies: Hydro and Statoil.

2 There were no awards in 2005.

3 SDFI is included in the group large Norwegian companies for the years 2000 and 2001.

Source: Norwegian Petroleum Directorate.

cutting-edge expertise. The companies must have a minimum level of expertise within all relevant disciplines in order to be able to analyse, understand and follow-up the operator's activities in the production license. The licensees must also have sufficient own capacity and expertise to safeguard applicable health, safety and environment requirements. In addition, the companies must document their ability to handle the financial obligations they undertake as licensees. This entails, for instance, that the companies must have a solid foundation of equity and that there is a reasonable

ratio of equity and debt. In connection with a prequalification process it may become relevant to require the companies to submit a plan for activities with associated financial obligations and how the companies will meet these obligations during the first years of activity.

Upon receiving a request for prequalification, the Ministry will assess the company as it appears when the company requests this. In certain cases, consideration may be given to prequalifying a company based on a binding plan for improvements and build-up of the organisation. In such instances the companies must, within a given deadline, document that the required improvements are met before a final prequalification can take place. This scheme will only be relevant in instances where the company largely satisfies expertise, capacity and financial requirements, but has certain areas where the company is expected to be able to meet regulatory requirements in the near future. As a main rule, this applies when the parent company has significant expertise and resources, and can for a short period handle production licenses on the Norwegian Shelf from another country. This primarily applies to international oil companies with large, competent organisations abroad that can provide assistance. For small companies without large, competent organisations abroad, requirements for having sufficient organisation and expertise in Norway are stipulated before the company can be prequalified.

The operators have a central role on the Norwegian Shelf. An operator must therefore have sufficient resources and personnel in order to manage and carry out the relevant operations and activities in accordance with the applicable regulations. In addition, the company must be able to document an ability to safeguard financial requirements in connection with the obligations the player has in relation to its ownership interests in the relevant licenses. Operators normally have significant interests in the licenses and have a considerable responsibility for carrying out the work obligations, development and clean-up after operations cease, as well as in the event of accidents. There is therefore a significant difference between being an ordinary licensee and being an operator, as regards requirements placed on the companies.

The requirements made during prequalification will be the same as are made for license awards or in connection with consent to a transfer. If a company is not prequalified, the same assessments must be made in a prequalification process before license award or consent for transfer can be granted. Several companies have been prequalified in recent years, cf. Figure 5.8. About 50 current companies have undergone the process and many of these are now also operators. The record year for introducing new players was 2006. It is positive that many companies are now active in the industry.

5.4.2 New players contribute to more exploration

New companies that have arrived after 2000 have gradually received a considerable number of awards in the licensing rounds. Particularly after 2003, the involvement of new companies has increased. From 2007, the majority of the licenses have been awarded to new companies, cf. Figure 5.8.

During the period 2000 to 2011, 241 production licenses have been awarded to new players. Sixty-seven per cent of these are operated by new companies. The new companies have been particularly active in mature areas. From and including APA 2005, the new companies have been awarded more ownership interests than the companies that were established before 2000. The picture is different in frontier areas, where the established companies have taken a significant percentage of the awards. There has also been a gradual increase in the number of awards to new companies. In the 20th licensing round, the new companies received about half of the awarded interests, and this diversity has been maintained in the 21st licensing round.

New players now possess about half of all areas covered by licenses, cf. Figure 5.8. The majority of the new companies are operating production licenses in the initial period. The new companies have contributed to competition for areas and have received a large percentage of the licenses in the last decade. Through the work commitments, an increased number of licenses results in increased exploration activity. New companies bring new ideas and new priorities. They thus contribute to areas being considered from different viewpoints and in different ways. They not only assess new areas, but also areas previously relinquished by other companies. Previously awarded area could thus be the object of new assessments. Prospects and discoveries that are not a main priority for the well-established companies might be of interest to other players.

New companies are active in the second-hand license market. Since 2000, new companies have

been responsible for a considerable part of ownership interest purchases in active production licenses, cf. Figure 5.8. The percentage of transfers with new companies has increased from 2000 to 2010.

An important aspect of having a second-hand license market is to provide the companies with the possibility of balancing risk and having good portfolio management. It is thus easier for companies to have their desired risk profile and the opportunity to build up a portfolio of exploration activity outside the licensing rounds.

Some companies' strategy is to only explore, which means that they must be able to sell discoveries and let other companies be responsible for development and operation. Furthermore, there are companies that do not possess the financial ability or do not have sufficient resources to develop discoveries. A second-hand market provides the possibility to sell out and leave the discovery to players that want to develop and then produce the resources. In addition, new companies will have the possibility of taking over area which established companies are not working with actively. In this way, the second-hand market can contribute to ensure exploration activity in older licenses as well.

Assessing the efforts of new companies on the shelf can be seen in light of investments made in exploration activities. The investments include geological and geophysical work such as seismic and drilling. The investment level in exploration activity was relatively regular up to 2005, and then increased considerably, cf. Figure 5.8.

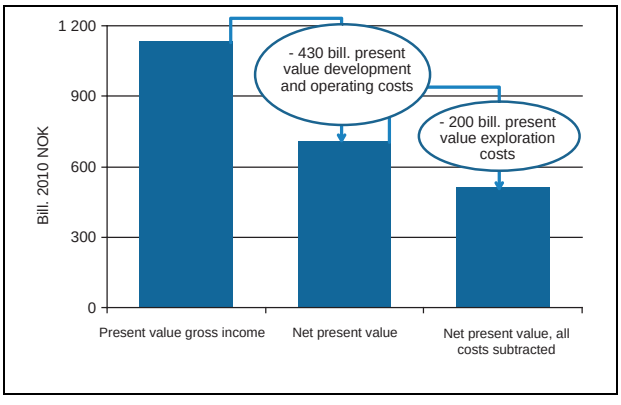

Figure 5.9 Value creation from exploration, 2000–20101.

[1] The assumptions that form the basis for the calculations are a seven per cent discount rate and the MPE's price forecasts, in addition to Statistics Norway's historical export prices. The NPD's modelling tool has generated the future cash flow from the discoveries.

Source: Norwegian Petroleum Directorate.

From 2007, the investments in exploration from new companies increased significantly. In 2007, these companies invested nearly NOK 6 billion in exploration. In 2009, this increased to more than NOK 9 billion. In the last three years, new companies have invested a total of nearly NOK 27 billion in exploration. In 2010, the new, small companies were responsible for 40 per cent of the exploration investments. Statoil and the State through SDFI, still make considerable investments in exploration, and this has increased in recent years. The large, established companies have had a relatively steady investment rate in recent years.

373 exploration wells have been spudded during the period from 2000 through 2010. 97 of the wells were drilled by new operators, 87 of these were located in the North Sea and ten in the Norwegian Sea. During the same period, 141 discoveries were made, and 23 of these were made by new operators.

In 2010, new companies discovered about 60 million scm o.e., which was the largest discovery volume since the access regime was changed. During the period 2000 to 2010, these companies have contributed to an overall resource growth of 190 million scm o.e. In comparison, Statoil and Petoro have contributed 233 million scm o.e. and the large international companies have contributed 177 million scm o.e. Experience shows that it takes an average of eleven years from when a discovery is made until a producing field is developed. This means that many of the new companies have not yet been able to start producing their own discoveries.

When the policy was changed in 2000 to open for new companies, the authorities carried out a campaign vis-à-vis companies to inform them about the opportunities on the Norwegian Shelf.

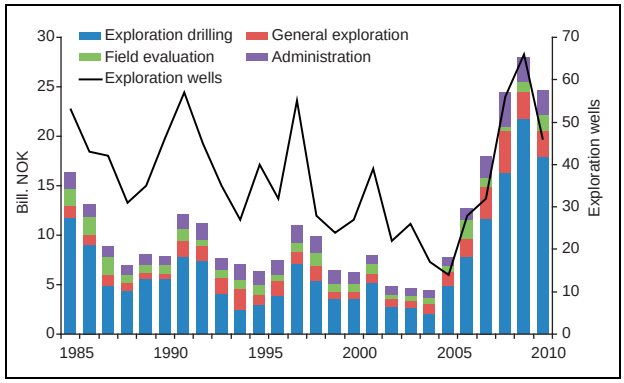

Figure 5.10 Exploration costs and number of exploration wells, 1985–2010.

Source: Norwegian Petroleum Directorate.

Meetings were held with companies and Norwegian authorities were in attendance at central meeting venues. In the subsequent period, many new companies have been established in Norway.

The major international companies established in Norway are a crucial part of the diversity and have played an important role on the Norwegian Shelf. They will continue to do so. They possess unique expertise and knowledge about the Norwegian Shelf, as well as substantial resources in the form of technology, personnel and capital. Recovery of oil and gas on the Norwegian Shelf still presents many challenges suitable for this type of company. There are areas with deep waters and basalt layers, areas requiring deep, costly and complicated wells, and areas in the north with challenges associated with polar night and tough climatic conditions. These areas often require expertise and experience on the part of the companies, as well as considerable resources.

Healthy competition and diversity in all parts of the value chain have been important for good resource utilisation on the Norwegian Shelf. The Government will continue to facilitate this, including actively seeking out interesting oil companies to inform them about the business opportunities on the Norwegian Shelf.

The Government will:

- Facilitate the establishment of new, competent companies on the Norwegian Shelf, including actively seeking out interesting oil companies to inform them about the business opportunities on the Norwegian Shelf.

5.5 Exploration is profitable

Achieving the highest possible value creation is a paramount goal for the petroleum activities. The NPD has carried out a study of value creation from exploration activity during the period 2000-2010. The study shows that considerable value creation has taken place during the period. The net present value of proven discoveries excluding exploration costs has been calculated at about NOK 700 billion, cf. Figure 5.9. This is the difference between the present value of future sales income for oil and gas and the present value of the future development and operations costs for the discoveries. The present value of sales income for all discoveries has been calculated at about NOK 1150 billion, while the present value of the development and operations costs has been calculated at just under NOK 430 billion. This emphasises that the proven discoveries during the period have considerable value.

The present value of all costs associated with exploration on the Norwegian Shelf in the same period is NOK 200 billion. This applies both to successful exploration and exploration that has not proven recoverable resources. If these historical costs are also included in the calculation, value creation from exploration during the period 2000 – 2010 is about NOK 500 billion. This shows that the exploration activity since 2000 has been profitable.

Exploration has been profitable in all sea areas on the shelf. The North Sea has been the most profitable with a present value of about NOK 360 billion.

The exploration activity measured in the number of exploration wells has increased considerably in recent years. A record-high number of exploration wells were spudded on the Norwegian Shelf in 2009, with 65 exploration wells, nearly four times more exploration wells than in 2004, when the last petroleum white paper was submitted, cf. Figure 5.10.

While the exploration activity has created substantial values in recent years, costs have also increased significantly. Exploration costs on the Norwegian Shelf have increased and it is more expensive to explore now than it used to be. The total exploration costs in 2004 were about four billion fixed 2011-NOK. In 2010, the corresponding costs were NOK 25 billion. The cost per exploration well was NOK 260 million in 2004, and it was NOK 500 million in 2010. High costs reduce the values in the activity and can impact exploration activity.

It is important that both the industry and authorities focus on costs and implement measures to curb and potentially change the cost trend. It is possible to implement measures to ensure the best possible resource utilisation while also limiting costs. Even though many of the rigs on the Norwegian Shelf have been adapted to tough conditions in relatively deep waters, much of the drilling activity in Norway takes place in relatively shallow waters. This could indicate that the rig situation on the Norwegian Shelf has led to several rigs carrying out operations for which they are over-specified. This could entail unnecessarily high costs. Several companies have formed cooperative cartels to ensure better utilisation of rig capacity. This will allow players to adapt their rig use based on needs both as regards time and specifications. This topic is also addressed in Chapters 2.5 and 4.3.

6 Management of unopened areas

Experience shows that the largest discoveries are made in the early phases of exploration of a petroleum province. This is natural since the largest mapped structures are often drilled first. The expectations of making new, large discoveries in the future are therefore greatest in the less-explored parts of the Norwegian Shelf.

Over the last 40 years, the Norwegian Continental Shelf has been mapped through gradual exploration. This means that we currently possess the best knowledge about the geology in the opened areas, but also that the possibilities for making new, large discoveries are reduced in these areas. The last time new acreage was opened for petroleum activity was in 1994 when the deepwater areas in the Norwegian Sea and south-western parts of Nordland VI were opened. The last large discovery on the Norwegian Shelf was Ormen Lange in 1997. The discovery was made in the area opened in 1994.

In the numbered licensing rounds carried out today, all area has been available for nominations from companies in several rounds. The most attractive parts of these areas have, in part, been well-studied. Opening new areas is necessary if we are to make important new discoveries and to maintain significant petroleum production, value creation, investment, employment and State income after 2020. The Government has therefore decided to initiate an opening process for the sea areas surrounding Jan Mayen and the part of the formerly disputed area that is located

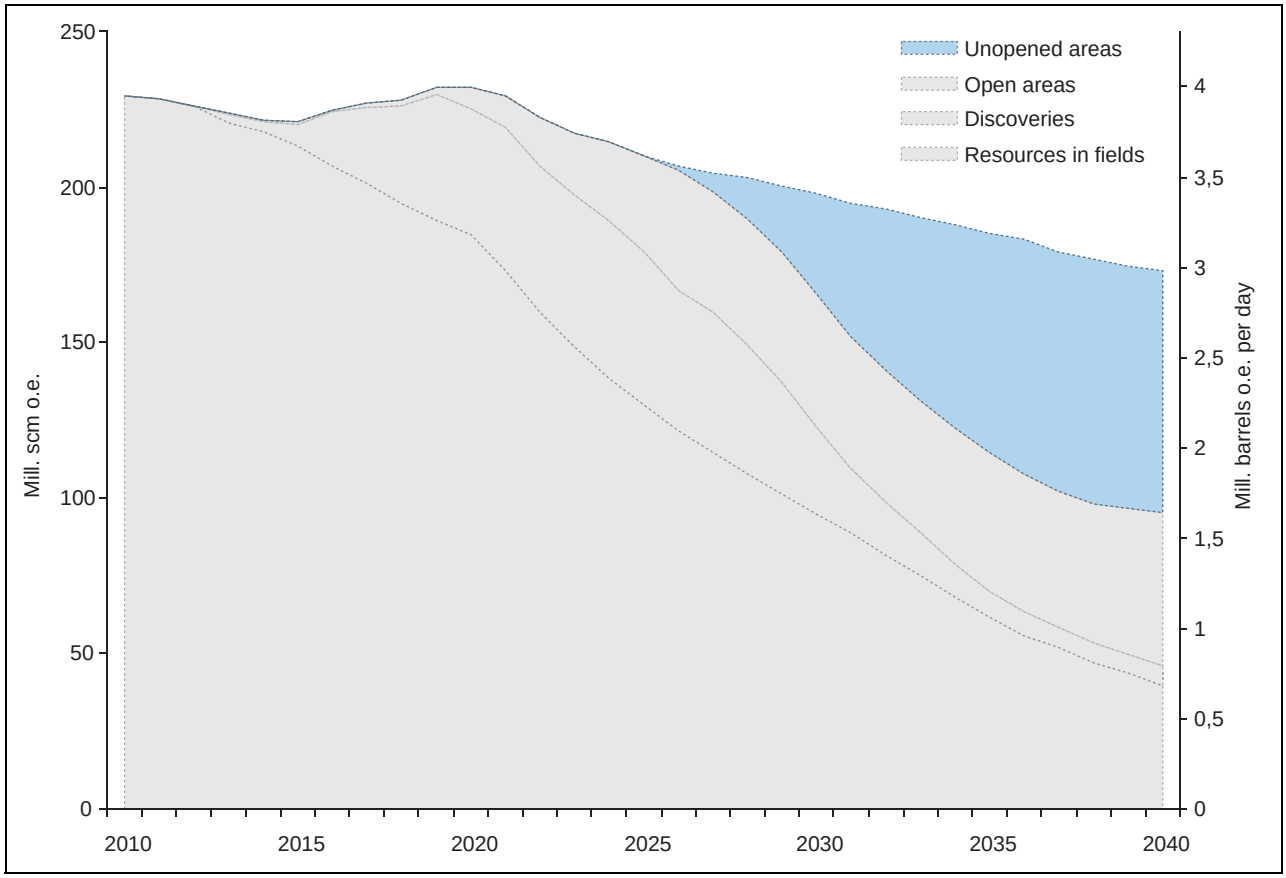

Figure 6.1 Possible production course on the Norwegian Shelf.

Source: The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate.

west of the delimitation line in the Barents Sea South.

6.1 Timely opening of new area

Half of the areas where we expect that petroleum might be found are now open. There are thus large unopened areas remaining on the Norwegian Shelf. This means that there are possibilities for making significant discoveries in the future as well. The expected undiscovered resources in both opened and unopened areas have been estimated at 2 570 million scm o.e. by the Norwegian Petroleum Directorate (NPD). These numbers include the areas with a data basis which makes it possible to estimate undiscovered resources. The resource estimates therefore do not include the sea areas around Jan Mayen and the part of the formerly disputed area in the Barents Sea located west of the delimitation line.

The unopened areas on the Norwegian Continental Shelf are mainly located outside Northern Norway. The process that has been initiated to open new areas in the Barents Sea provides great possibilities for Finnmark county.

To achieve continuous activity on the shelf, it is important that oil and gas policies are knowledge-based, comprehensive and provide for a long-term management of the petroleum resources. New exploration acreage is an important prerequisite to maintain investment and the expertise in the industry, as well as maintaining production over time. This will in turn provide a foundation for long-term value creation and State income. The main objective in Norwegian petroleum policy is to facilitate profitable production of oil and gas in a long-term perspective.

Major discoveries and access to new prospective areas are important factors defining where large companies will carry out exploration activity. Exploration is a complex activity, and if the expertise moves away, it takes many years to rebuild it. Continuous exploration activity is therefore an important part of good resource management.

It takes a long time to start producing from new areas. A new area must go through an opening process, which entails an impact assessment, before the Storting can decide whether to open the area for petroleum activity. If the area is opened, history on the shelf shows that it will take 10-15 years following license awards until production. A decision to start an opening process today could result in production start-ups in 2025 or later.

The areas on the shelf are different. The lead time from opening until production is shorter in areas close to shore and developed infrastructure, as compared with more remote areas. These are important factors when determining petroleum policy.

6.2 Area overview

The sum of all Norwegian marine areas amounts to 2 140 000 km^2. About half of the area is covered in sedimentary rocks that could contain petroleum, cf. Figure 6.2 and Table 6.1. The North Sea, the Norwegian Sea and the Barents Sea South, with certain exceptions, have been opened for petroleum activity. The areas opened as of today amount to 523 800 km^2.

Several of these areas have a potential for petroleum activity. There are considerable differences between areas as regards knowledge level, distance to markets and existing activity, environmental assets and other user interests. The areas thus have various degrees of maturity and different challenges.

Unopened areas for new petroleum activity include the sea areas near Jan Mayen, the north-eastern Norwegian Sea (parts of Nordland IV and V, Nordland VI and VII, Vestfjorden and Troms II), parts of Trøndelag I and II, Møre I, Skagerrak, the part of the formerly disputed area in the Barents Sea located west of the delimitation line, as well as a 35-km belt from the baseline along the coast from Troms II to the Russian border, the Barents Sea North /Arctic Ocean, the Ice edge, the Polar front, the Bjørnøy fan and a 65-km belt around Bjørnøya.

6.3 Opening history

The Norwegian Continental Shelf has been opened in three major rounds, in 1965, 1988 and 1994. In addition, smaller areas were opened in several rounds after 1979, cf. Box 6.1 and Figures 6.3 and 6.4.

In 1965, large parts of the North Sea were opened for petroleum activity. Discoveries in this area enabled development of the industry and still contribute to the main part of production and State income. Petroleum activity was allowed north of 62 degrees latitude in 1979. In 1988, large parts of the Barents Sea were opened, while the deepwater areas in the Norwegian Sea were opened in 1994.

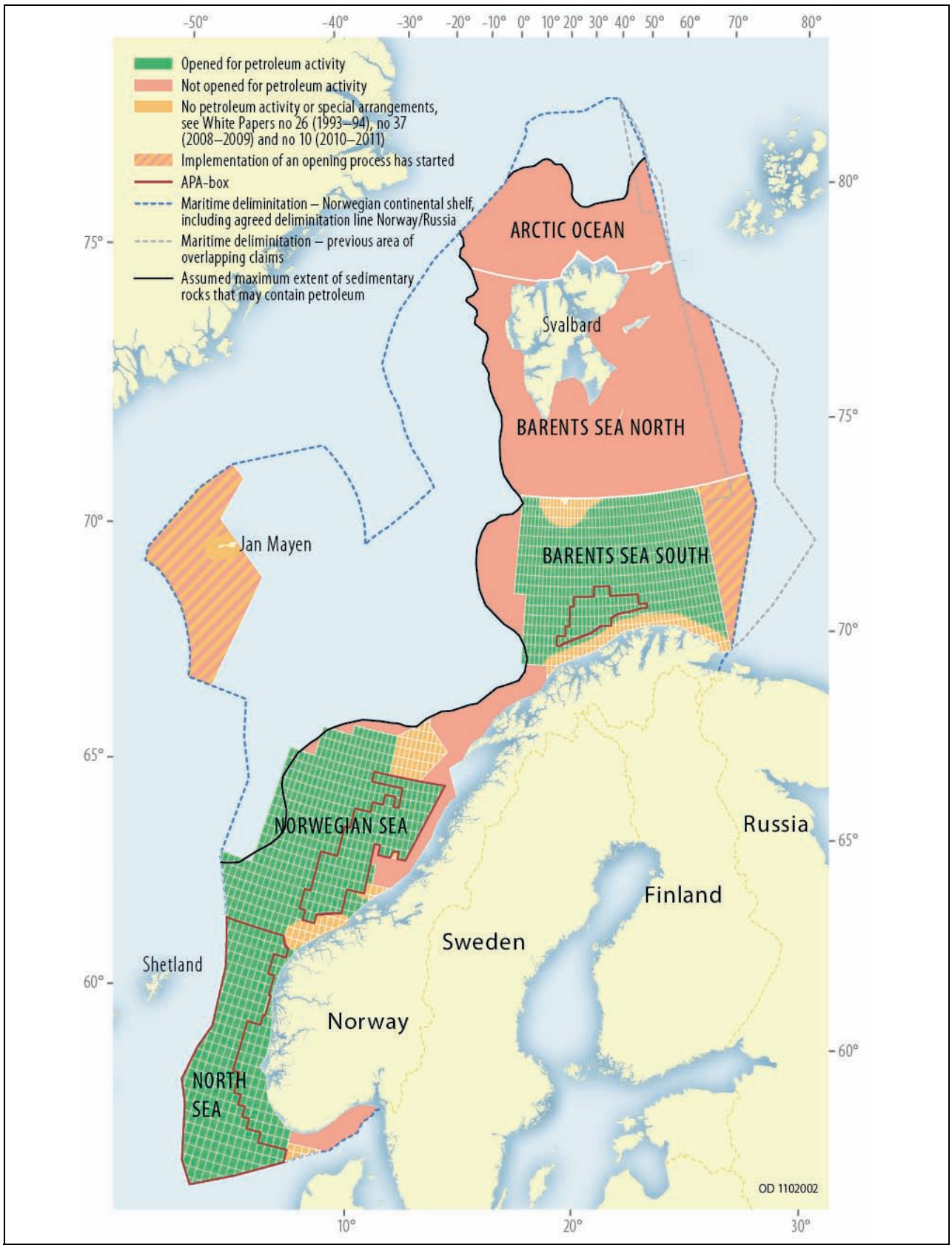

Figure 6.2 Opened and unopened areas on the Norwegian Shelf, estimated maximum spread of sedimentary rocks, for illustration purposes only.

Source: Norwegian Petroleum Directorate.

Table 6.1 Area overview of the Norwegian Shelf

Area accounts Norwegian Shelf (km²)				
Total Norwegian sea areas				2 140 000
Areas with sedimentary rocks (could contain oil and gas)				1 312 000
Area open and available for petroleum activity				523 800
Individual sea area, areas with sedimentary rocks (km²)				
		Unavailable area		
	Area opened and available for petroleum activity	Exempted through management plans	Unopened	Total
North Sea	129 700		12 300	142 000
whereof Skagerrak[1]	*2 500*		*12 300*	*14 800*
Norwegian Sea[2]	204 100	28 600	56 300	289 000
whereof northeastern part[3]		*17 600*	*41 600*	*59 200*
Barents Sea South[4]	190 000	44 100	78 000	313 000
Barents Sea North[5]			469 000	469 000
Jan Mayen, surrounding sea areas			100 000	100 000
Total	523 800	72 700	715 600	1 312 000

1 Skagerrak was opened for petroleum activity along with the rest of the North Sea. Parts of the area were subsequently closed (see text).
2 Including Troms II. Vestfjorden is not included.
3 Northeastern part is unopened part of Nordland IV, V, VI, VII and Troms II.
4 Including Bjørnøy fan and the delimitation line with Russia in the Barents Sea South.
5 Including the delimitation line with Russia in the Barents Sea North and the Arctic Ocean.

Skagerrak was opened for petroleum activity in 1965 along with the rest of the North Sea, however, from the end of the 1970s, the area was not considered suitable for exploration activity. In 1994, a decision was made to allow the drilling of a limited number of exploration wells in the south-western part of Skagerrak, before potentially raising the question regarding further opening with the Storting. Since 1994, no new areas have been opened for petroleum activity.

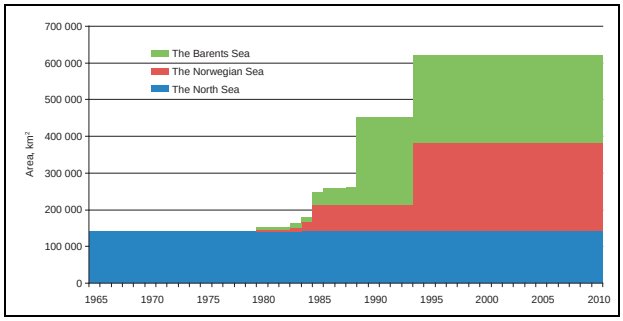

Figure 6.3 Opening history on the Norwegian Shelf.

Source: The Norwegian Petroleum Directorate.

When an area has been opened for petroleum activity, the authorities can announce areas and award production licenses. The scope of the awards is determined independently of how large the areas opened for petroleum activity are. An effective way of identifying prospective exploration acreage is by opening large areas and gradually exploring the areas through sequential exploration. Awards in frontier areas will therefore often be limited to a smaller number of key blocks. This has been the main strategy for exploring new areas on the Norwegian Continental Shelf.

6.4 The unopened areas

6.4.1 Sea areas near Jan Mayen

The island of Jan Mayen is located on the Mid-Atlantic Ridge in the Norwegian Sea, north of Iceland. Jan Mayen is located 500 km east of Green-

land, 550 km northeast of Iceland and 900 km from mainland Norway.

The Jan Mayen Ridge encompasses a micro continent stretching from the Jan Mayen Island to the northern tip of Iceland. The geological development of the area is connected to the formation of the northernmost part of the Atlantic Ocean. The Jan Mayen Island and the rocks below the island are entirely volcanic.

Technical description

The bedrock surrounding Jan Mayen is dominated by lava rocks and young sedimentary rocks. Below these rocks, we expect to find older sedimentary rocks. Areas where sedimentary rocks could occur cover up to 100 000 km^2 in total. The water depth in the largest part of this area varies between 1000 and 2000 metres.

The volume of petroleum resources in the sea areas around Jan Mayen is uncertain, but the necessary geological preconditions for the formation of petroleum could be in place in the same way as on East Greenland and in the Møre basin. The NPD has acquired about 5800 km of 2D seismic in 1979, 1985 and 1988. The seismic data is collected in four data packages that have been made available to the industry. In addition, seismic data has been acquired by Iceland in 2001 and 2008. There is a need for acquiring new seismic data to define prospects and clarify the resource potential in the area.

There is a need to acquire new knowledge and carry out studies in the form of both geological and environmental mapping. The NPD will map the petroleum potential. The results from seismic acquisition and shallow drilling will strengthen the knowledge and increase understanding of the area's geology.

Possible use of Jan Mayen

The Jan Mayen nature reserve was established during the autumn of 2010. The nature reserve encompasses most of the island and the territorial waters, about 375 km^2 of land area and 4315 km^2 of marine area. The parts of the island where there is currently activity are not a part of the nature reserve.

Box 6.1 Gradual exploration

1965: The first announcement on the Norwegian Shelf. Announcement discussed in Storting White Paper No. 22 (1965–1966).

1979: Petroleum activity was allowed north of the 62 degrees in restricted areas of the Norwegian Sea (six blocks) and the Barents Sea (20 blocks on Tromsøflaket). Discussed in Storting White Paper No. 95 (1969–1970), Storting White Paper No. 30 (1973–1974), Storting White Paper No. 81 (1974–1975). Considered in Storting White Paper No. 91 (1975–1976) and Storting White Paper No. 57 (1978–1979), announcement discussed in Storting White Paper No. 46 (1979–1980).

1981: 12 blocks announced in the Norwegian Sea (Helgeland). Considered in Storting White Paper No. 57 (1978–1979), opened in Storting White Paper No. 67 (1980–1981), discussed in Storting White Paper No. 58 (1982–1983).

1983: 13 blocks announced in the Norwegian Sea (Haltenbanken). 19 blocks announced in the Barents Sea (Trømsøflaket). Discussed in Storting White Paper No. 58 (1982–1983).

1984: 30 blocks announced in the Norwegian Sea (Haltenbanken). Discussed in Storting White Paper No. 80 (1983–1984).

1985: 68 blocks announced in the Norwegian Sea (16 blocks in Møre south, 41 blocks in Trøndelag II, 16 blocks in Nordland III, 41 blocks on Møre) 70 blocks announced in the Barents Sea (20 blocks in Troms II, 30 blocks in Bjørnøya south, 20 blocks in Finnmark west) Discussed in Storting White Paper No. 80 (1983–1984). Opening proposed in Storting White Paper No. 79 (1984–1985).

1986–1987: Strategic blocks in the Barents Sea discussed in Storting White Paper No. 79 (1984–1985) and Storting White Paper No. 46 (1986–1987)

1988: The majority of the Barents Sea South is opened for petroleum activity. Was submitted in Storting White Paper No. 79 (1984–1985). Opening proposed in Storting White Paper No. 40 (1988–1989).

1994: New deepwater areas are opened in the western part of the Norwegian Sea, including the western part of Nordland VI. At the same time, Skagerrak is closed for petroleum activity. Considered in Storting White Paper No. 26 (1993–1994).

After 1994, no new areas have been opened for petroleum activity on the Norwegian Shelf.

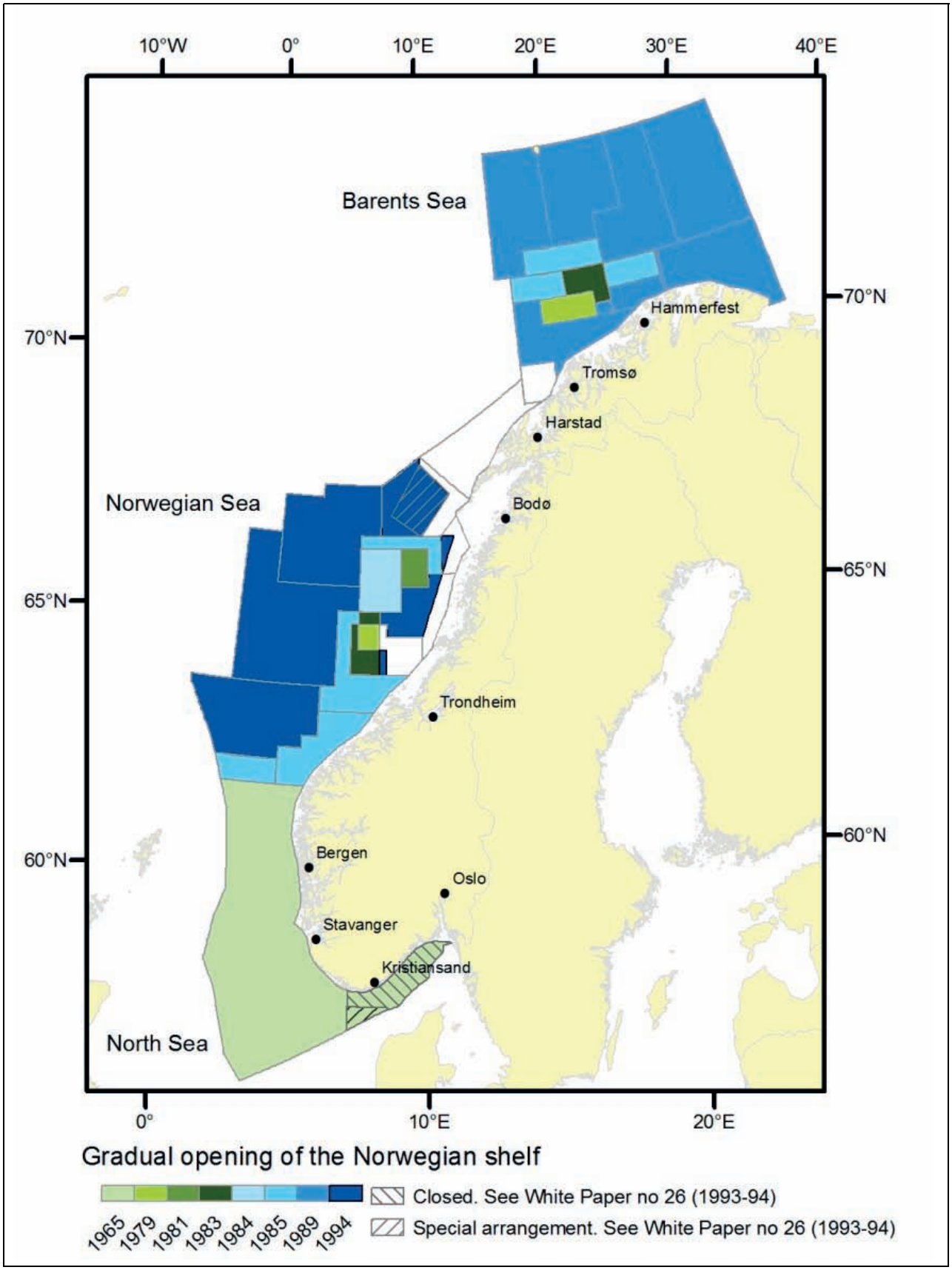

Figure 6.4 Gradual opening of the Norwegian Shelf.

Source: Norwegian Petroleum Directorate

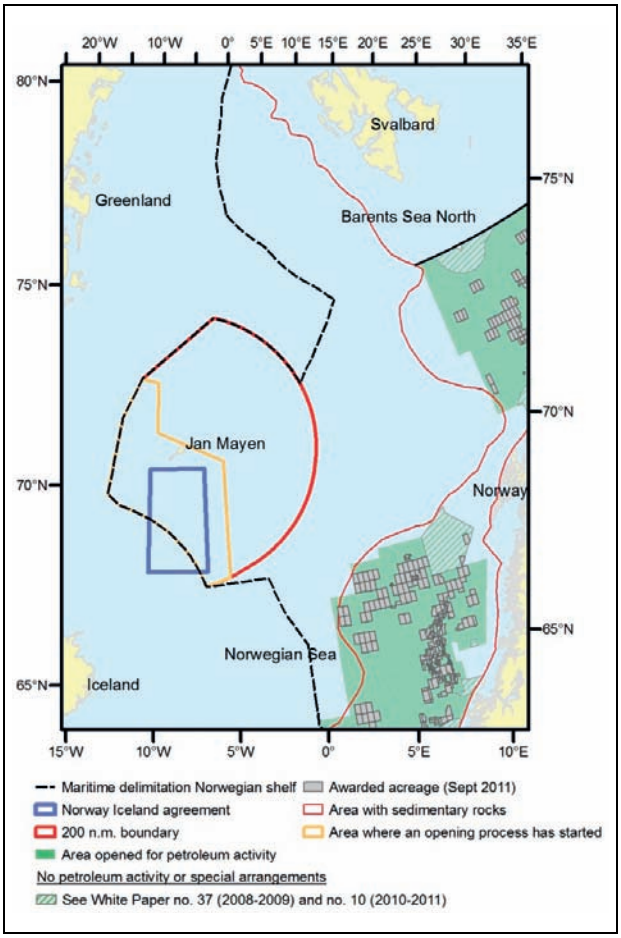

Figure 6.5 The Jan Mayen area

Source: Norwegian Petroleum Directorate

Potential petroleum activity in the marine areas near Jan Mayen, could entail a need to use Jan Mayen for certain activities, for example to safeguard health, safety and the environmental concerns. Possible uses include establishing a base, preparedness storage, infrastructure such as roads and buildings including a quay facility, pier, heliport, petroleum treatment and storage facility and landfall for pipelines.

Potential petroleum activity is not envisaged within the current nature reserve. At present, the necessary type and scope of activity is uncertain. If weighty societal considerations require the framework for the use of Jan Mayen to be adjusted due to petroleum activity in the area, this can be accomplished by the King in Council making the necessary changes to the preservation provisions.

Assessment and conclusion

The Jan Mayen Ridge is a new petroleum province. An opening process has started in the sea areas on the Norwegian side of Jan Mayen with the aim of awarding production licenses. This is the first time this marine area has been assessed as regards potential petroleum activity. The opening process consists of two main elements, a geological mapping and an impact assessment. The draft program for the impact assessment was submitted for public consultation on 14 December 2010. The deadline for comments on the draft program expired on 22 March 2011. Twenty-three submissions were received. Further activities in the assessment process will include:

- Determining the program
- Defining and planning field studies
- Carrying out field studies
- Analysing and reporting updated knowledge basis
- Assessment of basis for petroleum activity, establishment of scenarios
- Impact assessment – relevant issues associated with petroleum activity
- Public consultation regarding the impact assessment
- Presenting a White Paper for the Storting

The course of the various activities will be determined during the process. The field work and seismic surveys, in particular, will be crucial as regards the timing of several other activities. The Government has allocated NOK 10 million in 2011 for environmental mapping. Such mapping could include surveys at sea to increase understanding of the seabed and mapping seabirds and fauna in the area. The ongoing impact assessment process will clarify the details. It is important to strengthen the knowledge concerning geology in the area by collecting new data. Seismic acquisition and shallow drilling will be necessary in order to assess the prospectivity and the future possibilities for petroleum activity in the area. The NPD will carry out these activities starting in 2011.

The Government will:

- Carry out an opening process in the sea area near Jan Mayen, comprising environmental and resource mapping, including seismic data acquisition and shallow drilling.

Table 6.2 Overview of unopened area in the Norwegian Sea

Nordland IV	5 600 km^2
Nordland V	4 000 km^2
Nordland VI	21 600 km^2
Nordland VII	23 400 km^2
Troms II	5 300 km^2
Trøndelag I	7 000 km^2
Trøndelag II	2 000 km^2
Møre I	9 000 km^2
Nordland IV	5 600 km^2
Nordland V	4 000 km^2

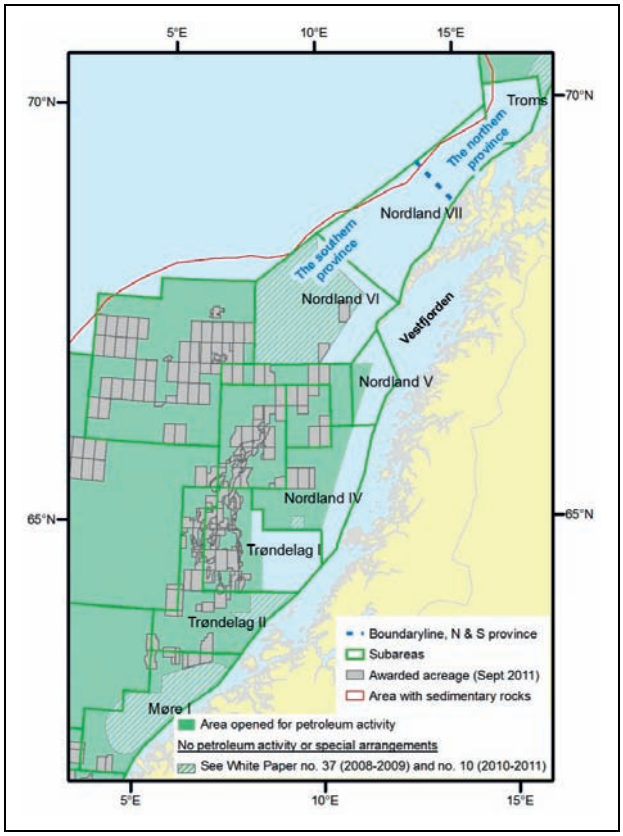

Figure 6.6 The northeastern Norwegian Sea.

Source: Norwegian Petroleum Directorate.

Delimitation of the continental shelf between Norway and Iceland

On 22 October 1981, Norway and Iceland entered into an agreement regarding the continental shelf in the area between Iceland and Jan Mayen (Storting Proposition No. 61 (1981–1982)). The agreement stipulates that the delimitation line between the parties' sectors of the continental shelf in the area between Iceland and Jan Mayen shall coincide with the delimitation line for the countries' economic zones. Furthermore, the agreement stipulates provisions regarding special cooperation in the event of future petroleum activity in a more precisely defined area between Iceland and Jan Mayen. This area covers a total of 45 470 km^2. Of this, 32 750 km^2 is located on the Norwegian side of the delimitation line and 12 720 km^2 on the Icelandic side.

In 2006, Icelandic authorities submitted a strategic impact assessment as preparation for petroleum activity on the Icelandic shelf. In 2009, a licensing round was carried out in the Icelandic sea area. The licensing round did not result in awards. Iceland is working on a new licensing round, with the aim of awarding production licenses in 2012. There will be a continuous dialogue between Norwegian and Icelandic authorities in connection with the petroleum activity on the Icelandic side and implementation of the opening process for Norwegian marine areas near Jan Mayen.

In the part of the cooperation area located north of the delimitation line (Norwegian Continental Shelf), Iceland has been given access to participate with an interest of 25 per cent in connection with exploration and production of petroleum deposits. Iceland may make this decision once a decision is made to develop a new field. In the cooperation area south of the delimitation line (Icelandic continental shelf) Norway has been given access to participate in the petroleum activities with a corresponding interest, but only from and including the time a license award.

The Government will:

- Continue the dialogue with Icelandic authorities to safeguard Norwegian interests in the cooperation area near Jan Mayen.

6.4.2 The Norwegian Sea

An area northeast in the Norwegian Sea has not been opened for petroleum activity. This area includes acreage in Nordland IV, V, VI, VII and Troms II. In this White Paper, these areas are called the northeastern Norwegian Sea. Farther south along the coast there are also areas in Trøndelag I and II, as well as near Møre where licensing rounds will not be announced until the management plan for the Norwegian Sea is updated,

in 2014 at the latest. In total, this amounts to a considerable area, cf. Table 6.2. This Chapter also addresses the part of Nordland VI that is opened, but where there will be no petroleum activity during this parliamentary term.

Technical petroleum description of the northeastern Norwegian Sea

The geology in the northeastern Norwegian Sea is varied and complex. The water depth is generally less than 400 metres in this area. The continental slope to the west and north-west plunges to more than 2500 metres. In terms of petroleum geology, the area can be divided into a southern province containing Nordland IV, Nordland V, Nordland VI and southern Nordland VII, and a northern province containing the northern part of Nordland VII and Troms II.

The seismic data basis in the northeastern Norwegian Sea varies in both scope and quality. From 2007-2009, the NPD carried out acquisition of 2D seismic, 3D seismic and other data relating to the subsurface in Nordland VII and Troms II. 2D seismic has also been acquired in this area previously. In addition, several shallow drillings have taken place and a wildcat well has been drilled. Several wildcat wells have been drilled just outside the area. Based on new and previously collected data, the NPD has mapped the areas and calculated the resource potential.

The main characteristics of the geology, resource estimate and value assessment of various resource outcomes are described in separate reports from the NPD[1]. Nordland VI appears to be the most prospective area for petroleum resources. At the same time, the mapping work shows that the unopened parts of Nordland V, Nordland VII and Troms II also have a petroleum potential. The mapping indicates that the necessary geological preconditions for making a discovery are present, and that the possibilities of making discoveries are considered good. Based on new mapping, prospect evaluation and exploration model analysis, the total expected undiscovered resources are estimated at just over 200 million scm o.e. The range of uncertainty is estimated at between 76-371 million scm o.e. The majority of the resources are expected in Nordland VI. Nordland VII and Troms II have an overall expected resource estimate on par with Nordland VI.

Other areas in the Norwegian Sea

The Møre coast was subject to several periods of uplift and erosion. This has resulted in the removal of thick sediment packages. The uplift and skewed position of the layers could have led to hydrocarbon leaks.

The seismic data coverage on Møre is relatively good. Several wildcat wells were drilled and shallow drilling was carried out in the area before it was exempted for petroleum activity. Hydrocarbons were not proven in these wells, but several small discoveries were made just south of the area. Storting White Paper No. 37 (2008-2009) Comprehensive management of the marine environment in the Norwegian Sea (management plan) states that "Until the management plan is updated, in 2014 at the latest, licenses will not be announced on the Møre banks. The Government will then re-assess this issue".

The seismic data coverage in Trøndelag I and II is relatively good. A number of wildcat wells that are relevant for this area have been drilled on the Trøndelag platform. In the unopened part of Trøndelag I, a scientific, shallow well has been drilled. The shallow boreholes outside the Trøndelag and Nordland coast also provide useful information concerning the rocks' composition and age. The most critical element for prospectivity is whether mature source rocks exist. Several dry wildcat wells have been drilled on the Trøndelag platform west of the unopened area. However, the presence of oil and gas in the unopened area cannot be precluded.

Assessment and conclusion

Since 1984, various parts of the northeastern Norwegian Sea have been impact assessed, cf. Box 6.2. Parts of Nordland VI have been opened, but there will not be petroleum activity there during this Storting period. In addition, no new blocks will be announced in the area in the period. The other areas have not been opened.

No impact assessments pursuant to the Petroleum Act will be carried out in Nordland VII and Troms II and unopened parts of Nordland IV, V and VI during this Storting period. The Ministry will carry out knowledge acquisition concerning the effects of petroleum activity in unopened parts of Nordland IV, V, VI, VII and Troms II. The knowledge acquired must be suited for use in a

[1] Petroleum resources in the sea areas outside Lofoten, Vesterålen and Senja (NPD, 2010), Geo-technical assessment of petroleum resources outside Lofoten, Vesterålen and Senja (NPD, 2010), Financial assessment of undiscovered petroleum resources in the sea areas outside Lofoten, Vesterålen and Senja (NPD, 2010).

potential impact assessment regarding petroleum activity, and must be suited for use as a basis for the next update of the management plan. The work will start quickly. The knowledge acquisition topics will e.g. include societal and industrial effects and spin-off effects, including effects on tourism and the fishery industry. The topics will be determined in cooperation with regional and local authorities, sector authorities and specialist environments.

In unopened parts of Nordland IV and V there will also be a need for strengthening the knowledge regarding petroleum resources through seismic surveys and other geological data acquisition, headed by the NPD and in dialogue with the fishing industry and fishery authorities. The NPD prepares data packages with relevant seismic from Nordland VI, VII and Troms II which are to be marketed for sale.

Based on the NPD's new mapping, Nordland VI appears to be the most prospective area for petroleum resources. Nordland VII and Troms II have a total expected resource estimate on par with what is expected in Nordland VI. The resource estimate for oil is greater than for gas in Nordland VI and VII. The greatest probability of gas is in Troms II.

The Government will:

- Carry out knowledge acquisition regarding effects of petroleum activity in unopened parts of Nordland IV, V, VI, VII and Troms II. The knowledge being acquired must be suited for use in a potential impact assessment regarding

Box 6.2 Unopened parts of the Norwegian Sea – history

1984: Troms II was impact-assessed, the area was not opened.
1989: The area was included in the assessments carried out prior to the opening of the Barents Sea South. The area was not proposed for opening.
1994: Nordland IV, V and VI were impact-assessed and partially opened. Areas near the coastline were not opened. An opportunity to drill six exploration wells was granted in an area in the middle of Nordland VI. Nordland VII was not opened.
1996: Two production licenses were awarded in Nordland VI.
2001: The second well in Nordland VI was interrupted. A decision was made to carry out an assessment of consequences from year-round petroleum activity in the area Lofoten – Barentshavet (ULB) before any further petroleum activity in these areas.
2003: ULB submitted. A decision was made to not open Nordland VI for any further petroleum activity. Furthermore, that an assessment of further activity should be made in connection with the comprehensive management plan for the Barents Sea.
2006: Storing White Paper No. 8 (2005–2006) Comprehensive management of the marine environment in the Barents Sea and the waters off Lofoten (management plan) determines that petroleum activity must not be started in Nordland VI during the 2005-2009 Storting period. Furthermore, that petroleum activity must not be started in Nordland VII and Troms II in the current Storting period, but that the question as regards petroleum activity in these areas will be considered in connection with a revision of the management plan.
2009: When submitting Storting White Paper No. 37 (2008–2009) Comprehensive management of the marine environment in the Norwegian Sea (management plan), a decision was made to not start an opening process in the northern part of the coastal zone. Furthermore, that this question should be considered in connection with the update of the management plan for the Barents Sea – Lofoten.
2011: In Storting White Paper No. 10 (2010–2011) Updating the management plan for the marine environment in the Barents Sea and the waters off Lofoten, the Government decided that there should not be petroleum activity in the opened parts of Nordland VI during this Storting period, and furthermore, that an impact assessment should not be started according to the Petroleum Act in Nordland VII and Troms II and in unopened parts of Nordland IV, V and VI. The Ministry of Petroleum and Energy will carry out knowledge acquisition regarding effects of petroleum activity in unopened parts of Nordland IV, V, VI, VII and Troms II. The knowledge being acquired must be suitable for use in a potential impact assessment regarding petroleum activity.

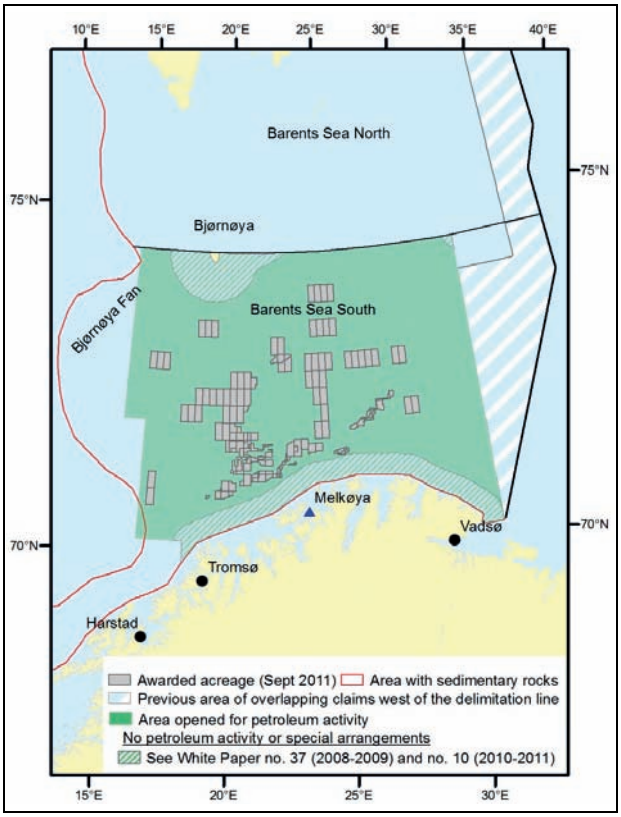

Figure 6.7 Barents Sea South.

Source: Norwegian Petroleum Directorate.

petroleum activity and must also be suitable as a basis for the next update of the management plan.

- Strengthen the knowledge regarding petroleum resources in unopened parts of Nordland IV and V through seismic surveys and other geological data acquisition carried out by the NPD and in dialogue with the fishing industry and fishery authorities.
- Offer data packages with relevant seismic data from Nordland VI, VII and Troms II for sale.

6.4.3 Barents Sea South

The parts of the Barents Sea located south of 74°30' N which are not currently available for petroleum activity, are discussed in this Chapter. This applies to the part of the formerly disputed area located west of the delimitation line, an area to the west that is also covered by sedimentary rocks called the Bjørnøy fan, a 65-km zone around Bjørnøya, the areas by the Ice edge and Polar front and the coastal zone along Troms and Finnmark. The water depth in the Barents Sea South averages less than 400 metres, while the continental slope to the west by the Bjørnøy fan is more than 2000 metres deep.

Technical description

Hydrocarbons have been proven to the east and west of the formerly disputed area. This provides hope that there could also be hydrocarbons in the part located west of the delimitation line. The data basis is too poor to provide a resource estimate for the area. In the early 1980s, an agreement was entered between Russia and Norway regarding a moratorium on further petroleum activity in the disputed area. Prior to the moratorium, the Norwegian side acquired certain seismic lines east of the sector line. These lines show that geological formations located west of the sector line continue into the area towards the centre line. On the Norwegian side, west of the agreement area, several minor discoveries have been made. On the Russian side, east of the agreement area, very large gas discoveries have been made, including Sjtokman and Kildinskoya. There are possibilities for petroleum resources in the new areas on the Norwegian side as well. There is a need for more data in the area to ensure good resource mapping and prospect definition. The NPD recommends acquiring 2D seismic first, potentially followed by aeromagnetic and gravimetric data[2].

The NPD does not have data for the area around Bjørnøya which makes it possible to establish a resource estimate for the area. The data basis is limited by the Ice Edge and Polar Front, and the petroleum potential in these areas is therefore uncertain. The NPD believes that the western continental slope (Bjørnøy fan) has a limited petroleum potential.

The coastal zone from Troms II to the delimitation line in the Barents Sea is considered to have a limited petroleum potential.

Assessment and conclusion

The southern part of the Barents Sea is generally open for petroleum activity, with the first announcement made in 1979. Increasing interest in the area is apparent both through numbered rounds and awards in pre-defined areas (APA). There are currently 53 active production licenses in the Barents Sea, and 86 exploration wells have been drilled. So far, Snøhvit is producing and Goliat has been approved for development. Skru-

[2] Gravimetric data shows the variation of the gravitational field (gravity) to reveal the composition of the subsurface.

Box 6.3 Delimitation line with Russia

The maritime delimitation between Norway and Russia in the Barents Sea and the Arctic Ocean has been the object of negotiations for nearly 40 years. The agreement between Norway and Russia regarding maritime delimitation and cooperation in the Barents Sea and Arctic Ocean was signed in Murmansk on 15 September 2010. During the winter of 2011, both countries' national assemblies consented to ratification of the agreement. Exchange of the ratification documents took place in Oslo on 7 June 2011. The agreement will enter into force thirty days following the exchange of ratification documents.

The agreement regarding maritime delimitation and cooperation entails that the disputed area of about 175 000 square kilometres will be split into two approximately equal parts. The agreement also contains provisions regarding cooperation between the parties should an oil or gas deposit extend across the delimitation line. If such transboundary petroleum deposits are discovered, the agreement contains detailed rules and procedures with the aim of ensuring prudent and cost-efficient management of the petroleum resources.

gard is a new discovery that could form the basis for a new, independent development in the area. In order to further develop the area, it is important to facilitate continuous activity.

In connection with the update of the comprehensive management plan for the marine environment in the Barents Sea – Lofoten, Storting White Paper No. 10 (2010–2011), adjustments were made in the framework for petroleum activity in the Barents Sea South. A decision was made to allow for petroleum activity in the area from 35-50 km from the coast from Troms II to the border with Russia; including Tromsøflaket. The same applies to Eggakanten (the area from the edge of Tromsøflaket and north). For other areas, the framework was continued: In the areas by the Ice edge and Polar front, within a 65-km belt around Bjørnøya and in a 35-km belt from the baseline along the coast from Troms II to the Russian border, petroleum activity will not be started during this Storting period.

The NPD considers the part of the formerly disputed area located west of the delimitation line with Russia interesting as regards petroleum activity on the Norwegian Shelf. Hydrocarbons have been proven to the east and west of the area. This gives hope that there might also be hydrocarbons in the part of the Barents Sea South located west of the delimitation line. The data basis in the area is very limited and it is therefore not possible to assess the resource potential. There is thus a need for more data from the area. Initially 2D seismic and potentially aeromagnetic and gravimetric data will be collected.

In connection with updating the comprehensive management plan for the marine environment in the Barents Sea and Lofoten, Storting White Paper No. 10 (2010-2011), a decision was made for the Ministry to start an impact assessment according to the Petroleum Act with the aim of awarding production licenses in the formerly disputed area west of the delimitation line in the Barents Sea South. If the impact assessment provides a basis for it, the Government will submit a Storting White Paper which recommends opening these areas for petroleum activity. The impact assessment will start when the agreement between Norway and Russia regarding maritime delimitation and cooperation in the Barents Sea and Arctic Ocean enters into force.

The Government will:

- Start an impact assessment according to the Petroleum Act with the aim of awarding production licenses in the formerly disputed area west of the delimitation line in the Barents Sea South when the agreement with Russia regarding maritime delimitation and cooperation in the Barents Sea and Arctic Ocean has entered into force.
- When the agreement with Russia regarding maritime delimitation and cooperation in the Barents Sea and Arctic Ocean enters into force, start data acquisition in the formerly disputed area west of the delimitation line in the Barents Sea South.
- Facilitate new petroleum activity in the area from 35–50 km from the coast from Troms II to the border with Russia and in Eggakanten by including these areas in future licensing rounds.

Box 6.4 Determining the outer limit of the Norwegian Continental Shelf

In its recommendation from April 2009, the UN's Continental Shelf Commission granted approval for Norway to determine the border for its continental shelf outside 200 nautical miles in three areas: in the Nansen basin in the Arctic Ocean north of Svalbard, in the Loophole between Norway and Russia in the Barents Sea and in the Banana Hole of the Northeast Atlantic, i.e. the area outside the 200-mile border between mainland Norway and Jan Mayen and Greenland.

The shelf area outside 200 nautical miles in the Nansen basin is about 14 000 km^2 and covers deep sea areas with depths of about 4000 metres. Based on joint interests between Norway and Russia regarding the northern delimitation of the continental shelf, technical agencies in the two countries cooperated on the mapping of the area.

After the agreement regarding the delimitation line between Norway and Russia was in place, it is now clear that the Norwegian Shelf in the formerly disputed area will be about 88 000 km^2, of which about 8 600 km^2 are located in the Barents Sea Loophole. The clarification has great significance for achieving an effective management of this part of the shelf in the future, and will make it easier for Norwegian authorities to cooperate with Russian authorities in the area.

The Norwegian Continental Shelf outside 200 nautical miles in the Banana Hole of the Northeast Atlantic can amount to up to 250 000 km^2. In the southern part of this area, however, Iceland and Denmark with the Faroe Islands are aiming to document a continental shelf outside 200 nautical miles. In September 2006, a negotiation protocol was signed between Norway, Iceland and Denmark/the Faroe Islands regarding the approach for delimitation of the continental shelf and in the southern part of the Banana Hole. The protocol must be followed up with formal delimitation agreements when the Continental Shelf Commission has issued its recommendation to Iceland and Denmark/the Faroe Islands for this area. If Iceland and Denmark/the Faroe Islands receive recommendations from the Continental Shelf Commission along the lines of their shelf proposals, the Icelandic and Faroese shelf areas will amount to about 60 000 km^2 in total. The Norwegian Continental Shelf in the Banana Hole will then be about 190 000 km^2. The majority of this area covers deepwater areas of 3000-3500-metres.

The deepwater areas in the Arctic Ocean and in the Banana Hole that are now included in the Norwegian Shelf outside 200 nautical miles, are not considered to be prospective areas for oil and gas. They could, however, contain other types of resources that are not yet known. The part of the formerly disputed area that is now located on the Norwegian side of the delimitation line, is however, part of the shallow shelf area in the Barents Sea, and thus a part of the prospective parts of the Norwegian Continental Shelf.

For utilisation of the inanimate resources on the continental shelf outside 200 nautical miles from the baselines, a special rule relating to a duty for relinquishment of a production fee according to Article 82 of the Law of the Sea Convention applies to the advantage of developing countries and landlocked countries. A more detailed description of the obligations in Article 82 is provided in Storting Proposition No. 37 (1995-1996) relating to consent for ratification of the Law of the Sea Convention.

In the 21st licensing rounds, new blocks were announced in the Vøring plateau, of which four are located outside 200 nautical miles from the baseline. This could actualise Norway's duty to relinquish a production fee according to Article 82 of the Law of the Sea Convention. The fee obligation enters into force during the sixth production year at a production location, and will amount to one per cent of the value of the amount of production at a production location during the first year. Following the first year, the rate is increased by one percentage point for every subsequent year until the twelfth year, and will then remain at seven per cent for the remainder of the production duration. The fee obligation lies with the Norwegian State, but can also be transferred directly to the companies.

6.4.4 The Barents Sea North and Arctic Ocean

The Barents Sea North encompasses the marine areas between the Norwegian Sea in the west and the maritime delimitation line with Russia to the east. To the south, the area stops at 74°30' N. To the north, the area stretches north of Svalbard. The area of the entire Norwegian part of the Barents Sea North as well as the parts of the Arctic

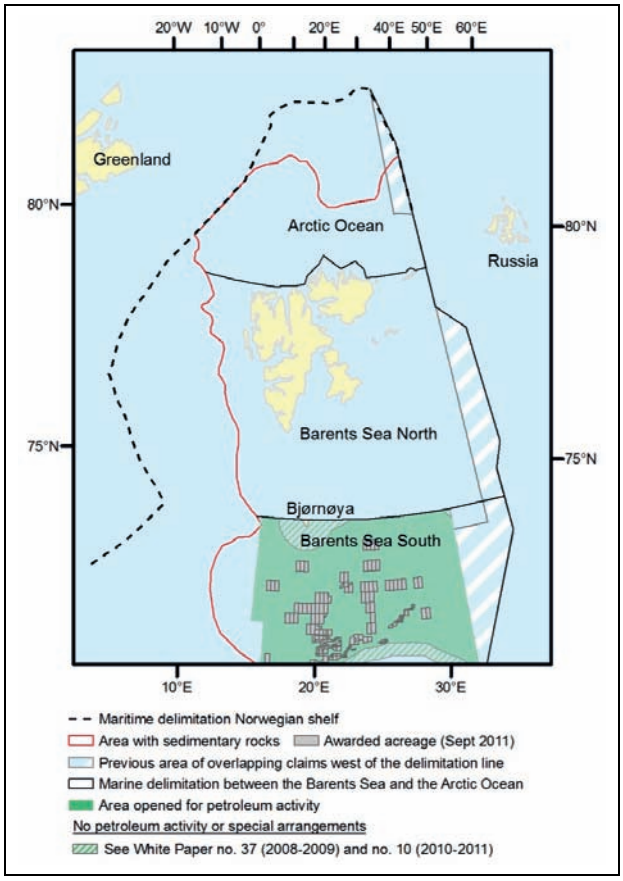

Figure 6.8 The Barents Sea North and the Arctic Ocean.

Source: Norwegian Petroleum Directorate.

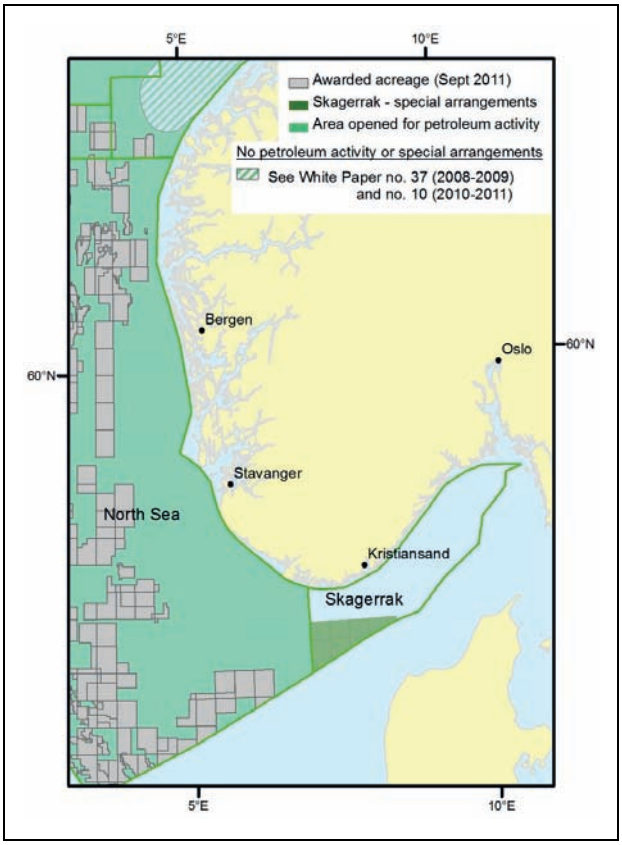

Figure 6.9 The North Sea.

Source: Norwegian Petroleum Directorate.

Ocean with sedimentary rocks, is roughly 489 100 km^2. The area of the new part of the Barents Sea North is 35 000 km^2. The water depth on the shelf is generally less than 400 metres, while the continental slope to the west and north plunges down to more than 2500 metres. During winter, large parts of the sea area are covered in drift ice.

Over the last 15 years, the scientific exploration of the Arctic Ocean has grown significantly. Countries such as the US, Russia, Germany and Sweden are carrying out extensive, continuous activity throughout the Arctic Ocean. The project of mapping the shelf's outer limit has made the NPD an interesting player to the international research communities in the area. The reason behind this is that the Norwegian authorities have had their own data and activity to reference. In this context, the NPD has had extensive cooperation with the State-owned Russian mapping institutes.

Technical description

Researching the petroleum potential in unopened areas of the Barents Sea has had a low priority for many years, but data acquisition has been carried out by the NPD. The surveys show that there is a large area where sedimentary rocks are present. The data basis in the Barents Sea North is old and has poor coverage.

Assessment and conclusion

Interest in the northern areas is increasing. The Government has defined the northern areas as its most important strategic priority area as regards foreign policy. Presence, activity and knowledge form the foundation of the efforts. The goal is for Norway to be at the top internationally as regards developing knowledge about, for and in the northern areas. Furthermore, the goal is for Norway to be at the forefront as a steward of the environment and natural resources in the northern areas. We currently possess limited knowledge regarding the Barents Sea North and the Arctic Ocean.

A key element in the northern strategy is carrying out projects to develop new knowledge.

6.4.5 The North Sea and Skagerrak

Skagerrak is the name of the sea area between Denmark, Sweden and Southern Norway. In this description, Skagerrak is limited to the area between the baseline and border with Denmark and Sweden, east of 7° E, cf. Figure 6.10. Skagerrak's total area amounts to 14 800 km^2, the unopened part of Skagerrak is 12 300 km^2. The water depth in Skagerrak varies from 100 to about 750 metres.

Technical description

In the northern part of the area, which has not been opened, a limited amount of seismic data has been acquired. This data is older and of poor quality. There is a need to acquire new seismic data if a new geological mapping of the area is to be carried out. A wildcat well has been drilled just west of Skagerrak. No hydrocarbons or source rock were proven in the well, but good reservoir rocks were discovered.

The NPD assumes the largest potential for oil and gas deposits is located in the southern part of Skagerrak.

Assessment and conclusion

In 1987, preparations for an impact assessment were started for all of Skagerrak. The impact assessment was submitted in Storting White Paper No. 26 (1993–1994). Based on this, the Storting decided to make a part of Skagerrak available for exploration activity in 1994. This area located north of the line 57°40' N and east of line 8°30' E, was made available for exploration activity, with special conditions. Permission to drill up to four exploration wells can be granted in the area, before potentially raising the question regarding further opening with the Storting. The other parts of Skagerrak have not been opened for petroleum activity.

In connection with the authorities' consideration of the question regarding exploration drilling in Skagerrak, Swedish authorities established contact and wanted additional assessments of possible consequences for the Swedish west coast. After an overall assessment of environmental and fishery considerations, as well as the activity level in the sector, production licenses were not awarded in Skagerrak.

Several dry wells have been drilled just west of the area. The greatest potential in the area is located in the southern part.

The Government will:

- Consider the future need for new knowledge regarding petroleum resources in Skagerrak.

6.4.6 Elements in an opening process

The Government has chosen to establish a comprehensive management plan as a tool for decisions associated with utilisation of the sea areas. The objective is to facilitate value creation and coexistence between the respective industries through sustainable use of resources and ecosystem services. As the same time, the structure, function and productivity of the ecosystems must be maintained, and the natural diversity must be preserved.

Before we can have petroleum activity in a sea area, an opening process must be carried out. The Petroleum Act provides a legal basis for the resource management, including starting opening processes. The Petroleum Act is administered by the petroleum authorities. Only when an area is opened will production licenses be awarded according to stipulated provisions and certain environmental and fishery considerations.

Elements in an opening process

Before an area can be opened for petroleum activity, an opening process must be carried out. An opening process has the objective of assessing the technical basis on which the Storting's decision is based. Deciding whether or not to open an area is carried out by the Storting.

An opening process consists of two main elements. One element entails mapping the geology and thus the resource potential in the area. The initial mapping of the geology could, for instance, entail seismic data acquisition, drilling shallow wells, electromagnetic surveys or aeromagnetic surveys. The surveys are normally carried out by the NPD.

The other part is an assessment of the industrial, environmental and other societal effects of petroleum activity in the area. This includes the possible risk of pollution, as well as the financial and social effects the petroleum activity might have. Such an evaluation is carried out through an impact assessment under the direction of the Min-

Box 6.5 Regarding opening processes in the Petroleum Act

Section 3-1 of the Petroleum Act states the following regarding opening new areas:

> «Prior to the opening of new areas with a view to granting production licenses, an evaluation shall be undertaken of the various interests involved in the relevant area. In this evaluation, an assessment shall be made of the impact of the petroleum activities on trade, industry and the environment, and of possible risks of pollution, as well as the economic and social effects that may be a result of the petroleum activities. The opening of new areas is a matter which shall be put before local public authorities, central trade and industry associations and other organisations which may be presumed to have a particular interest in the matter. Furthermore it shall be made known through public announcement which areas are planned to be opened for petroleum activities, and the nature and extent of the activities in question. Interested parties shall be given a period of time of no less than 3 months to present their views. The Ministry decides on the administrative procedure to be followed in each individual case.»

istry of Petroleum and Energy. An impact assessment is a crucial part of an opening process.

In the first part of the impact assessment process, a draft study program is prepared. This contains a description of what will be assessed. The draft study program must be submitted for public consultation. Based on the program proposal and submissions, the Ministry then determines the study program.

After determining the study program, there will be a need to strengthen the knowledge regarding e.g. the environmental assets in the relevant area. Examples include mapping seabirds, the seabed, pelagic species and the existing fauna. The need for data acquisition will, however, depend on the knowledge status within each discipline.

Based on the knowledge concerning environmental assets and other relevant social conditions, as well as viewpoints regarding potential future petroleum activity in the area, the actual impact assessment is carried out.

Topics of the impact assessment could include:

- Factors as regards solutions, design and operations
- Societal consequences
- Regular discharges to sea
- Physical intervention
- Consequences for other activities
- Incidents involving acute pollution

The impact assessment and underlying reports are submitted for public consultation.

The assessments, submissions and other relevant information that has emerged during the process form a basis for a report to the Storting. Possible conditions for an opening are discussed in the Storting White Paper. The Storting will make a decision regarding whether or not to open all or parts of the area in question, including any conditions.

7 The external environment, preparedness and safety

From the very beginning, consideration for other industries and safeguarding the external environment has formed an integral part of how Norway manages its petroleum activities. Over the course of 40 years, we have developed an extensive system of policy instruments designed to safeguard considerations for other industries and the external environment in all phases of the activity – from opening of new areas, via license awards, exploration, development and operation, through field cessation.

Emissions from the petroleum activity are often divided into three different categories: operational discharges to sea, operational emissions to air and acute discharges/emissions. Acute discharges/emissions are emissions or discharges that are not planned, and would not be permitted under the Pollution Control Act. Operational discharges to sea are mainly cleaned water that originates from the reservoirs (produced water) and drilled rock mass (drill cuttings) that originates from drilling activity. Emissions to air are largely exhaust from energy production needed to operate the facilities. In addition, some gas is combusted through flaring for safety reasons, as well as evaporation of light oil components in connection with storage and loading of crude oil.

As a consequence of a number of policy instruments established through more than 40 years of petroleum activity as well as strong focus on limiting emissions/discharges on the part of authorities and companies, the Norwegian Shelf is among the best in the world when it comes to emissions to air per produced unit, cf. Figure 7.1.

A goal has been established of zero environmentally hazardous and environmentally harmful discharges to sea (the zero discharge goal). This goal is regarded as having been achieved as regards environmentally hazardous chemical additives, while the goal for discharges of oil and naturally occurring environmentally hazardous substances in produced water has not been achieved to the same degree. In 2007, 90 per cent of the chemical substances discharged consisted of substances that are not considered to pose a danger to the marine environment. Today, some of the water that accompanies petroleum produced from the reservoirs is reinjected. This allows us to avoid discharging oil drops and chemical residues that remain after the water is cleaned. At the same time, this causes energy consumption on the facility, when the water is forced back into the subsurface.

The two largest acute spills to take place on the continental shelf were the blowout on the Bravo platform in 1977 and an accident in connection with oil loading on the Statfjord field in 2007. No acute spills on the continental shelf have ever reached the coast. Every day, both the companies and the authorities focus on diligent management of the risk associated with the activities to make sure that this will not happen in the future. Safety standards on the Norwegian Shelf are high.

Forty-five years of petroleum activity on the Norwegian Shelf have proven that production of oil and gas can be compatible with environmental considerations. However, there is still work to be done and the players must continue their efforts to find efficient new solutions that further reduce emissions and discharges from the activity. Comprehensive assessments in connection with estab-

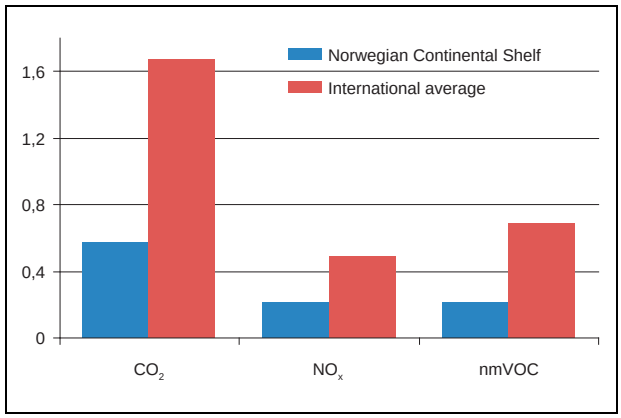

Figure 7.1 Emissions to air on the Norwegian Shelf compared with international average for other petroleum-producing countries for the year 2008. Unit in 100 kg per scm o.e. for CO_2 and in kg per scm o.e. for other components.

Source: OLF and EnvironmentWeb.

lishing new targets and cost-efficient use of policy instruments to achieve these targets are important, and we have proven that it is possible to balance various environmental considerations.

The administrative responsibility for the petroleum sector is divided among several ministries and directorates. The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate are responsible for ensuring sound and prudent management of the oil and gas resources. The Ministry of Labour and the Petroleum Safety Authority Norway are responsible for health, working environment and safety. In an upcoming Storting white paper on working environment, working conditions and safety in Norwegian working life, the Ministry of Labour will present a broader, updated review of the state of HSE in the petroleum activities. The Ministry of Fisheries and Coastal Affairs, represented by the Norwegian Coastal Administration, is responsible for the State's preparedness against acute pollution, and for coordinating private, municipal and State players in a national emergency preparedness system. The Ministry of the Environment and the Climate and Pollution Agency are responsible for regulating emissions to air and discharges to sea through discharge permits, as well as for stipulating preparedness requirements for acute pollution in the petroleum activities. In an upcoming Storting white paper on Norwegian climate policy, the Ministry of the Environment will present a broad-based review of the status and objectives of our climate policies.

7.1 Comprehensive and modern regulation

The petroleum activities are subject to strict requirements for safeguarding the external environment. A thorough and comprehensive system has been established consisting of e.g. management plans, impact assessments, emission/discharge permits and financial policy instruments. To ensure the best possible follow-up, the health, safety, environment and working environment authorities have worked together to develop integrated comprehensive regulations for health, safety and the environment.

Cost-effective use of policy instruments is a fundamental principle for management of the petroleum resources in Norway. This entails conducting cost-benefit assessments of measures that reduce emissions to air and discharges to sea, and implementation of the measures with the lowest cost first. The principle of cost-effectiveness is also a fundamental element in Norwegian climate policy. The polluter must pay, and the environmental and climate goals shall be achieved through the use of cost-effective policy instruments. The petroleum industry in Norway has paid a CO_2 tax since 1991, and has also been part of the emission quota system since 2008.

A general framework is established through the management plans to balance commercial interests with safeguarding the external environment. Extensive technical assessments underpin the decisions regarding terms and conditions for new petroleum activity in the management plan areas. These area-based conditions are stipulated particularly on the basis of balanced consideration between the petroleum and fishery industries, as well as the environment.

An opening process must be carried out before an area can be opened for petroleum activity. The purpose of an opening process is to study the technical basis on which the Storting (Norwegian Parliament) will base a potential decision to open an area. An opening process includes mapping the resource base for petroleum. An evaluation shall also be made of the commercial and environmental effects of potential petroleum activity, the potential hazard of pollution, along with the economic and social effects that may result from the petroleum activity. This is accomplished by means of an impact assessment.

As regards acquisition of seismic data, notification of this activity must be provided to the authorities five weeks before the activity commences. Furthermore, restrictions apply to seismic data acquisition in the most vulnerable areas through the management plans. Such restrictions can include time restrictions for such activity e.g. during spawning migration or spawning. This will contribute to preventing acquisition of seismic data when the natural resources can be particularly vulnerable. There are also requirements for a fishery expert to be on board the vessel during acquisition of seismic data. The fishery expert shall function as a connection between the petroleum and fishery industries, so that both industries can carry out their work in the best possible manner.

Strict requirements are stipulated for exploration drilling. An exploration drilling permit must be obtained from the Norwegian Petroleum Directorate for each well to be drilled. These permits presume that permission for activity under the Pollution Control Act and consent to conduct exploration drilling are secured from the Climate

and Pollution Agency and the Petroleum Safety Authority Norway, respectively. The management plans also stipulate restrictions on exploration drilling in particularly vulnerable areas, e.g. as regards spawning.

As part of a development plan (PDO/PIO) for individual fields, the operator must, among other things, study the consequences on nature and the environment if the discovery in question is developed. The study should describe potential climate and environmental effects of expected emissions/discharges, as well as potential limitation measures to reduce the emissions/discharges. Both the study program and the actual impact assessment must be submitted for consultation to affected stakeholders. The purpose of this is to ensure a broad-based, open process.

Since 1996, power from shore has been considered in connection with all new or revised development plans. This has contributed to several fields deciding to meet their energy needs with power from shore. Today, nearly 40 per cent of Norwegian gas production is carried out with power from shore. Large new power supplies to the petroleum sector have consequences for the power grid and reliability of supply on land and on the facilities. This must all be seen in context.

In the operations phase, emissions and discharges are regulated via permits under the Pollution Control Act, in addition to the continuous economic incentives the companies have to reduce emissions via the CO_2 tax, quota obligation for CO_2 and NO_x tax or payments to the Industry's NO_x fund, in which the companies take active part. The companies must apply to the Climate and Pollution Agency and the Norwegian Radiation Protection Authority for permits under the Pollution Control Act for emissions to air and discharges to sea, and to the Ministry of Petroleum and Energy for flaring permits.

The authorities play a central role in connection with shutting down fields or facilities. The licensees must submit a cessation plan two – five years before a license under the Petroleum Act expires or is relinquished, or when the use of a facility finally ceases. A disposal resolution is made after this plan has been considered by the relevant authorities. This ensures responsible shut down and disposal of the individual facility in terms of safety, environment and resource considerations.

Research and development are important to achieve more environmentally friendly production on the Norwegian Shelf. A number of projects related to discharges to sea and emissions to air are supported through the DEMO2000 and PETROMAKS research programs. A total of NOK 235 million has been allocated to support such environmental projects in the program period.

Environmental regulation thus takes place at all stages of the activity; from assessment of whether the area should be opened, through exploration, when considering how a field should be developed, through specific permits associated with operation of the field, through annual amendments of these permits and up to cessation of production and disposal of the facilities. This ensures a comprehensive and solid system, where all relevant authorities are involved. Updates of management plans and new impact assessments with updated knowledge shall contribute to ensuring that decisions can be based on the best and most up-to-date factual basis possible. Consultation rounds and submissions provide an opportunity for all relevant players to be heard, while the NO_x and CO_2 taxes, along with the quota obligation for CO_2, give the companies financial incentives to safeguard environmental considerations in daily operations. In addition, the authorities can make administrative decisions in connection with e.g. approval of development plans.

7.2 Operational discharges to sea

Regular discharges to sea are permissible discharges regulated through discharge permits. The discharges can include drill cuttings and produced water containing residues of added chemicals, oil, heavy metals and other naturally occurring substances from the bedrock, including radioactive substances. Chemicals are added in drilling and well operations and in connection with production of oil and gas. The added chemicals are divided into categories – green, yellow, red and black - depending on the properties of the substances.

Chemicals in the green category are substances that are not considered to entail harm or drawbacks for the marine environment. Chemicals in the yellow category are normally not defined as environmentally hazardous, while chemicals in the red and black categories are defined as being hazardous to the environment. Chemicals in the red and black categories are subject to strict control, and discharge is only allowed when warranted by significant safety or technical reasons.

The total volume of chemicals used in 2009 was 480 000 tonnes. Of this, 174 000 tonnes were

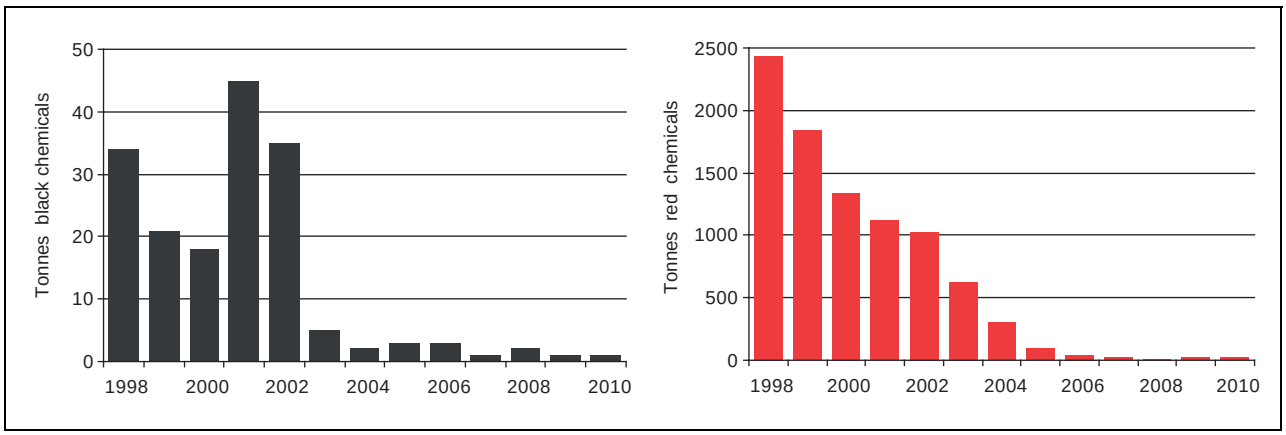

Figure 7.2 Discharges of added chemicals from Norwegian petroleum activities, distributed between red and black categories.

Source: Norwegian Petroleum Directorate.

discharged, 99.9 per cent of which were in the green or yellow categories. The remaining volumes were injected, re-used or handled as waste. With regard to the environmental toxins on the authorities' prioritisation list, the petroleum activities contribute up to four per cent of the national discharges.

After the goal of zero discharges of oil and environmentally hazardous substances was introduced in 1997, discharges of chemicals in the black category have been reduced from 34 tonnes in 1998 to scarcely 1 tonne in 2010, cf. Figure 7.2. Discharges of chemicals in the red category have been reduced from 2440 tonnes to 16 tonnes in the same period. More than 99 per cent of all environmentally hazardous chemicals have been removed during the last ten years. About 80 per cent of the total chemical discharges occur in connection with drilling and well operations.

This confirms that the work done by operators and the authorities to reduce discharges of environmentally hazardous chemicals on the Norwegian Shelf has yielded results, and that the zero discharge target for these chemicals is considered to be achieved. The efforts to reduce discharges continue, e.g. through examining the possibilities of injecting produced water and drill cuttings, while the substitution work in relation to added chemicals also continues.

The drilled rock mass that comes out of the borehole when drilling for petroleum is called drill cuttings. Drill cuttings have adhering residues of the drilling fluid used during drilling. Whether or not drill cuttings can be discharged to sea often depends on the type of drilling fluid used in the drilling operation. Discharge of drill cuttings originating from drilling operations with water-based drilling fluid (green category) will normally be permitted, while drill cuttings originating from drilling operations with other drilling fluids (oil-based or synthetic) will normally be injected subject to a permit from the Climate and Pollution Agency, or transported to land for treatment and disposal.

If discharge of drill cuttings is allowed, the cuttings will spread out over the seabed in the immediate vicinity of the discharge point. The thickness of the layer will depend on the size of the discharged particles, current velocity in the water masses and the depth at which the discharge occurs. This is the accumulation of cuttings and mud in so-called cuttings piles, and it is assumed that vulnerable organisms such as corals and sponges are sensitive to this accumulation.

In connection with production of oil and gas, water from the reservoir will follow the well-stream. This water contains residues of added chemicals, oil and other naturally occurring substances, such as heavy metals and radioactive substances. The water is either returned to the reservoir and deposited in a suitable formation, or cleaned and then discharged to the sea. Although the produced water is cleaned before it is discharged, it will still contain small residues of oil and dissolved substances. As a consequence of new cleaning technology and a greater percentage of water that must be injected, both discharges and the concentration of oil in water have been reduced in recent years, cf. Figure 7.3.

The volume of produced water is closely linked to the activity level on the shelf, and to how

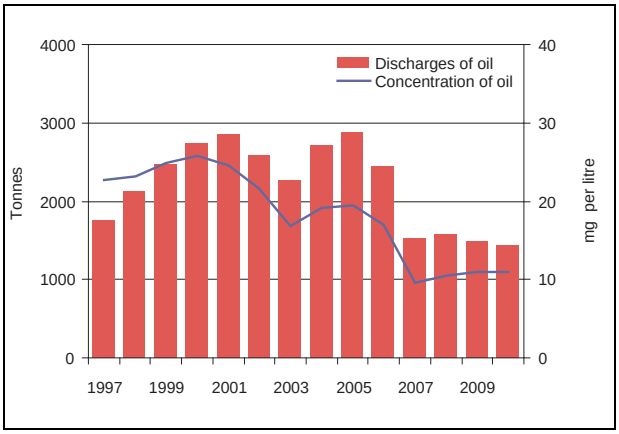

Figure 7.3 Discharges of oil.

Source: Norwegian Petroleum Directorate.

Box 7.1 Mussels measure discharges

To ensure prudent oil activities on the shelf, accidental polluting spills must be measured efficiently and accurately, and the information must quickly be sent to the right people. The company Biota Guard has started using a biological "metering tool" to track potential discharges from platforms, in addition to physical and chemical sensors. This "metering tool" is mussels. Biota Guard's system is based on measuring the health of individual mussels. If the shellfish are exposed to harmful substances or if they experience physical stress due to other threats, the shells close to varying degrees. This can be recorded and measured, and can provide an immediate indication of potential spills. The project receives support from the PETROMAKS program under the direction of the Research Council of Norway.

long the wells have produced. The percentage of water in the wellstream increases the further a field has progressed in its tail production phase. In order to reduce discharges to sea, support is also provided for a number of projects relating to produced water, handling acute discharges to sea and monitoring and detection of spills.

The concentration of oil in the produced water discharged to sea in 2009 was about 11 mg per litre. This is well below the maximum level of 30 mg per litre, stipulated in national regulations based on resolutions in the OSPAR Convention for the protection of the marine environment of the northeast Atlantic.

7.2.1 Policy instruments designed to reduce regular discharges to sea

The zero discharge goal for oil and environmentally hazardous substances to sea from the petroleum activities was established in Storting White Paper No. 58 (1996–1997), Environment policy for sustainable development, and is detailed and clarified in a number of subsequent white papers. The main rule is no discharges of environmentally hazardous substances, neither chemical additives nor naturally occurring substances. It has been stated that the zero discharge objective will be reached within an acceptable framework as regards the environment, safety and economy. In 2005, the Climate and Pollution Agency declared that the zero discharge goal was achieved for added environmentally hazardous chemicals.

Since 2005, the goal of no discharges of environmentally hazardous added chemicals (black and red categories)[1] has been regarded as being fulfilled. There will continue to be some discharges of environmentally hazardous substances to sea in the years to come, due to safety and technical considerations. Radioactive substances were also included in the zero discharge objective in 2009.

Norwegian regulations carry out international requirements through the OSPAR Convention for the protection of the marine environment of the northeast Atlantic (the OSPAR Convention). Pursuant to this convention, the oil content of discharges must be as low as possible and no more than 30 mg per litre. Under OSPAR, the chemicals are also characterised according to their inherent properties.

Produced water is normally discharged at a point that is relatively high in the water column, and the most toxic of the water-soluble fractions will rapidly be diluted with seawater. Short-term (acute) effects of regular operational discharges of produced water and drill cuttings are regarded as being insignificant, as these will generally be of a local and temporary nature, with no conse-

[1] Chemicals are divided into categories (yellow, green, red and black) depending on potential hazard to the environment. As a point of departure, use and discharge is not permitted for chemicals in the black category, which include e.g. the environmental toxins on the prioritisation lists of the environmental authorities and OSPAR. Chemicals in the red category are hazardous to the environment and must be prioritized for replacement with less environmentally-hazardous alternatives (substitution). Substances in the green category are not considered to have a significant impact on the environment and are listed on OSPAR's PLONOR list. Substances in the yellow category include substances that do not fall under any of the other categories (cf. Section 63 of the Activities Regulations).

quences at the population level. There is more uncertainty surrounding potential long-term effects. Based on current knowledge and monitoring, no consequences have been proven at a population level, however, research in this area is continuing.

As a measure to reduce discharges of produced water, water is injected on several fields without being used for pressure support. This solution will entail higher energy consumption and increased emissions of greenhouse gases. This will often be expensive and technically challenging on older fields. New policy instruments designed to reduce discharges of produced water to sea from the petroleum sector must therefore be viewed in an overall perspective. The discharges to sea must be seen in context with other factors such as emissions to air, generation of waste, safety and costs. The authorities' assessment is that no general injection requirement should be issued.

The volume of polluting substances in produced water will vary from field to field, as is also the case for the costs of reinjecting this water. On some fields, the costs will be relatively low, e.g. because the field already uses water for pressure support, and the produced water can be used in the pressure support system. On other fields, the quantities of produced water will be relatively small, while the costs of reinjecting the water can be extremely high.

A case-by-case evaluation which takes into consideration both benefit to the environment and possible other upsides compared with the costs of such a solution is a well-established practice in Norwegian resource and environmental management. The Climate and Pollution Agency's zero discharge report from 2010 concludes in part that no general requirement for injection of produced water should be introduced on the Norwegian Shelf. However, transparent socio-economic cost/benefit analyses, which also include comprehensive environmental assessments of measures to prevent discharge of produced water, should be carried out for new developments. No new factors have emerged that would indicate that the conclusions from the report cannot be applied over the entire shelf.

Stricter requirements were set for discharges to sea in the Barents Sea than for the rest of the shelf. The requirement was introduced in 2003 and entailed that petroleum activities in the area were to be carried out with zero discharges to sea during normal operations, represented by zero discharges to sea of produced water and drilling fluid/cuttings from drilling operations. This policy was adjusted in Storting White Paper No. 10 (2010–2011), Updating of the management plan for the marine environment in the Barents Sea and the waters off Lofoten. In the future, regular discharges to sea from the petroleum activities in this management plan area will be regulated in the same manner as petroleum activities on the other parts of the Norwegian Continental Shelf.

7.3 Emissions to air

In 2009, the petroleum sector was responsible for 27 per cent of the Norwegian emissions of greenhouse gases. This is because the sector is quite large in Norway, the activity carried out is energy-intensive and fossil fuel is not used to any great extent for stationary combustion on the mainland. This is due to extensive use of electricity for heating and generation of electricity that is dominated by hydropower. The greenhouse gas emissions largely consist of exhaust from combustion of gas in turbines, flaring of gas and combustion of diesel. These exhaust gases contain substances including CO_2.

The sector is also responsible for significant contributions to other types of emissions. Among the other environmentally harmful substances released are volatile organic compounds other than methane (nmVOC), methane (CH4), nitrogen oxides (NO_x) and sulphur dioxide (SO_2). CO_2 and CH4 are greenhouse gases, while NO_x and SO_2 contribute to acidification. NmVOC reacts with NO_x in the air to form ozone which can e.g. cause diminished plant growth. Exposure to nmVOC can also be hazardous to health, and can entail a working environment problem. Emissions to air from the petroleum activities on the Norwegian Shelf are considerably lower than the international average for oil-producing countries.

It is difficult to estimate the future development in an industry. A number of factors influence greenhouse gas emissions. Projections are therefore based on a number of technical assumptions for calculation purposes. The uncertainty in the prognoses is also easily illustrated by comparing previous projections with actual emissions. The emissions from the petroleum sector up to 2010 have, for example, been lower than estimates indicated in the spring of 2007[2]. However, the latest emission projections indicate an upward adjust-

[2] Projections included in the background information for Storting White Paper No. 34 (2006–2007).

Box 7.2 Greenhouse gases, NO_x and nmVOC emissions on the Norwegian Shelf

In 2009, total emissions of greenhouse gases in Norway amounted to 51.3 million tonnes of CO_2 equivalents. Production of oil and gas accounted for 12.4 million tonnes, or a share of 27 per cent. Greenhouse gas emissions from the facilities on the continental shelf largely originate from combustion of gas in turbines, diesel consumption, and flaring of gas.

It is estimated that greenhouse gas emissions from the petroleum activities in the next few years will be around 14 million tonnes of CO_2 equivalents per year. The development in emissions is uncertain, but forecasts indicate that we will reach peak emission level by 2020.

Total NO_x emissions in Norway in 2009 amounted to 180 600 tonnes, a decline of 4 per cent from 2008. The petroleum activities were responsible for 49 800 tonnes, which means that the Norwegian Shelf accounts for 29.7 per cent of the total Norwegian emissions. About 65 per cent of the NO_x emissions from the Norwegian Shelf come from turbines. NO_x emissions from turbines depend on turbine loads as well as the type of fuel. For example, combustion in gas turbines results in lower NO_x emissions than combustion in diesel engines.

NO_x emissions from the petroleum sector are estimated at about 44 000 tonnes in 2020.

The Norwegian emissions of nmVOC were 141 200 tonnes in 2009. The petroleum sector was responsible for about 45 000 tonnes of this. The emissions in the petroleum sector have been reduced by 82 per cent from the peak year, 2001. The majority of the reduction is due to emission-reducing measures targeting loading and storage of oil on the continental shelf.

NmVOC emissions from the petroleum sector are estimated at about 28 000 tonnes in 2020.

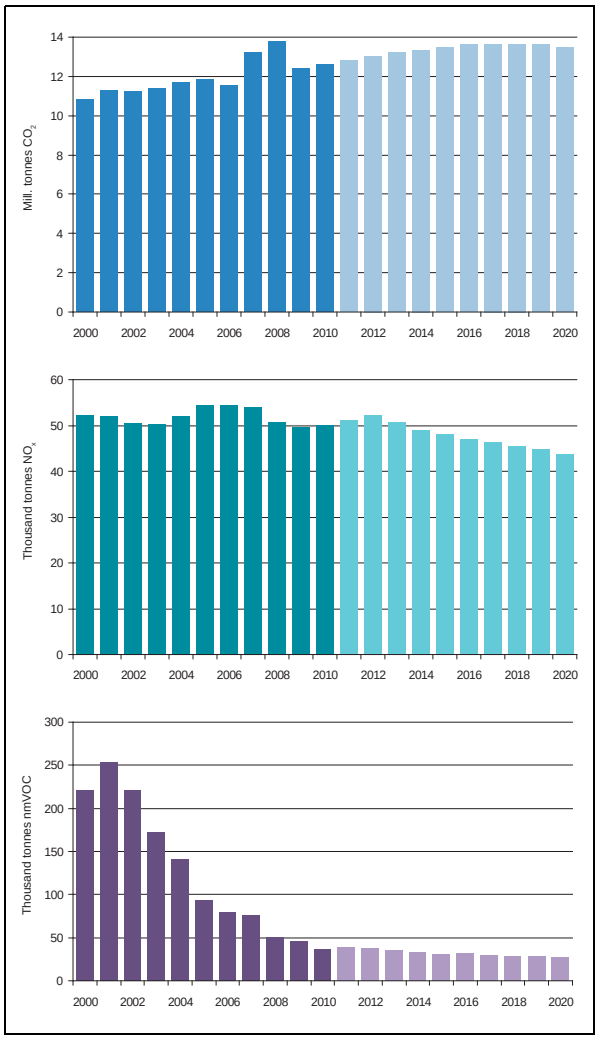

Figure 7.4 Greenhouse gases, NO_x and nmVOC emissions on the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

ment of the emissions in 2020 by about 23 per cent, from the same point in time, cf. Figure 7.5.

The development in large parts of the Norwegian Continental Shelf is trending towards more mature fields, while gas transport distances are rising as many of the new gas fields are situated farther from the markets. Gas production makes up an increasingly larger part of the production on the continental shelf. Treatment and transport of produced gas is more energy-intensive than production and transport of liquid. In addition, reservoir pressure declines as the fields age, thus increasing the need for energy in process facilities and for gas compression. Each of these factors alone tends to increase energy needs, which in turn often means greater emissions per produced unit.

Reservoir conditions are another factor that can lead to more need for energy. The further out in the field's lifetime, the more water in the well-

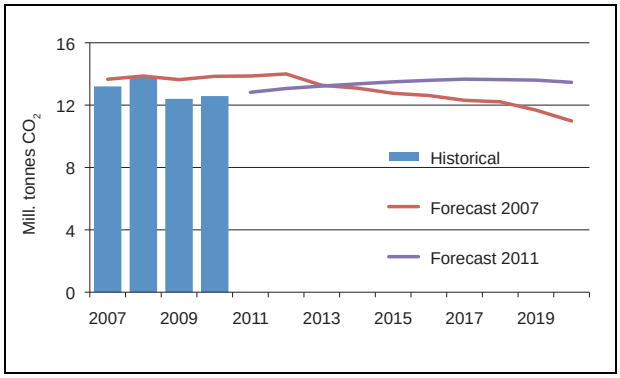

Figure 7.5 CO_2 emissions from the petroleum sector.

Source: Norwegian Petroleum Directorate.

stream. Since the total volume of liquid and gas (water, oil and gas) generally determines the need for energy in the process facility, a field will have higher emissions per produced unit when production declines. Therefore, improving the recovery rate from the fields will also tend to increase emissions per produced unit.

Different types of emissions must be weighed against each other. One example is the connection between discharges to sea and emissions to air. Stricter requirements for e.g. discharge of produced water will lead to increased need for cleaning or injection. These processes demand energy and will entail increased emissions to air. Likewise, efforts to reduce NO_x emissions from a facility can impact emissions of CO_2, as this entails a special way of operating the turbines. All of these considerations must be sensibly balanced through the correct use of policy instruments.

7.3.1 Policy instruments for reducing emissions to air

Based on resource management considerations, ever since the beginning of the petroleum age, Norway required that all fields have a solution in place for gas. Extensive flaring of gas – a practice with significant associated emissions seen in many other countries – has therefore never been a relevant solution on the Norwegian Shelf. Instead, the gas has become useful, e.g. in meeting the energy needs of purchasers of Norwegian gas on the Continent, or for injection for improved recovery. Flaring gas and cold venting, beyond what is necessary to ensure normal operations, is not permitted pursuant to the Petroleum Act without approval from the Ministry.

The introduction of a CO_2 tax in 1991 contributed to development and use of technology which allowed us to switch off the flares. The solution entailed the flare being automatically lit when it was necessary to burn the gas for safety reasons. This contributed to reducing the flare volume. In 2010, flaring was responsible for 11.6 per cent of CO_2 emissions from petroleum activities in Norway. This is low compared with other petroleum-producing countries.

The largest source of CO_2 and NO_x emissions is energy production on the facilities. There are two main ways we can reduce this:

- Reduce the energy need
- Produce the energy more efficiently and/or with less emissions

The best way to achieve this is to establish policy instruments to ensure that the companies benefit from limiting their emissions. This can be done by setting a cost for the emissions, so that the companies maximize profits when they implement the appropriate emission measures. On the continental shelf, this is accomplished by the companies having to pay CO_2 tax and purchase greenhouse gas emission quotas for their emissions. This comes in addition to the value the companies can achieve by exporting and selling their gas instead of using it on the field.

The petroleum sector has paid CO_2 tax since 1991, and has participated in the quota system since 2008. Before the petroleum sector joined the quota system, the CO_2 tax for the petroleum sector amounted to about NOK 350 per tonne of CO_2. When the petroleum sector joined the quota system in 2008, the CO_2 tax was reduced to correspond with the level of the quota price, so that the total CO_2 cost (tax + quota price) for the petroleum sector would remain at the same level as before. However, the total CO_2 cost does vary in step with the quota price, which is also the case for other EU industries subject to a quota system.

Both the CO_2 tax and the quota system are cross-sector policy instruments that have had a significant effect in reducing emissions. "Cross-sector" means that these policy instruments cover several sectors. Nevertheless, the CO_2 tax is a differentiated tax across sectors, and the petroleum sector are among the sectors that have traditionally paid the highest CO_2 tax. Therefore, the Norwegian petroleum sector has long had a substantially stronger incentive to carry out relatively expensive emission-reducing measures, as compared with most other players in Norway and abroad.

Over time, this has triggered emission-reducing efforts where the cost of measures has ranged up to this CO_2 cost. In total, the petroleum industry estimates that the CO_2 tax has triggered measures that have reduced CO_2 emissions by 40 million tonnes since 1991. As many measures have already been triggered, the sector has few remaining emission-reducing measures with low costs. The work done under Climate Cure 2020 confirms this cost picture.

The best available technology must be used for the installation of new energy production equipment on facilities. The requirement for use of such technology has contributed to considerable reductions in emissions to air.

In 1996, the Storting resolved that an overview of energy needs and the costs associated with using power from shore instead of gas turbines must be submitted for all new field developments. Power from shore must be evaluated by the operator and followed up by the authorities in connection with processing each individual new plan for development and operation. Power from shore is discussed in more detail under Chapter 7.3.3.

Research aimed at reducing emissions to air was reinforced through the Climate Compromise. Publicly-funded petroleum research was to have a sharper focus on greenhouse gas emissions. Starting from 2009, NOK 25 million has been earmarked for research on energy efficiency and reduction of greenhouse gas emissions related to oil and gas production on the Norwegian Shelf. Relevant research challenges include reduced greenhouse gas emissions through less flaring (optimised running of processes, fewer shutdowns, etc.) and lower emissions from power generation (managing and exploiting gas turbines, etc.), as well as more efficient use of energy (optimising operations, heat recovery).

Box 7.3 Examples of emission-reducing measures

The emissions from the petroleum sector in Norway are subject to relatively strong policy instruments, and much has already been done to reduce the emissions to air from this sector. Emissions of CO_2 from power production on the continental shelf account for about 90 per cent of the total emissions from the offshore activities. Many energy efficiency measures have been implemented after the introduction of the CO_2 tax in 1991. In order to achieve a significant increase in energy efficiency over the longer term, a shift in technology and energy supply concept is necessary. This requires a long-term commitment to development, testing and implementation of new technology.

Combined cycle power is an example of emission-reducing technology where heat from turbine exhaust gas is used to produce steam, which is in turn used to produce electricity. Combined cycle power boosts energy efficiency, and is currently used on the Oseberg, Snorre and Eldfisk fields. These facilities are unique in a global offshore perspective. More low-NO_x turbines have also been installed, which leads to a substantial reduction in NO_x emissions.

Another example is the work related to injecting and storing CO_2 in depleted oil or gas reservoirs, or in geological formations under water or on land. Since 1996, about one million tonnes of CO_2 has been separated out on Sleipner in order to meet the gas quality requirements. This CO_2 gas has been stored in the Utsira formation. When Gudrun starts producing and is tied in to Sleipner in 2014, the plan is to separate CO_2 and store it in the Utsira formation. In April 2008, the Snøhvit field started to separate and store CO_2, before the natural gas is cooled into liquid gas (LNG). The CO_2 gas runs in a pipeline from the LNG facility on Melkøya and back to the field where it is injected and stored in the Tubåen formation, 2600 metres below the seabed. When there is full operation on Snøhvit, up to 700 000 tonnes of CO_2 per year can be stored. These facilities where offshore CO_2 injection takes place are unique in a global context.

The petroleum activities are subject to many policy instruments designed to reduce emissions to air, both in the planning and operations phases of the projects. Focus on reducing emissions to air has been, and will continue to be, important for the petroleum sector. Over time, the sector has had a higher CO_2 cost than other sectors, both in Norway and abroad. This has already resulted in major emission reductions. Further measures in the petroleum sector will be relatively costly, a fact which was highlighted most recently in the Climate Cure Report.

NO_x emissions do not depend solely on fuel and efficiency, as is the case for the CO_2 emissions, but also on combustion technology and turbine loads. The activity on the Norwegian Shelf has also been in the forefront of the work to develop gas turbines with lower NO_x emissions – so-called low -NO_x-turbines.

The Storting introduced an NO_x tax[3] in 2007, and excluded emission sources that entered into an environment agreement with the Norwegian state. In 2008, the Ministry of the Environment and the industry organisations signed the first NO_x agreement, entailing a reduction of annual NO_x emissions by 30 000 tonnes by the end of 2011, although this has subsequently been downgraded to 18 000 tonnes. A new agreement was signed in December 2010 with the aim of ensuring that Norway reduces its annual NO_x emissions by an additional 16 000 tonnes by 2017. The Environment Agreement on NO_x regulates the industry organisations' obligations vis-á-vis the authorities to reduce total NO_x emissions from the sources covered under the agreement. All operating companies with active operations on the Norwegian Shelf participate in this agreement. The rate of payments to the Industry's NO_x fund is NOK 11 per kilogram of NO_x. These funds will be used to provide subsidies to enterprises that implement cost-effective NO_x measures.

In 2009, a total of NOK 653 million was paid into the NO_x fund. The oil and gas industry accounted for NOK 444 million (68 per cent) of that amount. Through 2009, 80 per cent of the emission reductions supported by the fund were triggered in the maritime sector, while 7 per cent of the fund's emission reductions were carried out directly in the oil and gas sector, and 4 per cent on rigs. While NO_x emissions in the petroleum sector have remained relatively stable over the last ten years, the oil and gas industry finances significant emission reductions in other sectors. The payment rate for the petroleum sector is nearly three times higher than for other sectors that participate in the NO_x fund. Through the SDFI scheme and the tax system, the Norwegian state covers a substantial part of the revenues to the NO_x fund.

Some light oil components (nmVOC) evaporate from the crude oil in connection with storage and loading. The oil terminal at Sture started to use technology to recover this oil vapour as early as in 1996. Following a requirement from the Climate and Pollution Agency to reduce emissions of nmVOC in connection with storage and loading offshore, an industrial cooperation agreement was signed in 2002 to satisfy these requirements in the most cost-efficient manner. During the last decade, this has led to the installation of oil vapour recovery technology for use on ships. Together with reductions in the volume of oil stored and loaded, this has yielded results. From 2001 to 2009, nmVOC emissions have been reduced from 250 000 to 45 000 tonnes.

7.3.2 Climate Cure 2020

Climate Cure 2020 has studied measures so that the Norwegian petroleum industry can reduce its overall greenhouse gas emissions by 5.5 million tonnes of CO_2 equivalents. The measures have a price range from NOK 400–4000 per tonne of reduced CO_2. There is great uncertainty associated with the estimated costs of measures and technology development.

These measures are major, complex industrial projects that will take time to realise. It has been deemed feasible for the petroleum sector to implement reductions of up to three million tonnes by 2020. In Climate Cure 2020, the petroleum sector encompasses all of the petroleum facilities on the Norwegian Shelf, as well as the land facilities at Kollsnes, Stura, Nyhamna, Melkøya, Mongstad and Kårstø. Climate Cure 2020 has studied measures within three areas:

- Energy efficiency
- Electrification
- Carbon capture and storage (CCS)

In 2009, the petroleum industry was responsible for 27 per cent of Norway's total greenhouse gas emissions. Most of the emissions are linked to energy production. Introduction of the CO_2 tax on the shelf in 1991 caused the companies to be more aware of energy-efficient operations. Many CO_2-reducing measures have been triggered as a consequence of the tax. Reduced flaring and upgrading of turbines are examples of measures that have had substantial impact. There are still opportunities for reducing emissions through energy efficiency measures. Emission projections (reference path) for the petroleum sector include expected measures in energy efficiency and improved technology. The measures are not specified and amount to about one million tonnes of CO_2 in 2020.

In Climate Cure 2020, the NPD has updated the estimated costs of measures from the report

[3] NO_x tax in 2010 is 16.14 NOK/kg NO_x

Box 7.4 Climate Cure 2020

In 2008, the Ministry of the Environment appointed an agency group under the leadership of the Climate and Pollution Agency. This group was called Climate Cure 2020. The mandate called for the final report to cover the following Chapters:

1. Assess the expected quota price in 2012, 2015 and 2020
2. Review international goals and instruments in climate policy. The development in Europe was to receive particular attention, including examining potential consequences for Norwegian policy instruments
3. Consider the need for new or adapted policy instruments in Norwegian climate policy. Particular emphasis was to be placed on policy instruments that contribute to fulfilling the goal of reducing emissions by 15 to 17 million tonnes by 2020. At the same time, there was a desire to identify policy instruments with long-term efficiency in terms of both management and costs.

The Norwegian Petroleum Directorate (NPD) has been responsible for administration of the petroleum sector analyses.

Power from shore to the Norwegian Shelf, submitted in January 2008. This report calculated the cost of measures and emissions reductions through replacing equipment for electrical power production on the facilities with power from shore. Updated costs of measures associated with area electrification (southern, central and northern parts of the North Sea and the Norwegian Sea) were estimated at between NOK 1350 and 3100 per tonne of reduced CO_2. The NPD has studied measures that could provide overall emissions reductions of about 4.6 million tonnes. The updated analysis shows that the southern part of the North Sea is the area with the lowest measure costs for electrification, in part because the fields here have long expected lifetimes. In 1996, the Storting resolved that power from shore must be studied by the operator and followed up by the authorities in connection with each new development on the shelf. See also Chapter 7.3.3.

The NPD has also considered electrification of the land facility on Melkøya and parts of the Kårstø facility. CCS has also been considered for these facilities. These measures are mutually exclusive, which means that carbon capture and storage will not be relevant if the facility is electrified, and vice versa.

The costs of measures to reduce emissions for first-generation full-scale facilities are estimated at NOK 1300–2250 per tonne of CO_2.

No costs of measures have been calculated for capture and storage of CO_2 from offshore emission sources. Previous analyses indicate that the cost of measures will be considerably higher than for petroleum facilities on land. However, technological development could change the cost picture for offshore carbon capture and storage.

Use of CO_2 to increase recovery from producing fields can provide a revenue contribution for carbon capture and storage in Norway. A high oil price can make it profitable to inject CO_2 for increased recovery. However, this requires stable access to large volumes of CO_2, larger than can be provided from Kårstø and Mongstad. No assessments have been made of the possibilities of using CO_2 for improved recovery in Climate Cure 2020.

Together with e.g. the consultation submissions regarding this work, updated emissions estimates and macroeconomic analyses of measures, the studies carried out under Climate Cure will form the background material for the work on the upcoming Climate White Paper.

7.3.3 Power from shore

Starting from 1997, power from shore has been considered for all new developments and major modifications on the continental shelf. The Troll A platform was the first facility on the continental shelf to be run using power from shore. Subsequently, fields such as Ormen Lange, Snøhvit and Gjøa have been powered by electricity from land. Valhall and Goliat will receive power from shore when they come on stream. The Kårstø, Kollsnes, Tjeldbergodden and Nyhamna land facilities receive all or part of their power from the grid. Nearly 40 per cent of Norwegian gas production currently comes from these fields.

In 2009/2010, the NPD and NVE conducted an analysis of the power need for fields that already receive power from shore, or have decided to implement this. It is estimated that these fields will demand slightly less than 5 TWh in 2011, growing to nearly 6.5 TWh in 2020. It is important to view power from shore to the petroleum activities in context with the power system on land. Delivery of power to the petroleum activities beyond what has already been approved can be challenging. Building new transmission lines is

important in order to make the onshore power system more robust.

The Ministry has also examined the possibilities of taking power from shore to existing fields on the continental shelf. The Norwegian Petroleum Directorate, the Norwegian Water Resources and Energy Directorate (NVE) and the Climate and Pollution Agency prepared the report entitled "Power from shore to the Norwegian Shelf" in 2008. This analysis has been updated in connection with the work on the Climate Cure 2020 study.

The solution for energy supply to a petroleum facility is considered in connection with the authorities' approval of a development. This takes place both in the impact assessment process and in the subsequent consideration of the development plan. All plans for development and operation of oil and gas fields must contain an analysis of the possibility of obtaining power from shore. This applies both to new field developments and to major modifications of existing facilities.

Access to power

In light of the desire for increased use of power from shore to facilities on the shelf, particular attention to the interface between the power system and the petroleum sector is important. A precondition for a solution involving power from shore is that it can be implemented without negative effects on the power system, and that the consideration for nature diversity must be safeguarded. Therefore, electrification of the shelf presumes simultaneous development of sufficient new power, or that there is sufficient new grid capacity to ensure that regional imbalances do not occur.

When estimating the cost of electrification measures, Climate Cure assumes that the necessary power is available at the presumed power price. In some cases, however, electrification could entail considerable extra costs associated with the development of new transmission lines.

Hydropower accounts for nearly all land-based production of electricity in Norway. The dominant role of hydropower means that Norwegian electricity production varies substantially from year to year, depending on water inflow to the reservoirs. It is important to take this aspect of the Norwegian power system into consideration, also when assessing power supply for the petroleum activities.

Production and consumption of electricity is not evenly distributed throughout the country, and the ability to transfer power between the various parts of the country depends on sufficient grid capacity. This entails that a planned increase in power consumption as a consequence of further electrification must be considered in relation to both regional and national reliability of supply. Establishment of new consumer units could occur faster than the establishment of new production and transmission grids. Therefore, careful planning is necessary to ensure that this type of establishment does not result in regional power system imbalances. Establishment of large new consumer units has contributed to the regional imbalances we have experienced in recent years.

Earlier, the establishment of enterprises involving high power consumption were often linked with the development of major production facilities. Much of the power production developed today consists of small-scale power plants and wind power with little regulation ability and significant geographical spread. This means that a solid electricity grid and transmission capacity is even more important than previously. A sound electricity grid is extremely important for delivering power from shore to new facilities on the continental shelf. Statnett's development plan for 2010 aims for a significantly strengthened central grid, with an investment scope of about NOK 40 billion towards 2020. The plan also includes facilitation for planned petroleum activity and increased use of power from shore.

The Energy Act was amended on 1 January 2010[4] to improve coordination of investments in the grid, production and consumption, in part by introducing a requirement for the grid companies to tie-in new production facilities at all levels of the grid, when the production project and grid investment makes good socioeconomic sense. The previous practice of tying consumption to the regional and central grid was laid down in the law. If necessary, the grid companies must invest in grid facilities, but it is emphasised that tie-ins to the power system must wait until it is prudent from an operations viewpoint. In extraordinary cases, the Ministry can also grant exemptions from the tie-in and investment obligation for consumption. This entails that large consumer units must take greater responsibility for their own power supply, also within the petroleum sector.

[4] Odelsting Proposition No. 62 (2008–2009) Regarding amendments to the Energy Act.

The time aspect

Development projects on the Norwegian Shelf are comprehensive and require a substantial amount of time for both planning and development. To offset regional imbalances, operators of fields considering tie-in to the power system on land, or that plan to significantly increase existing power consumption, must contact the energy authorities and the relevant grid company at an early point in time.

Very extensive processes are associated with planning, licensing and developing the electricity grid. In many cases, development of the grid will take considerably longer than the development projects on the shelf. This underlines the importance of early contact by the developer to energy authorities and relevant grid companies.

Accordance between production, consumption and transmission capacity is important to prevent regional imbalances. This will be a significant issue for the Ministry when considering these issues.

The time dimension is also important when planning field developments as, in extraordinary cases, the operator can risk that the grid company is exempted from the tie-in and investment obligation for the field's consumption. If such an exemption is granted, there is a risk that the projects will not be implemented, or that a different energy solution will have to be selected.

Statnett plays an important role as facilitator for consumption through its grid development work. The NPD plays a key role in mapping potential development in consumption in the various areas of the continental shelf. Such a mapping will include consumption from developers that have not progressed far enough for it to be natural for them to contact the energy authorities and relevant grid companies. This will ensure that knowledge concerning potential future power consumption in the petroleum sector is passed on for the benefit of central power sector players at the earliest possible point in time.

A specific assessment in each individual case is necessary in order to clarify the extent to which power from shore to fields on the continental shelf is a potential solution in terms of the power system.

Impact on emissions

Power from shore to the petroleum sector will reduce emissions of CO_2 from the Norwegian Shelf. It will also contribute to a reduction of emissions within Norway's borders as long as the power need is met by emission-free power production in Norway, or by imported power. Therefore, power from shore can be a way of reducing national emissions.

Increased power going to the petroleum sector will have an impact on the Norwegian power balance. Recent years have seen considerable variation as to whether Norway is a net importer or net exporter of power. The result of increased consumption as a consequence of power from shore to the petroleum sector will therefore reduce our exports or increase our imports of power.

Both the petroleum sector and production of electricity are subject to mandatory quotas under the EU ETS (Emission Trading System). The fundamental basis for this system is that the overall emissions are determined during the quota period. This means that reduced emissions from one location within the system are offset by increased emissions somewhere else. Therefore, in such a system, the only direct way to reduce emissions is to reduce the number of quotas. During the period from 2008–2010 (the Kyoto period), Norway will contribute around seven million tonnes of CO_2 per year in reduced emissions through the EU ETS. We will accomplish this by awarding fewer quotas than were entailed by our estimated emissions from Norwegian enterprises subject to the quota obligation. The quota volume in the EU's system is largely fixed. For the period 2013–2020, the quota volume in the EU system must be reduced by 21 per cent, or 1.74 per cent each year. The EU Commission has indicated that the quota volume could be further reduced by setting more rigorous European climate targets. Therefore, the quota system will be a key policy instrument for achieving reduced emissions in Norway and Europe over the next decade.

New developments

The authorities do a thorough job of assessing power from shore in connection with new developments and major modifications on the Norwegian Shelf. Historically, power from shore has not been a realistic alternative due to high costs and technical challenges. Over time, technological development has made power from shore more relevant. Power from shore still requires very significant investments, and will usually only be relevant in connection with major, independent developments or major modifications of larger fields.

Table 7.1 Projects where power from shore has been considered since 2005.

Field	PDO year	Type of facility	Approx./ original reserves as of 31 Dec. 2010* million Sm³ o.e.	Energy supply
Knarr	2011	FPSO	8	Traditional power supply
Visund Sør	2011	Subsea to Gullfaks	10	Host facility
Valemon	2011	Platform	34	Existing facility
Eldfisk II	2011	Platform	35	Existing facility
Ekofisk Sør	2011	Platform	35	Host facility
Gudrun	2010	Platform	20	Host facility
Marulk	2010	Subsea to Norne	12	Host facility
Gaupe	2010	Subsea to Armada	5	Host facility
Trym	2010	Subsea to Harald	6	Host facility
Oselvar	2009	Subsea to Ula	9	Host facility
Goliat	2009	Floater – Sevan	39	Power from shore
Yttergryta	2008	Subsea to Åsgard	2.5	Host facility
Morvin	2008	Subsea to Åsgard	14	Host facility
Alve	2007	Subsea to Norne	9	Host facility
Gjøa	2007	Floater – semi	55	Power from shore
Vega and Vega Sør	2007	Subsea to Gjøa	25	Host facility
Skarv	2007	FPSO	70	Traditional power supply
Valhall Redevelopment	2007	Platform	53	Power from shore
Yme	2007	Platform	12	Traditional power supply
Rev	2007	Subsea to Armada	7	Host facility
Volund	2007	Subsea to Alvheim	7	Host facility
Tyrihans	2006	Subsea to Kristin	77	Host facility
Oseberg Delta	2005	Subsea to Oseberg	9	Host facility
Blane	2005	Subsea to Ula	1	Host facility
Fram Øst	2005	Subsea to Troll C	12	Host facility
Ringhorne Øst	2005	Wells from Ringhorne	15	Host facility
Volve	2005	Platform	9	Traditional power supply
Vilje	2005	Subsea to Alvheim	8	Host facility
Enoch	2005	Subsea to Brae	0.5	Host facility

* Reserves recorded for PDO received in 2011.
Source: Norwegian Petroleum Directorate.

A calculation of the costs of measures for power from shore is based on a number of assumptions regarding future development, including the scope of potential modification, investment and operating costs, field lifetime, as well as future electricity and gas prices. It is important that the calculations prepared in the years to come are based on realistic assumptions regarding field lifetime. When considering the cost of the measure for the Ekofisk Sør and Eld-

fisk II developments, for example, a cost of measures was estimated for lifetimes both to 2028 and 2049. Lifetime is an important factor in the cost level of the measures. Calculations prepared by the operator of the Ekofisk area provide a good illustration of this. The costs of measures were estimated at NOK 5310 per tonne of CO_2[5] with a lifetime to 2028 and NOK 3585 for a lifetime to 2049.

Today, the Troll A platform, Gjøa, Ormen lange and Snøhvit all receive their power supply from shore. The new platform on Valhall, scheduled to start operation in 2011, will also receive power from shore. Of the new developments, it has been decided that Goliat will receive power from shore when the field starts operations in 2013. At the same time, the Kårstø, Kollsnes, Tjelbergodden and Nyhamna land facilities receive all or part of their power from the grid.

A review of all developments approved since 2005 shows that four of the developments have a solution entailing power from shore, cf. Table 7.1. As regards subsea developments (including new wells), power from shore is only realistic if the host platform already has this as its power solution, such as is the case for Vega and Vega Sør. If a host platform receives power from shore in the future, the tied-in resources will also be produced with power from shore. The Gudrun platform gets its power from Sleipner, and will therefore also receive power from shore if Sleipner were to adopt such a solution in the future.

A coordinated development could be very beneficial in the event of multiple smaller discoveries in the same area. A coordinated development can also make power from shore a more realistic alternative than if the fields are developed individually. The NPD plays an important role in ensuring that these alternatives are studied. The assessments made by the companies and the authorities in each individual case will determine whether or not power from shore is an expedient solution.

Existing fields

The energy needs of most of the fields on the shelf are currently met by gas turbines. Extensive modifications and retrofits are usually necessary in order to modify these units to receive power from shore. This is cost-intensive and requires available space on the facility. A lengthy shutdown would, for example, entail significant losses in the form of deferred sales revenues. Such solutions are more realistic when the existing energy supply must be replaced or upgraded.

Power from shore to existing fields on the Norwegian Shelf has been analysed and considered on a number of occasions. In 2002, the NPD and the Norwegian Water Resources and Energy Directorate prepared a report on power from shore to the Norwegian Shelf. This report was updated in 2008 as a consequence of guidelines in the 2007 Climate White Paper. The Petroleum Safety Authority Norway and the Climate and Pollution Agency also participated in the update. The recently presented Climate Cure report also estimates the costs of measures for power from shore, both for existing and new fields.

The Climate Cure report shows costs of measures varying from NOK 1350 per tonne of CO_2 and upward for power from shore to existing areas (power from shore to multiple facilities at the same time). For individual fields, however, it will in most cases be far more costly to replace the power supply on individual facilities with power from shore.

All of the power from shore projects presented in Climate Cure are based on partial electrification. This means that only the power from the turbines that generate electricity will be replaced with power from shore. About half of the turbines on the Norwegian Shelf produce electric power, while the rest of the turbines directly run equipment such as pumps and compressors. In total, the turbines account for 75 per cent of the CO_2 emissions from the petroleum sector. The potential for emission reductions as a consequence of partial electrification will therefore be limited to about half of this.

In some cases in connection with major modifications of existing fields, power from shore can be a real alternative, as a rule in cases where there is talk of replacing old facilities on fields with new facilities. These types of cases normally require a new development plan, which means that power from shore is considered on an equal basis with new developments. Valhall is an example of the possibility of running power from shore to existing fields that are rebuilt. The development plan for redevelopment of the field was approved in 2007. The new field centre on Valhall will receive power from shore and replace two older facilities, with planned start-up in 2011.

[5] Estimated at seven per cent annual real discount.

The Government will:

- Require consideration of power from shore as an energy solution for new fields and in connection with major modifications of existing fields, including consideration of relevant lifetime.
- Follow up to ensure that operators of new field developments in the petroleum sector apply for tie-in to the grid at an early point in time, in those cases where power from shore is relevant.
- Statnett will facilitate future power consumption, including major specific increases in petroleum sector power consumption, if this is socioeconomically profitable.

7.4 Acute discharges to sea

It is important to differentiate between normal and acute discharges to sea. Acute discharges to sea are spills that are not planned, and not approved by the Climate and Pollution Agency. Acute discharges to sea can consist of oil, chemicals and drilling fluids.

The great majority of acute discharges are small, but some larger oil spills can also occur. There were 139 acute discharges of oil in 2010, of which 132 were less than one cubic metre. The total volume of all the discharges was 105 m^3, cf. Figure 7.6.

We can never reduce the risk of acute pollution to zero, which means that good risk management is even more important. In order to achieve this, we must work to reduce both the likelihood and the consequences of acute discharges. Under the Pollution Control Act, the operating companies are both responsible for and have a duty to establish necessary emergency preparedness to deal with acute pollution.

The environmental consequences of an acute discharge of oil depend on many factors. While the size of the spill is obviously the key factor, the location, season, wind speed, current and emergency preparedness will be crucial as regards the scope of the damage. Most spills in Norway have occurred from ships near the coast.

There has been extensive growth in the activity level in the petroleum industry, without an accompanying increase in discharges. Over time, the petroleum activities on the Norwegian Shelf have experienced a varying number of smaller acute discharges and some larger acute spills.

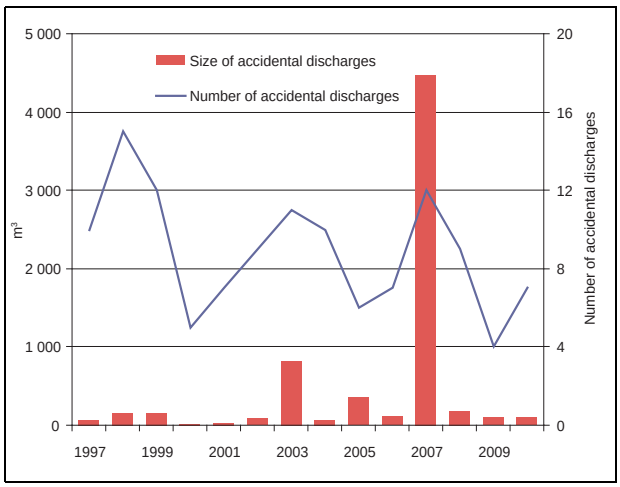

Figure 7.6 Acute discharges of oil greater than 1 m^3 from the petroleum sector.

Source: Norwegian Petroleum Directorate.

During the course of 40 years of activity, there have been only three incidents involving discharges of oil greater than 1000 cubic metres: the Bravo blowout in 1977, the spill from Statfjord C in 1989 and from Statfjord A in 2007. To date, there have been no acute discharges of oil from the petroleum activities on the Norwegian Shelf that have reached land.

7.4.1 Risk of acute discharges of oil

The Petroleum Safety Authority Norway monitors risk development in the petroleum activities in several different ways. One important tool in this context is the mapping work in RNNP – Risk level in the petroleum activity. Since 2001, extensive data material has been gathered under the auspices of RNNP and analysed primarily with a view towards risk related to major accidents and working environment.

In 2010, the Petroleum Safety Authority published the report entitled "RNNP – acute discharges 2001–2009". This report provides an analysis of the above-mentioned basic data, supplemented with information from the Environmental Web database, with a view towards acute discharges (actual and potential) in the period 2001–2009. A total of 452 acute discharges of crude oil have been reported on the Norwegian Shelf from 2001 to 2009. 439 of these end up in the lowest category, 0 to 10 tonnes.

The RNNP data show that the number of acute discharges of crude oil to sea on the Norwegian Shelf, viewed together, was more than halved in the period 2001–2004, while the level remained

Box 7.5 Deepwater Horizon accident

On 20 April 2010, there was an explosion on the Deepwater Horizon drilling rig as it was in the process of completing drilling on the Macondo prospect in the Gulf of Mexico. The rig burned for two days before it sank. The well was shut in mechanically on 16 July, and declared permanently plugged on 19 September. The accident claimed 11 lives, and caused the largest blowout ever experienced in US waters. About 800 000 m^3 of oil leaked out of the well until the discharge could be stopped. US authorities have estimated that more than 40 per cent of the oil was either naturally broken down or evaporated. Seventeen per cent of the leakage from the well was recovered at the wellhead. Another 16 per cent was collected, dissolved using chemical dispersants or burned.

The investigation report drawn up by the Presidential commission was submitted in January 2011. The main conclusion was that the accident could have been prevented, and that the underlying causes were: "a complex and interwoven series of mechanical failures, bad decisions, design, operational implementation and team cooperation".

The Norwegian Ministry of Labour will cover the HSE authorities' follow-up of the Deepwater Horizon accident in the Gulf of Mexico in an upcoming Storting white paper.

The accident took place in one of the USA's most important fishing areas. One-third of all the seafood in the US comes from this area. Fishery activity was halted throughout large parts of the areas immediately after the accident. In June 2010, 37 per cent of the waters in the US sector of the Gulf of Mexico were closed for fishing. On 19 April 2011, the last remaining closed areas above the discharge point were reopened for fishery activity. Differences in seafood quality before and after the accident have been noted to a limited extent. Even the extreme levels that were measured are well within the US authorities' requirements for seafood. The region is also one of the US' most important tourism areas, with tourism accounting for an annual turnover of more than NOK 240 billion (USD 40 billion).

A total of 8 183 seabirds, 1 144 sea turtles and 109 sea mammals were found, dead or alive, that were most likely affected by the spill. Four of 100 dead sea mammals were observed fouled with oil. A total of 210 km of the coastline was moderately to heavily affected by oil. The immediate consequences of the accident have not been as extensive as many feared in the early phases of the incident. It is too early to say anything about the overall consequences of the spill on the ecosystem. Almost one-quarter of the spill remained in the marine environment. In addition, there has been no previous experience with such extensive use of dispersants.

It will take years before we have a complete overview of the effects of the accident. A lot of work will be done to map this in the years to come. BP alone has allocated NOK 3 billion (USD 500 million) towards independent studies of the consequences of the spill. A number of investigations and reports related to follow-up of the accident in the USA are still under preparation.

constant in the period 2004–2009. There has been a clear reduction in the number of crude oil spills per year in the North Sea. This reduction was greatest in the period up to 2003, while there was a more modest reduction in the last six years. In the Norwegian Sea there was an increase in the early 2000s, followed by a substantial reduction, and then a stable level from 2004.

Looking at the last five-year period, there have been 15 incidents in the petroleum activities that have resulted in discharges larger than 5 m^3, cf. Table 7.2. By far most of the spills are small, and only eight spills were larger than 10 m^3 during the period. These spills have many different causes. The majority of the spills relate to operational errors, and a large percentage are related to diesel leaks/discharges. Information like this is important in the preventive work to reduce the risk of acute discharges to sea.

7.4.2 Policy instruments and measures to reduce the risk of acute discharges

The risk of acute discharges is equal to the likelihood of an acute spill multiplied by the associated consequences. To reduce this risk, we must therefore focus on measures that can reduce the likelihood and consequences of acute discharges.

The RNNP work is an important supplement to the factual basis for prioritising accident pre-

Table 7.2 Acute discharges greater than 5 cubic metres in the period 2005–2009.

Field	Year	Cubic metres of oil	Description
Statfjord	2007	4400	Loading hose rupture in connection with loading crude oil at Statfjord A
Norne	2005	340	Valve in wrong position when flushing flowlines and risers
Tordis	2008	100	Leak to seabed from injection well for produced water.
Draugen	2006	98	Discharge in connection with loading crude oil
Statfjord	2009	95	Oil-contaminated water to sea.
Statfjord	2008	50	Oil leak in Statfjord A leg, controlled discharge to sea for safety reasons
Åsgard	2007	22	Incorrect valve setting led to overflow from diesel tank
Ekofisk	2008	12	Incorrect operation in connection with draining raw diesel tank.
Snorre	2007	10	Operational error led to diesel going to sea from fire pump.
Snorre	2007	10	Valve and operational error led to diesel going to sea via fire pump.
Gullfaks	2005	8.8	Incorrect operation following repair of flotation cell
Statfjord	2007	8.5	Leakage of seal oil to open drain.
Heidrun	2008	7	Discharge of diesel oil to sea after diversion to new diesel tank
Statfjord	2005	7	Pipe leakage
Draugen	2008	6	Coupling rupture due to pressure build-up when loading crude oil

vention work so that the likelihood, and thus also the risk, of acute discharges can be reduced. In addition to illustrating the development of risk on the Norwegian Shelf as a whole, it is also organised so as to view each sea area independently, making this also suitable for use in the work on management plans.

The report entitled "Technology and knowledge status of significance for reducing the risk of undesirable incidents that can lead to acute discharges to sea in connection with petroleum activities in the Northern Areas" was released in January 2010. The report prepared by the Petroleum Safety Authority Norway, the University of Stavanger and the International Research Institute of Stavanger confirms that technology and knowledge development is crucial for keeping accident risk at a low level. This can reduce the likelihood and consequences of acute discharges. It is therefore important that the industry and the authorities learn from undesirable incidents, so as to reduce the risk of new acute discharges.

Oil spill preparedness on the Norwegian Shelf is important in reducing the consequences of potential major acute discharges. The Climate and Pollution Agency sets requirements for oil spill preparedness, and the operating companies are responsible for combating oil spills from petroleum facilities on the seabed or the sea surface. This responsibility includes strategic management. The Norwegian Clean Seas Association for Operating Companies (NOFO), on behalf of the operators, is responsible for strategic and operational management of the oil spill response resources that are used. NOFO establishes and safeguards oil spill preparedness on the Norwegian Shelf in order to combat oil pollution on behalf of 25 operating companies, both in open waters, in coastal areas and in the beach zone. Both public and private sector oil spill resources are combined in the Norwegian preparedness model. The cooperation between municipal and state oil spill preparedness and NOFO means that Norway's overall emergency preparedness resources are available 24/7. The Norwegian Coastal Administration handles the State's responsibility for acute preparedness and will supervise oil spill campaigns. The Norwegian Coastal Administration can also consider whether the State should take over as leader of an oil spill campaign.

There is no guarantee that a future oil spill will not reach vulnerable resources in the sea or on land. Oil fields are being developed further north than ever before. The risk of an acute spill reaching land increases (seen in isolation) when the activities are carried out closer to the coastline. This requires development of new equipment, so

as to discover, monitor and recover pollution. The geographical spread of the activities all along the coastline could also initiate a need for more equipment.

NOFO has access to considerable oil spill response resources that can be mobilised to all parts of the Norwegian Shelf. This includes 20 dedicated full-time employees, 50 on-call/reinforcement personnel from operating companies, 25 oil recovery vessels, 25 towboats, 20 ocean-going mechanical recovery systems and 80 people associated with 5 oil spill response bases. There are large stores of dispersants, oil spill recovery equipment for operations near the coast with access to fishing vessels, and special teams for organising and managing the need for operations in the beach zone. The oil spill response work focuses on 5 barrier levels, where Barrier 0 is preventing the oil from reaching the water, Barriers 1, 2 and 3 are related to recovery at sea and Barrier 4 is clean-up in the beach zone.

There are also restrictions on exploration drilling in oil-bearing layers during certain parts of the year. This is done to limit environmental consequences for e.g. fish and birds as a consequence of potential acute oil discharges in connection with exploration drilling. These restrictions are specified in the license documents from the authorities or in the management plan for a specific sea area. Requirements relating to preparedness against acute pollution are stipulated for all exploration drilling.

7.5 Safety on the Norwegian Shelf

The Ministry of Labour/Petroleum Safety Authority Norway are responsible for the regulations relating to, and supervision of, both technical and operational safety, as well as the working environment in the offshore petroleum activities and certain land facilities. The authorities' responsibility covers all phases of the activity, such as planning, engineering, construction, use and subsequent final removal, if applicable.

RNNP was initiated in 1999/2000 to develop and apply a measurement tool to illustrate development in the risk level on the Norwegian Shelf. This work occupies an important position in the industry in that it contributes to a unified understanding of risk development among the parties. The RNNP work follows risk level developments using various methods such as incident indicators, barrier data, interviews with key sources, working seminars, field work and a major questionnaire survey every other year. The results are presented in annual reports, which also provide a basis for implementing measures to counteract negative trends.

Overall, the latest RNNP survey shows a weak negative trend in the risk picture in 2010. The overall indicator for major accidents has levelled out in the last five-six years, both for production facilities and mobile facilities. Continuous improvement is the goal.

There were no fatal accidents on the shelf in 2010, and the frequency of serious personal injuries has shown positive development in recent years. The injury rate for the entire shelf is now 0.68 serious personal injuries per million hours worked. This is significantly lower than in the previous ten-year period.

Up to 2008, we saw a consistently positive development in the number of well control incidents. However, there was a sharp increase in the 2008–2010 period, from 11 incidents in 2008 to 28 in 2010. The increase is also clear when taking into account the development in activity level (number of wells drilled). The Petroleum Safety Authority Norway has asked the industry to address the challenges associated with hydrocarbon leaks and well control incidents, urging it to come up with concrete measures that can contribute to a trend in the right direction.

Over the past decade, the industry has aimed considerable focus on reducing the number of hydrocarbon leaks, and has established clear reduction targets. Gas leaks have high damage potential due to the danger of explosion associated with the spread of gas clouds. The target of maximum 20 leaks was achieved in 2005, while the target of maximum ten leaks per year was achieved in 2007. Since then, the trend has been negative; with 14 leaks in 2008, 15 in 2009 and 14 in 2010. There was a particular increase in 2010 in the category 0.1–1 kg/s. One leak with a rate higher than 10 kg/s was reported in 2010. More goal-oriented and continuous efforts from the industry are necessary to reverse this trend.

The indicator for the most serious helicopter incidents shows positive development from 2009 to 2010, as is also the case for the number of ships on collision courses.

In an upcoming Storting white paper on working environment, working conditions and safety in Norwegian working life, the Ministry of Labour will present a broader updated status of HSE conditions in the activities. The white paper will also point out important features of the HSE regime for the Norwegian petroleum activities, as well as

the most important challenges for the HSE work in the years to come. The information will also include the HSE authorities' follow-up of the Deepwater Horizon accident in the Gulf of Mexico.

7.6 Disposal

The Petroleum Act requires licensees to submit a cessation plan to the Ministry two to five years before the production license expires, or use of the facility ceases. The cessation plan must consist of two parts: an impact assessment Chapter and a disposal Chapter. The impact assessment provides an overview of the various consequences associated with disposal of the facilities, such as environmental consequences. The impact assessment Chapter is submitted for consultation to affected parties. The disposal Chapter is processed by the Ministry of Petroleum and Energy and the Ministry of Labour, both of which will submit their evaluation. Based on the impact assessment with pertinent consultation statements and the disposal Chapter with pertinent evaluation by the two ministries, the Ministry of Petroleum and Energy will prepare a Royal Decree regarding disposal, which will be submitted to the Government.

To date, the Ministry has processed more than ten disposal plans for disused facilities. In most cases, the facilities have been removed and taken to land for scrapping, with examples of this including Odin, Nordøst Frigg, Øst Frigg, Lille Frigg and Frøy. Two consents have been granted for abandoning facilities at sea: the concrete substructure for the Ekofisk tank and the concrete substructure for the TCP2 facility on the Frigg field.

Great uncertainty is associated with disposal activity in the years to come. It is difficult to predict when a facility will be shut down. The shut down dates for the various fields and facilities depend on a number of factors; primarily oil price, expected production development, operating and maintenance costs and technical condition.

In addition to the fact that the shutdown date may deviate from the original plan, start-up and duration of the cessation project itself can also be uncertain. The respective fields have considerable differences with regard to size, complexity and number of facilities. Some fields may undergo development and operation in several phases, where some facilities are phased out and others will remain in operation. For many other fields there will also be other factors, such as the period during which wells are plugged, disconnecting pipelines or third party use, that will affect the removal work. The availability of heavy lifting vessels will be another important factor, along with weather conditions, as many such activities will be restricted to the summer months.

The authorities base their disposal decisions on both national and international regulations. The Petroleum Act of 1996 regulates disposal of facilities, and Norway's own regulations also encompass the ban on dumping disused facilities at sea adopted under the OSPAR Convention. The OSPAR resolution determines what types of disposal alternatives are acceptable for the various types of offshore facilities, and allows for exceptions in certain specific cases. Norway has issued two such exceptions: the concrete substructure for the Ekofisk tank and the concrete substructure for TCP2 on the Frigg field. There are ten other concrete facilities on the Norwegian Shelf where removal may be possible. However, this could also have environmental and safety consequences that could make it most appropriate for these facilities to be left in place. In 2013 OSPAR will once again consider whether there are grounds for reducing the possibility of exemptions from the dumping ban based on experience and technological development. The Norwegian Petroleum Directorate has taken the initiative for a collaborative project with the Climate and Pollution Agency and the Petroleum Safety Authority to consider future challenges and measures for removal and scrapping of concrete facilities on the Norwegian Continental Shelf.

8 Employment, spin-off effects and research

The petroleum resources on the Norwegian Shelf have laid the foundation for a highly competent and internationally competitive oil and gas industry. Oil companies, in cooperation with the supply industry and research and educational institutions, have found solutions to challenging conditions offshore. Major development projects have stimulated new technological solutions. Favourable framework conditions for research and technology development have been an important precondition.

One of the goals in the Government's petroleum policy is facilitating profitable production of oil and gas, which can also provide a foundation for profitable and attractive jobs onshore. The petroleum activity on the Norwegian Shelf generates jobs all over the country. The industry currently employs about 43 000 people, but over 200 000 jobs can be directly or indirectly linked to the demand from the activities on the shelf. This amounts to nearly eight per cent of overall employment in Norway.

The activity level on the Norwegian Shelf is at a very high level. It looks like this will continue in the coming years. A continued high activity level means that there is a considerable market for a petroleum-oriented supply industry and for other associated industry activity. However, small discoveries make it more challenging to achieve new, joint technology advances in the industry.

The activity level in the petroleum activities over time depends on how much of the remaining resources are utilised. If merely the current investment plans are implemented, the petroleum activity will quickly decline. Strong efforts in existing fields, new profitable field developments

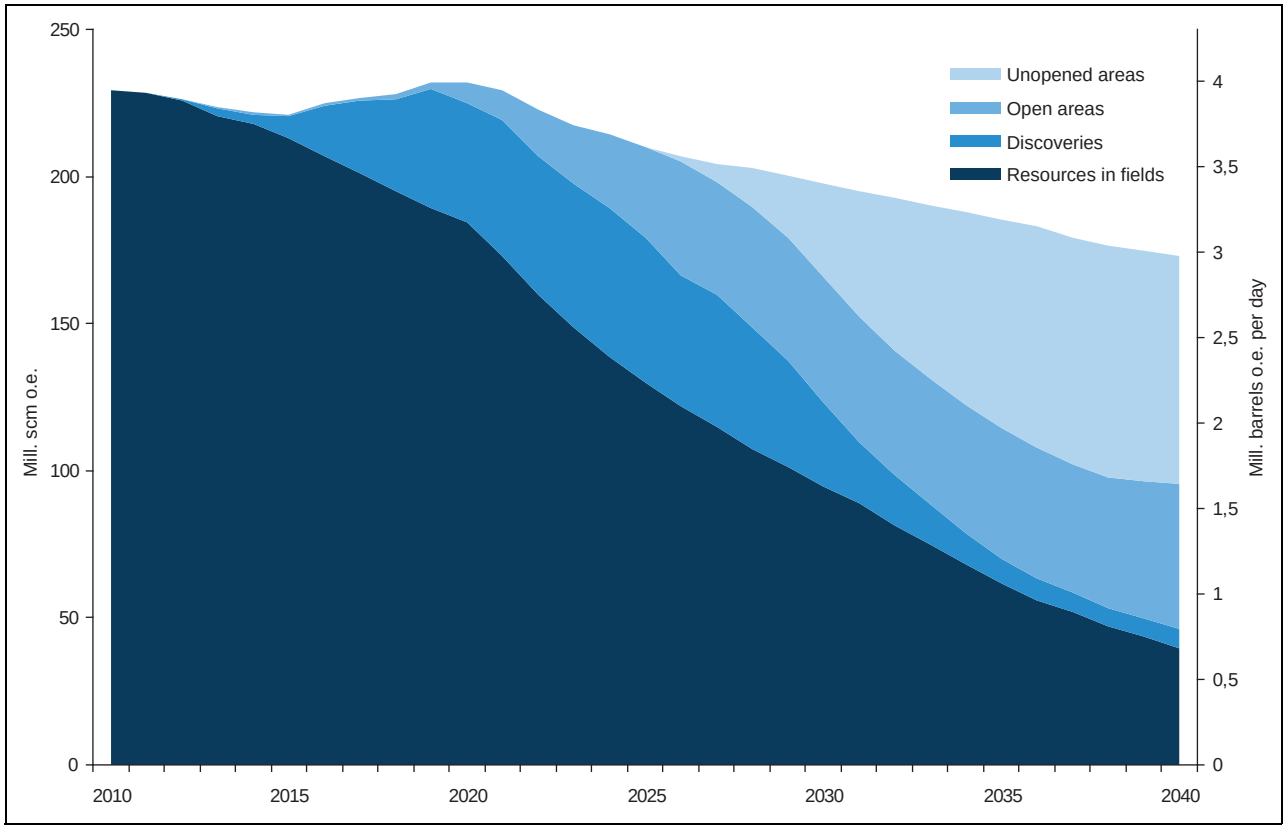

Figure 8.1 Possible production course on the Norwegian Shelf.

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

and exploration will provide the basis for a high and stable activity level in the future as well. In a time perspective beyond 2020, exploration in opened areas and access to new exploration area will be crucial as regards the activity level. Measures are necessary within all these areas to ensure the industry has new tasks. Therefore, the Government has decided to start an opening process for the sea areas around Jan Mayen and the part of the formerly disputed area west of the delimitation line in the Barents Sea South.

New discoveries provide the basis for new developments and associated spin-off effects. The greatest potential for making major, new discoveries is in the waters off Northern Norway. New activity and significant spin-off effects in the north are facilitated through expanded exploration activity. The development of Snøhvit, Goliat and Skarv illustrate that petroleum activity provides considerable value creation and employment, locally and regionally.

By utilising the resource potential on the Norwegian Shelf, the oil and gas industry will be able to create considerable activity in the country's economy for decades to come Development and operation of fields will create knowledge-intensive jobs and other positive spin-off effects. Utilisation of the resource potential will contribute to research activity and development of expertise. Research and development are important to improve recovery of resources and ensure that the industry is internationally competitive. The industry is, and must continue to be, a driving force within research and development. The authorities play an important role as facilitator, and in certain areas where the industry's efforts are not sufficient, there is a need for public funds.

8.1 Shelf and shore

A continued high level of demand from the activity on the Norwegian Shelf is crucial for the future of several companies and jobs across the country. This applies to both companies and jobs in oil companies, the petroleum-oriented supply industry and in other associated industry activity.

Norwegian companies are involved throughout the production chain. Various companies carry out e.g. offshore activity, exploration, development, modification, maintenance, operation and disposal. For these companies and associated employment, the total level of demand is not the only important factor. These companies are dependent on activity throughout the entire petroleum activity value chain.

Over the last decade, the investments and operating costs on the Norwegian Shelf have increased significantly. The activity level on the Norwegian Shelf is high, and indications are that this will continue in the coming five-year period, cf. Figure 8.2. A continued high activity level also entails that there will be a considerable market for a petroleum-oriented supply industry and other associated industry activity in the future.

The volume of assignments associated with operating fields is a core market for the Norwegian supply industry. Norwegian suppliers are particularly well-positioned to compete for assignments associated with operating fields because they are geographically close to the Norwegian Shelf and often have experience from previous assignments on the relevant fields.

If merely the approved investment plans are implemented, the Norwegian Shelf will experience a swift decline in production. Amplified efforts in improving the recovery rate from existing fields can curb the decline in production. This will provide great possibilities for new assignments as measures that increase the recovery of resources on fields often require considerable investments. It will also form the basis for more long-term operation of the fields. In this year alone, investment decisions are planned for new facilities, modification and wells on Ekofisk, Eldfisk, Åsgard, Snorre and Troll, each with investment frameworks exceeding NOK 10 billion. Measures to improve the recovery rate and lifetime are important for large parts of the supply industry's volume of assignments in the medium term.

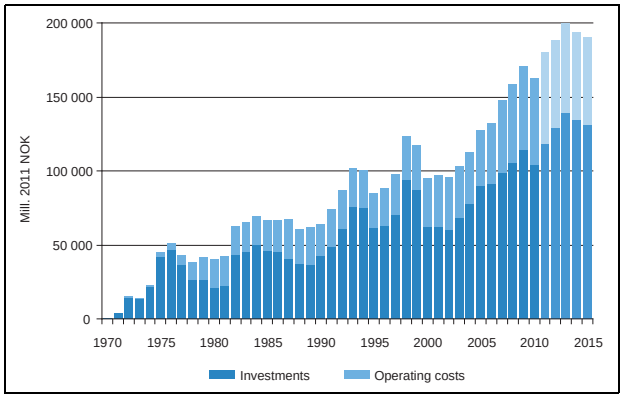

Figure 8.2 Level of activity (1971–2015).

Source: Ministry of Petroleum and Energy and Norwegian Petroleum Directorate.

The number of new discoveries on the Norwegian Shelf is increasing in mature areas. The average size of discoveries is, however, significantly lower than in the 1970s and 80s.The size of discoveries is important for development solutions and the prevailing trend is fewer independent developments and more wells and satellites connected to existing infrastructure. Smaller discoveries, combined with a relatively high cost level compared with other petroleum provinces, mean that the industry is facing new technological and financial challenges in the coming years.

Large parts of the exploration area the industry currently has access to, are relatively well-explored. The promising deepwater areas in the Norwegian Sea have not yet met expectations. The recent Skrugard discovery is good news for exploration of the Barents Sea. The last time new area was opened for petroleum activity was in 1994. It takes a long time for discoveries to mature so they result in field development and production. For example, the years of discovery for Snøhvit, Gjøa and Skarv are 1984, 1989 and 1998, respectively. Snøhvit started production in 2007, Gjøa in 2011, while Skarv is still being developed. In the last ten years, the discoveries have been smaller than previously. This will play a role in which developments move ahead.

Access to new, prospective exploration area is important to facilitate new, larger projects that can harbour the future's technological solutions. Therefore, the Government has decided to start an opening process for the sea areas around Jan Mayen and the part of the formerly disputed area west of the delimitation line in the Barents Sea South. The petroleum industry prioritises its resources where there are interesting business opportunities. In order for Norway to be a host country for an innovative and highly technological oil and gas industry, access to attractive exploration area is a prerequisite. Major discoveries in frontier areas often require larger basic investments in the form of independent developments and infrastructure. Such discoveries therefore provide a basis for larger assignments for the supply industry per field development than development of smaller discoveries in mature areas. Furthermore, new, independent developments provide the possibility for tasks for wider Chapters of the supply industry than smaller satellite fields. The industry must cooperate to find cost-effective solutions that enable realisation of resources both in new areas and mature areas.

In the long-term, it is crucial that sufficient new resources are proven to ensure regular and high activity on the shelf, and thus also new tasks for the industry. Continued new field developments require access to new area. Without access to area, the demand impulses toward the supply industry will wane in correlation with reduced activity level on the shelf, and thus weaken the basis for a Norway-based supply industry.

When production ceases, the facilities on the Norwegian Shelf must be removed. Currently, there are about 500 facilities on the Norwegian Shelf. There will be considerable work involved in phasing out fields that have been in production. The costs associated with handling the facilities on the Norwegian Shelf have been estimated at about NOK 160 billion[1]. This means that handling scrapped facilities will be a large market that can provide great industrial opportunities for onshore companies.

It is estimated that about 30 facilities on the Norwegian Shelf will be taken out of use on the Norwegian Shelf in the period 2010-2020. On the UK shelf, it is estimated that about 260 facilities will be taken out of use during the same period. This is a growing and interesting market for Norwegian removal players and receiving facilities. Currently, there are three facilities in Norway that can receive and process scrapped oil installations. The uncertainty associated with the prognoses is great since it is difficult to predict when a facility will be shut down. The shutdown time for the different fields and facilities depends on several factors, mainly oil price, expected production development, operation and maintenance costs and technical condition. Historically, the lifetime estimates have varied greatly and the current trend is for lifetimes to be continuously extended. The capacity of the above-mentioned facilities is expected to be sufficient to handle the volumes expected for scrapping towards 2020[2].

The Government will:

- Maintain an effective petroleum industry in Norway over time by facilitating profitable future activity on the Norwegian Shelf through development of discoveries, improved recovery, exploration in open areas and opening new areas.

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[1] See the Climate and Pollution Agency, Phasing out scrapped platforms, TA-2643/2010

[2] See the Climate and Pollution Agency's report: Phasing out scrapped platforms, TA-2643/2010.

Box 8.1 Industry founded on traditions

The petroleum activity on the Norwegian Shelf requires solutions that are adapted to the weather and sea conditions in the North Sea, Norwegian Sea and Barents Sea. The strong traditions and knowledge from shipping and shipbuilding provided a good foundation for taking the next step and delivering goods and services to the petroleum activity as well. With this point of departure, the Norwegian maritime sector and associated equipment suppliers have developed into an important part of the petroleum-oriented supply industry. About 90 per cent of the overall contract value of ships delivered from Norwegian shipyards during the period 2009-2013 goes to vessels used in the oil and gas activities.

Norwegian offshore shipowners own and operate one of the world's most advanced offshore fleets. The Norwegian fleet of service vessels (supply, anchor handling and specialty ships) is the second largest in the world. For every offshore ship built in Norway, jobs are created across the country. The building of the anchor handling ship «Normand Prosper» involved equipment deliveries from 91 Norwegian companies. The ship was delivered on 9 April 2010, from STX Norway Offshore in Brattvåg to Solstad Offshore ASA in Skudeneshavn.

8.2 The petroleum activity employs many people

Building a strong supply industry has been an objective since the petroleum activity started on the Norwegian Shelf. This has been successful and the supply industry currently consists of many competitive companies that deliver technologically advanced products and services to the Norwegian Shelf and to international markets. The industry is active within exploration activity, new developments, operation, maintenance, modifications and cessation of fields. Some focus on one of these markets, while others carry out activity in several parts of this value chain. Norwegian companies have become market leaders within seismic services, subsea production systems, drilling equipment, offshore service vessels, floating production and transport services.

In the aftermath of the development of a competitive supply industry in Norway, the import percentage in the petroleum sector has been reduced. This entails that the demand from the activity on the shelf has become more important for the activity level in the Norwegian economy. This also means that changes in the activity level on the shelf, and thus the demand from the industry in general, has a greater effect on employment in the country. Early in the 1970s, the import percentage was very high – nearly 100 per cent. As Norwegian industry has built up expertise within petroleum-related activity, the import percentage has now been calculated at between 20 and 30 per cent.

According to Statistics Norway's (SSB's) definition of the petroleum industries, they employ about 43 000 people[3]. About half of these are employed in the oil companies. This does not include all of the employees in the petroleum activities. If we include what Statistics Norway defines as petroleum-related industries, the number is higher. Using this definition, 63 000 people are employed in the industry, 65 per cent of which live in Rogaland and Hordaland. 424 of the country's 430 municipalities have at least one citizen employed in what can be called the core activity and includes direct employment in the petroleum activity.

The effect of the overall demand from the petroleum industry is significantly greater. Several companies deliver goods and services to the petroleum activity or to companies in the industry groups mentioned above. This applies to e.g. seismic companies, engineering companies and shipyards.

The demand from the petroleum industry has been and is very significant for the activity in many companies across the country. Researchers from Statistics Norway have analysed the effects of this demand[4] on e.g. employment in Norway. By taking a basis in direct and indirect deliveries to the petroleum activities, an estimate of the scope of employment that can be directly and indirectly connected to the deliveries to the petroleum industry has been carried out. The calculations –

[3] Statistics Norway's industry groups: "recovery of crude oil and natural gas", "services associated with oil and gas recovery" and "pipeline transport".

[4] Financial analysis 3/2010; The demand from the petroleum activities, significance for production and employment in Norway, Statistics Norway.

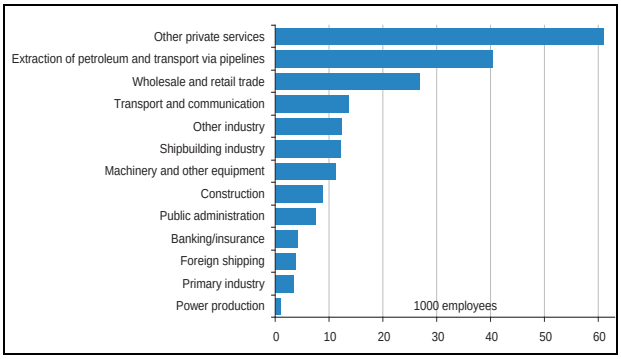

Figure 8.3 Number of employees that can be directly and indirectly linked to the demand from the petroleum activity, in 1000 employees, 2009.

Source: Statistics Norway.

based on numbers from 2006, show an employment of 206 000 in 2009, c.f. Figure 8.3.

The deliveries to the petroleum activity come from many parts of Norwegian industry. The demand from the petroleum activities influences not only what we primarily think of as supply industries. It applies to a wide spectrum of industries, including building and construction, communication, trade in goods, banking/insurance and other parts of private services, cf. Figure 8.3.

Over the last decade, the supply industry has experienced considerable growth. The growth is not only reflected in increased employment, but also in turnover and value creation. Expertise from petroleum activity is also relevant to other types of assignments. Norwegian construction yards have received considerable contracts for production of jackets for offshore windmills. Similarly, Statoil's expertise as an operator of oil and gas fields has had great significance for the development of full-scale floating windmills. In the same way as the knowledge and experience from shipping was important to the development of the supply industry, the current knowledge foundation provides a good basis for future activity within renewable energy as well.

8.2.1 The supply industry location

Menon Business Economics, IRIS and Ramm Energy Partner have carried out an analysis which shows e.g. location and employment in the Norwegian supply industry. The analysis shows that the Stavanger region is the economic region with decidedly the most full time equivalents connected with the supply industry. This region occupies a special position. Proximity to southern parts of the North Sea, where the petroleum activity started, is an important factor in this. Strong industry environments have gradually developed in the rest of the country. This includes strong environments within operation and maintenance in the Bergen region, for instance, subsea equipment in the Kongsberg/Asker region, shipowners and shipbuilding activity in Sunnmøre and Sunnhordaland and the NODE cluster in Southern Norway which is e.g. characterised by deliveries of drilling equipment, cf. Figure 8.4.

As the petroleum activity moved north, there has been onshore industry development further north as well. In recent years, there have been significant developments off Central Norway. This has created activity and employment in the region. Development and operation of Snøhvit has generated considerable spin-off effects for land-based activity in the north, particularly in Hammerfest, where several companies have experienced a boost as regards expertise, technology and capacity.

Supplier companies also give assignments outside their own local environment. Major supplier companies purchase from the entire country. In 2010, FMC Technologies purchased goods and services totalling more than NOK 3 billion distributed across 18 of the country's counties[5].

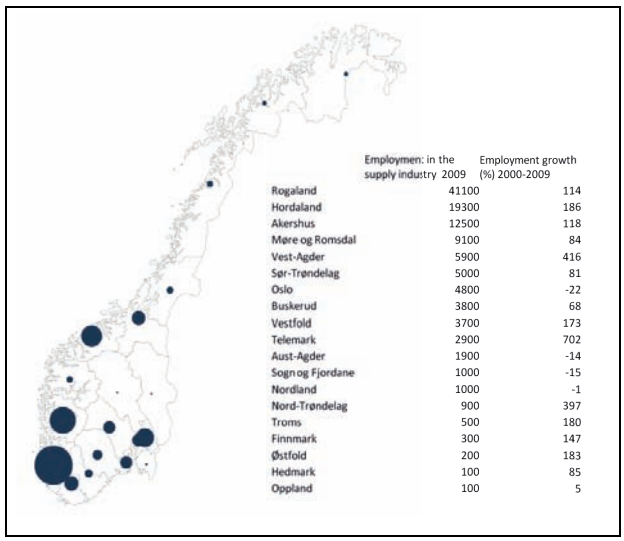

Figure 8.4 Location and employment in the Norwegian supply industry.

Source: Menon Business Economics, IRIS, Ramm Energy Partner.

5 Source: FMC technologies, March 2011

8.3 Development of the industry

In 1959, the Groningen field in the Netherlands was discovered. This caught the attention of the major international oil companies, who requested access to carry out seismic surveys in the North Sea off the UK and Norwegian coasts. At this time, there was little expertise within exploration, production or refining petroleum in Norway. There was no education directed at petroleum activity, and no public agencies or institutions working with oil and gas.

In the first years with oil activity on the Norwegian Shelf, the authorities were therefore concerned with establishing a good framework for the activity. Important considerations included maintaining national control over the resources and ensuring positive effects in the event of development of these. Furthermore, they were concerned with attracting the large, international oil companies. These companies' technical expertise and technical and financial capacity were key factors in ensuring a responsible start.

8.3.1 Industrial experience and culture

In the beginning, foreign suppliers dominated all areas. The newest technology and the best development solutions were imported. They were not necessarily adapted to the conditions in the North Sea. Therefore, there was room for improvement, which Norwegian industry quickly stepped in to fill. Initially, there was therefore a focus on learning to adapt solutions developed abroad.

Even though Norwegian companies possessed little expertise as regards petroleum activity, there were environments with industrial experience and industrial culture that could be utilised. For example, there were environments with experience from building large structures such as dams, bridges and ships.

The Norwegian contractor companies Selmer and Høyer-Ellefsen received the task of building a concrete storage tank for the Ekofisk field. Jåttåvågen outside Stavanger was chosen as the construction site. Using concrete was a French suggestion, and became a success and breakthrough for offshore concrete installations. The technology was developed further by several companies. The Norwegian contribution was named Condeep[6]. Norwegian Contractors was established by the companies Høyer-Ellefsen, Selmer and Furuholmen to build the first platform of this kind (for the Beryl field on the UK shelf). By the end of 1974, the companies had a total of six concrete platforms under construction in Jåttåvågen. Besides the Ekofisk tank, 18 concrete platforms were built in Norway, fifteen platforms in Stavanger, two in Åndalsnes and one in Hanøytangen.

Aker Solutions has continued the experiences within design, construction and installation of offshore concrete structures. Concrete has proven to be very suitable in Arctic regions and/or when encountering icebergs, drift ice and ice build-up. Aker Solutions still makes concrete platforms for rough weather areas in Canada and Russia.

The shipping knowledge Norwegians had gained over many generations, became a great advantage when oil exploration and production was starting. Many sailors who were used to working away from home for long periods were recruited to the oil industry. Experiences at sea and great adaptability were important in an international industry such as the oil activities. Norwegian shipowners had experience from operating internationally, and already had contacts in the oil industry. Many shipowners had strong capital and the shipowners were used to making major, and often risky, investments.

Norwegian companies quickly became important in e.g. further developing the seismic technology and adapting the technology to be used offshore. Norwegian factory trawlers were particularly suited for modification and were used as seismic vessels. Crews that previously manned fishing vessels joined the seismic vessels. Geophysicists and engineers received valuable knowledge about handling equipment from the fishing fleet. The synergy effect between fisheries and seismic has resulted in Norway playing a key role in this discipline. It started with the establishment of Computas and Geoteam, and continued with the development of Geco and PGS, which both became world-leading within seismology.

There were many large and small shipyards for new construction and ship repairs along the coast. These were not particularly involved with building platforms during the first years. After a decline in the oil price, and a collapse in the tank market and several discoveries on the Norwegian Shelf in the 1970s, many of the yards adapted to the needs of the oil industry. They did this through building drilling rigs, production platforms and supply and support vessels. The industry structure in Norway necessitated dividing large assignments into smaller units, as the yards were small and geographically spread. The work distribution between several yards enabled more

[6] Concrete Deepwater Structure

Box 8.2 Subsea expertise

The subsea segment has become a business area where the Norwegian supply industry is a world leader within technology. Norwegian companies operate within all segments of the supply chain, main contractors, system operators, product suppliers and service companies are all in the chain. Companies such as FMC Technologies, Aker Solutions, GE Oil&Gas, Framo, ClampOn and Subsea 7 are examples of various cutting-edge expertise areas within this market. Norwegian-based suppliers have, for example, about 60 per cent of the world market for x-mas trees. The force behind the strong subsea environment in Norway includes demanding customers (oil companies) that have contributed capital for R&D and the willingness to test technology on the Norwegian Shelf. At the same time, the suppliers have been able to recruit competent work forces in cooperation with university and college environments, e.g. in Kongsberg and Bergen. The University of Bergen holds the status of a Norwegian Centre of Expertise (NCE) within subsea solutions.

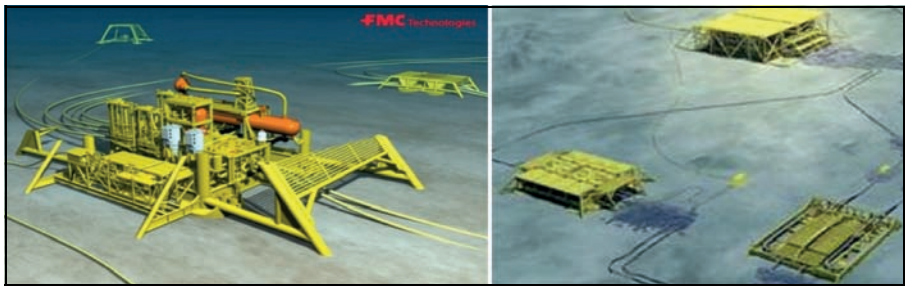

Figure 8.5 Templates.

Illustration: FMC.

rapid delivery and simultaneous utilisation of expertise in the individual local yards and workshops.

The first Norwegian platform was built in 1966. Rosenberg Mekaniske Verksted in Stavanger and Akers Mekaniske Verksted were also crucial in building the platform. Aker also developed a new type of drilling rig, the first of which started operations in 1974. The company's concept has been further developed and several shipyards around the world have built rigs on license from Aker. The most recent generation of these rigs can drill in water depths of up to 3000 metres. Throughout the years, several special vessels, platforms and various modules for the petroleum activities have been built at Norwegian shipyards.

Long industry traditions, strong scientific and technological expertise and a strong engineering environment are important reasons why companies in the Kongsberg-Oslo area are world-leading as regards subsea equipment for the petroleum activities.

8.3.2 Expertise

The authorities saw that the major oil companies possessed both the technological expertise and capital necessary to find and utilise potential petroleum resources. During the first years, Norway was therefore dependent on the multinational companies in order to utilise the resources. The State policy was based on attracting international oil companies and technology.

Several major fields were discovered in the 1970s and 1980s. The increased water depth and climatic conditions required considerable technological development before these fields could be developed. In connection with the fourth licensing round in 1979, technology agreements between the Norwegian state and the foreign oil companies were signed. The objective of the agreements was to stimulate Norwegian industry and increase Norwegian expertise. The foreign companies contributed the financial means and expertise to develop technology in Norway. The Norwegian research environments and companies thus received access to petroleum-related research. Through active policies from the authorities and great efforts on behalf of the companies, exper-

Box 8.3 Well service – a key area for increased oil and gas production

Well service entails operations in connection with drilling new wells and operations in producing wells to optimise or maintain production of oil and gas. Traditionally, the major international companies Schlumberger, Halliburton and Baker Hughes have dominated this market. The authorities' prioritisation of improved recovery and increased allocations to research institutions have contributed to a growth of steadily more specialised supplier companies in this market. Many have their origin in Norwegian research environments, for example IRIS in Stavanger. Currently, over 140 companies specialising in well service exist in Norway.

It is sometimes necessary to enter the wells to carry out maintenance or other technical operations, such as replacing pipes, monitoring production and logging pressure, flow and temperature. This is called well intervention. Aker Well Service, along with Statoil, has developed a so-called well tractor (pictured). This is a device of approx. five metres which can push equipment as far as ten kilometres along the horizontal parts of a well. A well tractor makes it possible to recover even small production volumes of oil. Statoil alone estimates that the well tractor will result in improved recovery with a value of NOK 300 million annually. In addition, Statoil estimates a cost savings of about NOK 500 million per year by using a well tractor instead of traditional coiled tubing or pressure pipe operations. Because a well tractor is relatively easy to handle, it also offers HSE benefits.

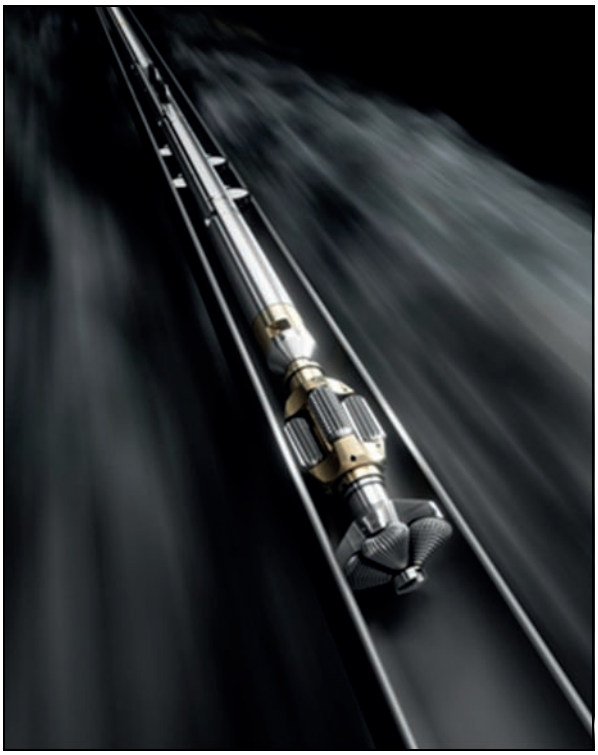

Figure 8.6 Well tractor – example of new well technology.

Illustration: Statoil.

tise and new activity within seismology, drilling, building supply ships, drilling platforms, production platforms, research and education were quickly built up.

The expertise within these areas has been important for the development of the Norwegian Shelf and Norwegian jobs. For example, new technology such as horizontal drilling, multilateral drilling, three and four dimensional seismic and many different injection technologies, have contributed to enabling development of new fields and have allowed many fields on the Norwegian Shelf to increase resource utilisation and thus extend their lifetimes. It was also important for the transition from large, integrated concrete platforms to subsea solutions tied in to existing platforms, new floating platforms, production vessels or simple, unmanned platforms. The development of solutions enabling both remote operation of platforms and wells at ever greater depths, has also been very important for this development.

Since 1980, activity has been ongoing to find solutions for transporting untreated wellstreams over long distances in the same pipeline, so-called multiphase transport. Active use of multiphase transport represented an important shift in the development, both on the Norwegian Shelf and internationally. The multiphase technology experienced a crucial breakthrough with the development of TOGI (Troll Oseberg Gas Injection). This also enabled the process part of the Troll A development to be established on land, through the establishment of the gas treatment facility at Kollsnes. Additional advances made the development solutions on Snøhvit and Ormen Lange possible.

The combination of new and challenging tasks within development and operation, strong university environments and competent supplier compa-

Box 8.4 Innovative industry with a starting point in Agder

Hardly any other oil and gas environment has experienced such considerable growth as the so-called Southern Norway cluster in recent years. The oil and gas environment in Southern Norway has formalised a cooperation through the NODE secretariat (Norwegian Offshore & Drilling Engineering), which also facilitates cooperation between industry and educational and research environments in the region. In 2009, NODE became a Norwegian Centre of Expertise and includes around 50 companies and about 6200 people. Drilling equipment, loading/offloading and anchoring systems as well as wave-compensating cranes are the most important products. Through close cooperation with demanding customers, targeted R&D work, particularly within mechatronics (mechanics and electronics), and cooperation across the cluster, the companies have developed innovative solutions that have proven most cost-effective.

The largest suppliers of drilling equipment include Aker Solutions, National Oilwell Varco, TTS Energy and Nymo. APL and Aker Solutions have specialised in anchoring and loading/offloading technology. The NODE companies make up a strong and important industrial environment in the Agder region, with a turnover of NOK 40 billion in 2009.

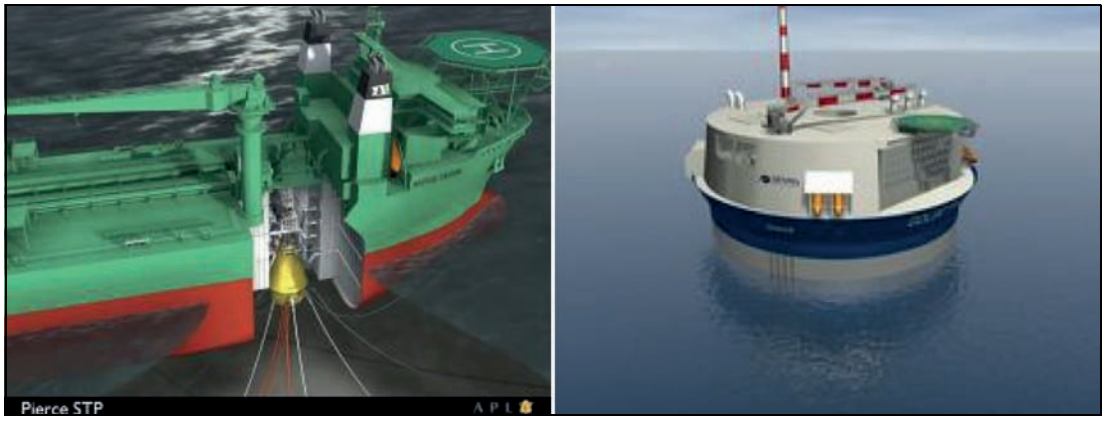

Figure 8.7 Examples of anchoring, loading and offloading technology and drilling technology.
Illustration: NODE.

nies and oil companies, have been important factors in Norway's success in these areas.

8.3.3 Regional development

Over a period of 35 years, Norway has built up a supply industry which is at the global forefront in several fields. During this period, specialised enterprises have been established and a knowledgeable work force has been developed. Particularly in the marine sector, investment environments have developed that have been visionary and willing to take risks, but several investors have become more willing to gamble on development of technology-driven enterprises over time.

For a great deal of activity in the supply industry, it is beneficial to be located near the development and operation activity. With the gradual advance to the north on the Norwegian Shelf, it can be expected that the same geographical development of employment in the supply industry will take place. This is also the case.

The Rogaland and Stavanger region is the largest region measured in the number of employees, but its position has over time been reduced due to significant growth in Southern Norway, in the "subsea corridor" Oslo-Kongsberg and with shipowners and shipyards from Flekkefjord to Rissa. Central Norway has also been included in the activities, while Northern Norway lacks larger dynamic growth enterprises outside the Hammerfest area.

Geographical proximity is, however, not sufficient. The growth of the industry has also settled in a regional division of labour where different regions have utilised their own advantages to establish new activity. Regional specialisation can be observed. The dynamics in the industry are strongest in the Stavanger region. The growth in the subsea environment in Kongsberg or the ship-

owner and ship building activities in Sunnmøre are other examples.

A common denominator for all of these environments is that they were not built from scratch, but developed from already existing environments for mechanical construction, machine production, shipping or seagoing fisheries. At the same time, the Norwegian Shelf and various oil companies on the Norwegian Shelf have offered many challenges that have required creativity and knowledge development. The merger of unique, highly specialised expertise has been important in order to achieve this and close regional environments contribute to this. Areas with many small enterprises with relatively weak resources have seen weaker effects than other regions with other qualifications.

8.4 Great possibilities in the north

The Government wants, and will facilitate, profitable offshore activity to also provide a basis for spin-off effects on the mainland. Creating spin-off effects on land when new offshore activity is established is also important for the population's support of the activity.

New discoveries provide a basis for new developments and associated spin-off effects. The waters off Northern Norway are the most interesting as regards making new, large discoveries. These areas have been important in the last numbered licensing rounds.

Environments across the country have experienced positive industry development in light of the petroleum activities. Central regions in Western Norway have experienced the strongest growth. The number of people employed in petroleum-oriented activity in Rogaland increased from the early 1970s from 2000 to 30 000 employed over a 15-year period. In the 1990s, Møre og Romsdal County experienced an increase in employment in the same industry from about 1000 to 5000. The basis for the development is complicated, but proximity to resources and existing expertise have been important preconditions.

It must be possible for Northern Norwegian industry to participate as competitive suppliers to the activity. The starting point for Northern Norwegian petroleum activity differs from the situation in the North Sea 40 years ago. The same fundamental drivers for development which increased activity entails are, however, present. The high exploration activity in the North Sea forms a basis for proving new resources and thus positive spin-off effects.

The development in the northern areas and the Arctic provides challenges and opportunities. The northern areas are the Government's most important strategic focus area in foreign policy and will contribute to a positive development in the northernmost areas. The overall goal of the Government's policy is to ensure peace and stability in the region. Furthermore, the target is to ensure a sustainable and environmentally responsible management and utilisation of resources for the future. This entails paving the way so that people in the north can build an existence in viable local communities, with future-oriented jobs, good health and educational opportunities and diverse nature and cultural experiences. The northern area policy also deals with utilising the possibilities for increased international cooperation on resource utilisation, environmental management and research through closer contact with our Russian neighbour and our partners in Europe and North America. Safeguarding Norwegian interests in the northern areas mainly concerns a strengthened presence and increased activity along multiple political dimensions, both national and international.

The current basic industries are an important foundation for further development, but they will not be able to create the desired growth by themselves. The region therefore also needs other growth impulses. The petroleum activity can provide such a contribution. This is contingent upon exploration for resources in existing and new areas to increase the likelihood of making new and large discoveries. The Government will facilitate further development of the petroleum activity in the Barents Sea and ensure that the activity will have significance for Norwegian and Northern Norwegian expertise development, as well as local and regional industry development.

A high percentage of the deliveries to the oil and gas activities on the Norwegian Shelf come from Norwegian industry. The positive spin-off effects of the petroleum activity in the north have not been as significant as in the rest of the country. In the areas where activity is taking place, the spin-off effects are considerable. The expertise, industrial experience and culture possessed by an area are crucial as regards how large the spin-off effects will be. During the summer of 2009, Petro Arctic in Hammerfest carried out a survey which showed that companies in Finnmark had deliveries to the oil and gas industry totalling NOK 1.9 billion. The corresponding number for Nordland

was NOK 1.6 billion and NOK 430 million for Troms.

Consequential research analyses show that petroleum activity results in considerable spin-off effects in the form of increased employment, a broader industry base and more expertise jobs. The petroleum activity thus represents an opportunity, both for Norwegian industry and local communities/regions in the province.

Spin-off effects from the petroleum sector are the result of both decisions regarding establishment and structure, as well as the ability of existing industry to compete to offer their goods and services in the value chain. It is desirable for companies in the province to have the opportunity to compete for relevant contracts.

In the work with ensuring spin-off effects from the oil and gas activity in the north, it is very important that companies in Northern Norway participate in more, and increasingly specialised areas. Sufficient expertise and market networks must be built in order to compete with an already well-established southern Norwegian or foreign industry. Northern Norwegian supplier networks and industry associations play an important role in strengthening the local industry's ability to prequalify for coming tender processes. The daily operation of the supplier network is financed by annual contributions from the oil companies and through membership fees. In order for the industry in Northern Norway to be able to benefit from the petroleum activities, the oil companies must also qualify competitive northern Norwegian companies. Through conscious strategies that do not hinder local purchases, regional effects of the petroleum activity can be strengthened.

The Sami people have a special status pursuant to international and national law, including the right to be consulted in matters that could have a direct impact on them. An agreement has been signed between the State and the Sami Parliament regarding how consultations will take place. The consultation procedures apply to all types of cases, such as in the work with laws or administrative measures that could directly impact Sami interests. This also applies in connection with the petroleum activity.

8.4.1 Spin-off effects from developments

One objective of the Government's petroleum policy includes facilitating profitable production of oil and gas, which can also provide a basis for profitable regional spin-off effects by contributing to development of industry and workplaces. In order to achieve this, the societal consequences of a development are an important topic when new development plans are highlighted. This ensures attention to this important area from both involved companies and local and regional authorities. The experiences from recent years' developments in the north show that new, large developments result in local and regional effects.

It is important that the petroleum policy is designed such that the northern areas become attractive and are prioritised in the companies' portfolio. This is contingent upon promising exploration areas being made available and that profitable and large discoveries are made. The increased access to interesting exploration areas that the Government has planned through the management plan for the Barents Sea – Lofoten, as well as the new discovery of Skrugard will contribute to achieving this.

The experiences from Skarv, Snøhvit and the studies from Goliat show that new, large developments provide spin-off effects in the north, regardless of development solution.

Snøhvit

The development of the Snøhvit field in 2002 was a milestone for the development of the Barents Sea as a petroleum province. It is the first gas development in the Barents Sea and the first facility for liquid natural gas in Norway. At its peak, 2500 people were employed during the construction activity until production started in 2007. Operation, maintenance, modification and support services for Snøhvit have created 400 jobs, where three-fourths of the employees have been recruited from Northern Norway. Nearly NOK 3 billion of the overall deliveries to the field come from companies registered in Northern Norway.

Consequential research analyses show that Snøhvit has reversed a negative population and employment trend in Hammerfest. New companies are being established in the city, and the region now has a shortage of labour. There has been a significant expansion in residential construction. There have also been considerable investments in upgrading school buildings, infrastructure, and development of cultural activities in Hammerfest. The development has created expertise building in the region, which also has a positive effect on other industries.

Goliat

The Goliat field located 85 km northwest of Hammerfest is the first oil field to be developed in the Barents Sea. Goliat is one of the biggest industry projects ever carried out in Northern Norway. Through this development, the industry in the region has continued to evolve. Goliat continues to build upon and strengthen the activity that was established in connection with Snøhvit.

The operator, Eni, is developing the field with a floating facility. The oil will be loaded onto tankers and transported to the market. Possible gas transport to Melkøya (Snøhvit) will be studied. A regional office for the Barents Sea with operational functions for the field, as well as a helicopter and supply base, are being built in the Hammerfest area. This will contribute to a total of about 150-200 jobs over the operational period.

The operator will facilitate further spin-off effects, including adapting the contract strategy on maintenance and operations contracts, cooperating with regional supplier networks, establishing auditing schemes for local companies in their own organisation, as well as ensuring that suppliers that win central contracts within maintenance and modification are present in Finnmark. They will also cooperate with upper secondary schools and higher education and research environments in Finnmark, to contribute to building local and regional petroleum expertise. With an expected operational phase of at least 15 years, local companies will be able to build expertise and capacity and become important suppliers to the petroleum industry in the north.

Norne and Skarv/Idun

The Norne field is an oil and gas field located in the Norwegian Sea off Helgeland. The field started producing in 1997. The Helgeland base in Sandnessjøen supports the oil fields off the cost of Helgeland, where the Norne field is the largest. About 50 people are employed at the Helgeland base, 30 employees in the base company and an additional 20 employees in associated activities in the base area. Furthermore, Statoil has established offices in Harstad.

For nearly 25 years, the Helgeland base in Sandnessjøen has delivered goods and equipment to the drilling activity off the Helgeland coast. The activity on the base purchased goods and services from companies in Nordland totalling about NOK 280 million in 2007. The same year, the base had nearly 390 ship calls.

Skarv/Idun is an oil and gas field under development in the Norwegian Sea. They will have an operation base in Sandnessjøen and a helicopter base in Brønnøysund. Production is expected to start in 2011. The Helgeland base in Sandnessjøen will be the supply base for Skarv/Idun. The operator, BP, has emphasised utilising the local and regional supplier network[7]. Sandnessjøen doubled its petroleum-related turnover from 2005 to 2008. This can indicate that the proximity to Norne, Skarv and Idun, stimulates growth in the region.[8]

The above examples show that new independent developments provide regional and local spin-off effects, both during development and in the operation phase. Field developments generate positive spin-off effects for the region, regardless of chosen solution.

8.4.2 Future developments

Apart from Goliat, there are currently no profitable discoveries in the region that are ready for a development decision. The further development of Melkøya is a concrete project that is being discussed. The new Skrugard discovery could result in a new, independent development sometime in the future.

Exploration in awarded area, annual licensing rounds in mature areas, as well as regular licensing rounds, usually every two years, in frontier areas is crucial as regards making new discoveries. The most prospective parts of the continental shelf that are not opened for petroleum activity are located off Northern Norway. In these areas, the potential for making new discoveries is greatest. Making discoveries large enough to warrant new infrastructure is important for a further development of the petroleum activity in Northern Norway.

The Government therefore wants to award further production licenses off Northern Norway. This will be in addition to the considerable number of licenses awarded in the present and previous years. In coming rounds, the Ministry will offer area in a belt off the Finnmark coast and parts of Troms, as well as by the so-called Eggakanten in the Barents Sea. New licenses have not been awarded in these areas in more than ten years.

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7 Regional spin-off effects from the oil and gas industry; a summary of the available mappings, Arbo, Eikeland, Hervik, Norut NIBR Finnmark, Report 2007:04.

8 Delivered! Petroleum-related supplier industry in Northern Norway. Andersen, Johansen, Norvoll, Nyvold, 2009.

Box 8.5 Petro Arctic

Petro Arctic was established in 1997 as an interest organisation for companies that want to position themselves as suppliers for development and operation of Snøhvit, the Goliat project, Norne, Shtokman and future development projects in Northern Norway and the Barents Sea. Petro Arctic's main objective is achieving the largest deliveries of goods and services possible from the member companies of Snøhvit and Goliat as well as future development projects in Northern Norway and the Barents Sea. This will be achieved through marketing the member companies vis-à-vis the developers, as well as motivating and preparing the members through participation in network and expertise building programs.

An opening process will start for the southern part of the formerly disputed area vis-à-vis Russia in the Barents Sea. In the northeastern Norwegian Sea, an opening process will not be started during this Storting period; however, the Ministry will carry out knowledge acquisition in the area, cf. Storting White Paper No. 10 (2010-2011).

When new, profitable discoveries are made in the future on the Norwegian Shelf, the Ministry will follow-up the development plans with the objective of promoting profitable production of resources and simultaneously ensuring that local and regional industry are given the possibility to participate as competitive suppliers to the petroleum activities. It is important that the operator facilitates local industry receiving the possibility to compete for the assignments from a development.

Early contact between the operator and local/regional industry and relevant authorities is important so that the industry receives good information about the business opportunities the new activity in areas will entail. Relevant societal factors must be studied in connection with development plans, including regional and local spin-off effects from the development. It is important that these elements receive early focus from the developer in order to achieve good solutions.

When a field is being developed, and as operations start, it is important that involvement of competent industry in the region is facilitated. It is important, for instance, to facilitate qualification of relevant local/regional suppliers, and that tender processes are established that enable participation from companies in the province. It is also important to ensure an efficient base and operation structure, which contributes to local and regional industry and expertise development.

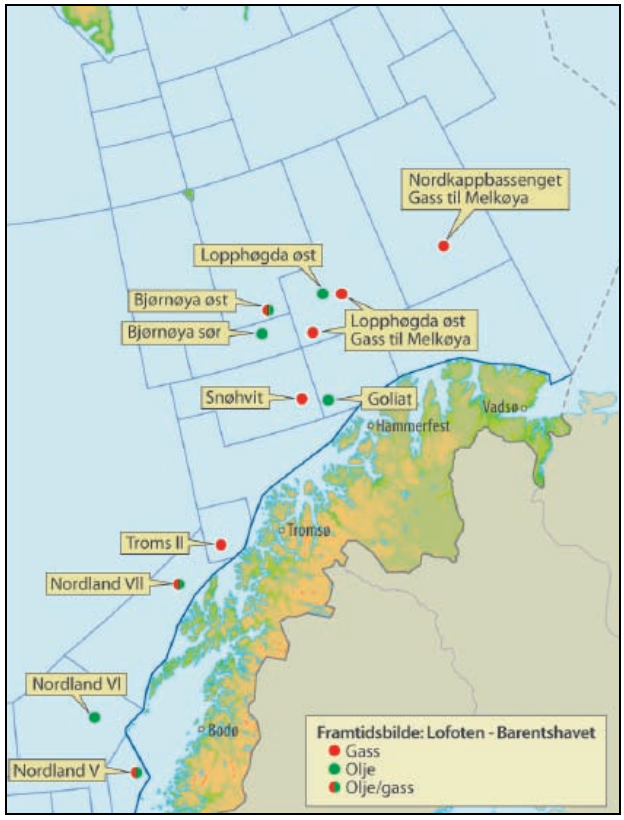

Figure 8.8 2009 Scenario.

Source: Norwegian Petroleum Directorate.

8.4.3 Analysis of spin-off effects in the region

Asplan Viak, in cooperation with the Nordland Research Institute, has carried out a study examining possible spin-off effects associated with potential expanded petroleum activity in the Barents Sea and the northeastern Norwegian Sea[9]. This study shows what spin-off effects various field sizes and development solutions could entail in the north.

The analysis is based on a resource scenario developed by the Norwegian Petroleum Directorate, cf. Figure 8.8. The resource scenario includes the sea area from the coastal zone in the Norwegian Sea up to and including opened areas in the southern part of the Barents Sea. The study has been planned so that it provides a basis for roughly assessing spin-off effects with different

[9] http://www.regjeringen.no/upload/OED/Rapporter/Ringvirkningsanalyse.pdf

resource outcomes. The calculations in the study show estimates for the size of employment effects to be expected when developing fields of varying sizes, with alternative location choices and alternative development solutions. The size of the spin-off effects to be expected depends on how large the discoveries actually are and whether they are commercially viable.

The 2009 prognosis was established to help illustrate what petroleum activity could mean for the area. The study shows the effects of a single field with a unique location, size and development. It contains 18 different fields with an overall resource estimate of nearly 600 million scm o.e. The study shows that development of these fields can provide increased employment in Northern Norway of between 4000 and 6000 full-time equivalents over a period of 30 years.

The expected recoverable resources in the northeastern part of the Norwegian Sea and the Barents Sea are considerably larger than what has been used as a basis in the 2009 prognosis. The NPD's expected value for the entire area is 1 090 million scm o.e. This estimate is uncertain; the resource base could be much larger, but also smaller. The fact that the expected value of the resource estimate is higher than what was used as a basis in the spin-off effect analysis indicates there might be larger spin-off effects.

The petroleum activity is already creating positive spin-off effects in the north. If this is to increase in scope, the industry must establish and develop itself in Northern Norway. New field developments will largely contribute to this, but in the long-term, the activity will be contingent upon more exploration and opening more new areas. A lasting petroleum industry in the north will not only increase employment, but also prevent depopulation. Depending on physical establishment of supplier companies in the region, this will also contribute to increasing expertise and building professional networks. This forms the basis for building a petroleum industry in Northern Norway.

8.4.4 Challenges associated with increased spin-off effects

The number of employees in petroleum-related industries amounts to about 63 000 people in the entire country. In 2008, about 2000 of these were employed in the three northernmost counties. In addition, the activity results in spin-off effects for several adjacent industries. The figures do not include this.

The petroleum industry is a difficult business to become established in, due to strong competition from existing players. There are certain factors that speak for a positive regional development in Northern Norway. The geographical proximity to new fields provides a cost advantage that is particularly important for players that compete for less technologically-advanced assignments. This provides a platform for further development. In order to achieve this, it is important to strengthen educational institutions and technological research environments located in Northern Norway. These must have close ties to other national and global knowledge suppliers. The establishment of oil companies and global service suppliers in the region is important as it facilitates improved contact with and knowledge regarding local industry with central purchasers.

When you look at possible local and regional industry and employment effects of increased petroleum activity, the industrial experience and culture, as well as the competence of the work force in the area, will be important. In Asplan Viak and the Nordland Research Institute's regional spin-off effect analysis, prepared in connection with updating the management plan for the Barents Sea – Lofoten, these elements are assessed for Nordland/Sør-Troms/Midt-Troms and Finnmark/Nord-Troms, respectively.

Industrial experience and culture

The two industrial environments best suited to qualify for and receive larger deliveries are the support industries that are related to the power-intensive process industry in Northern Norway, as well as the maritime industries.

There are substantial differences between these two regions, also as regards utilising opportunities to deliver goods and services to the petroleum sector. The southernmost region has more than twice as many inhabitants as the northernmost. A mapping of the number of employees in companies with head offices in Northern Norway and that deliver to or are in a position to deliver to the petroleum activity, shows that there are 118 companies with a total of 4 500 employees currently in Nordland/Sør-Troms/Midt-Troms. The corresponding numbers in the northernmost region are 36 and barely 500. These numbers include businesses that are currently mainly geared towards other sectors, but that have possibilities for delivering goods/services to the petroleum sector.

Nordland, Sør-Troms and Midt-Troms thus have a broader set of industries and more robust companies than Finnmark and Nord-Troms. The industry in the southernmost region therefore has greater qualifications in order to come into a delivery position in a competitive sector, which is the case here. There are also several strong industry environments that include educational and research institutions in Nordland, Sør-Troms and Midt-Troms which primarily revolve around the larger cities. These environments mean that larger spin-off effects can be expected in the southernmost region.

Companies in several industries are now emphasising expertise building and capacity development in order to position themselves as suppliers. This includes both development of cooperation relationships with the oil companies and company development. Supplier network initiatives have worked well. The initiatives are supported by the policy instrument systems of Innovation Norway, SIVA, and the Research Council of Norway.

Proximity is another important factor in the analyses. Finnmark and Nord-Troms have good locations as regards the activity in the Barents Sea, and can achieve employment connected to the oil and gas sector's operative core activity, as well as to some extent within transport and other related industries. This will mainly be newly established activity that is set up by players who are headquartered elsewhere in Norway, or outside the country's borders.

Another survey carried out in 2007[10] shows the same scenario. It concluded that growth of a specialised supply industry had started in Northern Norway as well. Many of these were established by players further south or bought by these. Northern Norwegian industry consists of small enterprises. During the decades with petroleum activity in Norway, they have not been able to establish themselves as volume producers or specialists in the business. There is little reason, with some notable exceptions, to believe that such local units will succeed solely because the activities move north. In addition, the market is already characterised by highly specialised enterprises that would likely move north with the activities that depend on proximity to the fields. It is also in this segment that the local industry in the north has its biggest chance. There are some small, but successful players in the north that could gain a better foothold due to increased activity in the north. Over time, you can then expect to see increased participation in the supply industry in the north. However, many of the heavy, established environments in the south will still be key in order to further develop the Norwegian supply industry in relation to increased activity in the north.

The study compares the industry in Northern Norway with the industry in Sogn og Fjordane. As is generally known, players in this county have not been as successful as the neighbouring counties in the south and north in acquiring positions in the supply industry that have contributed to employment and value creation in the county.

Expertise

When activity is established to meet demands arising from development and operation of a field, a large share of the local jobs created will require employees with a high level of expertise. The increased activity expected in the northern areas/arctic regions in the years to come will also demand expertise. Northern Norway faces considerable challenges in developing training and education schemes to meet the oil and gas industry's need for expertise.

In order for these jobs to benefit people from or with ties to the local community, the people must possess the right expertise and competence. Oil companies that are active in Northern Norway and the supply industry will face a growing need for personnel with vocational training from the upper secondary school system, as well as engineers. This currently poses a challenge. Moreover, there is no satisfactory program for students who want to pursue higher education within science and engineering subjects in Finnmark county. However, a partial engineering degree can be taken in Alta. The Nordkapp Maritime vocational school offers education in electrical disciplines as well as a maritime vocational school and safety training approved by Veritas.

EnergiCampus Nord – which is collaboration between NTNU (the Norwegian University of Science and Technology), the University of Tromsø, the University of Stavanger and the University Colleges in Finnmark, Narvik and Tromsø – represents an innovative collaboration between various educational institutions, the authorities, and the business and industry community. The objective is to develop technological education in Finnmark county, and thereby facilitate spin-off effects from petroleum development. Another objective is

[10] Regional distribution of employment in Norwegian petroleum-related supplier industry, Eirik Vatne SNF 22/07.

to contribute to utilising the growth stimulus from the petroleum activities to also develop adjacent industries and the public sector. This will take place through a gradual build-up of a course portfolio that can be worked into the curriculum of other institutions, and thus form a foundation for both national and international cooperation.

There is a need for special knowledge and expertise in the increased activity expected in the northern areas and arctic regions in the years to come. Many of the challenges require more research, development and expertise. There is a need for improved geological understanding that can form the basis for new and improved play models. Installation and operation in dark and cold conditions in a unique natural environment place different demands on technological and operative solutions. The same is true of development and production with potentially long distances to land and in areas where there could be drift ice during parts of the year. This is important knowledge acquisition for a long-term development in the Barents Sea and Northern Norway.

Therefore, the Ministry wants to focus on building up expertise and research communities linked to petroleum activity in arctic regions. In this connection, the Ministry will consider establishing a research centre for this purpose, cf. Chapter 8.7. Such a centre could contribute to developing expertise, e.g. through a Master degree program, as well as PhD and post-doctoral fellowships. This expertise will be important for the industry and the research sector, which will need to recruit new researchers and highly competent labour.

We must spark the interest of children and young people in science subjects in order to inspire them to pursue studies in oil and gas subjects. Therefore, a real commitment to science subjects is needed in the primary, lower secondary and upper secondary schools. As part of this effort, companies must also visit schools and inform the pupils about what they do and the opportunities they represent. As regards recruiting, the Ministry also works with the Norwegian Centre for Science Education to boost interest for energy and petroleum among young people in the so-called Energy School Project. Alta and Hammerfest upper secondary schools in Finnmark county are represented in this project.

In 1976, the Storting endorsed the establishment of a Norwegian Petroleum Directorate office in Harstad. The office was subsequently established in 1980 with the purpose of following up production licenses north of 69 degrees, and to conduct HSE supervision in relation to developments and operating fields in the northern areas. As of May 2011, there are ten employees assigned to the Harstad office. These personnel are closely integrated with the organisation at the NPD's office in Stavanger to ensure the best possible utilisation of the Directorate's professional capacity. The office has a solid staff of geological experts and the employees primarily work with production licenses associated with the Barents Sea and the Norwegian Sea. The NPD's goal is to gradually increase capacity at the Harstad office from May 2011, in line with the general growth in the industry.

The Government will:

- Facilitate additional discoveries outside Northern Norway by:
  - Implementing annual APA licensing rounds in mature areas.
  - Implement numbered licensing rounds; normally every other year.
  - Initiate an impact assessment pursuant to the Petroleum Act with the objective of awarding production licenses in the previously disputed area west of the delimitation line in the Barents Sea South, when the agreement with Russia on maritime delimitation and cooperation in the Barents Sea and the Arctic Ocean enters into force.
  - Initiate data acquisition in the previously disputed area west of the delimitation line in the Barents Sea South, when the agreement with Russia on maritime delimitation and cooperation in the Barents Sea and the Arctic Ocean enters into force.
  - Facilitate new petroleum activity in the area from 35–50 km from the baseline along the coast from Troms II to the border with Russia and in Eggakanten by including these areas in future licensing rounds.
- When large new commercial discoveries are made on the Norwegian Shelf:
  - Ensure that new discoveries create the greatest possible values for society, and facilitate positive local and regional spin-off effects.
  - Ensure early contact between the operator and local/regional business and industry and the authorities.
  - Stipulate requirements for assessment of societal aspects in connection with plans for development and operation, including regional and local spin-off effects.

Box 8.6 Some important international markets

Brazil's petroleum production is growing rapidly

The large discoveries made on the Brazilian shelf in recent years have made this an attractive market for the petroleum industry. The Norwegian petroleum industry and maritime sector, with their technology, expertise and experience from the Norwegian Shelf, are well-positioned for assignments in this market. Many companies have already secured major contracts in Brazil. Statoil will start production on the Peregrino field in 2011. The challenges associated with development of resources in deep water and under deep layers of salt mean that Brazil could be a research laboratory for tomorrow's technology. The industry considers Brazil to be one of the highest prioritised offshore markets in the years to come.

Australia – subsea market experiencing strong growth

Recent years have seen increasing drilling activity in Australia, in deeper and deeper waters, particularly on the northwest coast. Major discoveries have been made and several fields are under development. The offshore market in Australia is very interesting for the Norwegian supply industry because the developments that are located far from land require e.g. advanced multiphase technology and subsea solutions. Australia's considerable gas reserves also mean that LNG technology is in demand. Many Norwegian-based companies have expertise in these technologies. Australia is expected to develop into the world's largest subsea market in the next few years.

Houston and the US sector of the Gulf of Mexico (US GoM)

Houston is an international hub for the global oil and gas industry. Only the Norwegian Shelf comprises a larger offshore market than US GoM. At the same time, many of the largest oil and supplier companies carry out their international projects with Houston as their base. About 140 Norwegian oil and gas-related companies are established in Houston, and it is estimated that about 7000 Norwegians live there, most of them affiliated with the oil and gas activities. The supply industry's annual sales in this market are around NOK 10 billion, a large portion of which are generated through subsidiaries. Together with Statoil's commitment to the deepwater areas in US GoM, this makes the US and Houston the largest foreign market for direct Norwegian investments in the oil and gas sector.

The Norwegian supply industry has often built up a local presence in countries that require national content. Local presence is essential to compete for assignments in national maintenance and modification markets, which are a growth sector. To contribute to this process, INTSOK has established dedicated programs where Norwegian suppliers are offered local business counselling in foreign markets.

- Facilitate qualification of relevant local/regional suppliers in the development and operations phase.
- Facilitate establishment of tendering processes in connection with new developments that allow participation by companies from the region where the development will take place.
- Ensure an efficient base and operations structure, which contributes to local and regional development of business and expertise.
- No later than two years after the field starts producing, operators of new independent developments must conduct an analysis of regional and local spin-off effects from the development.

- Consider establishing a research centre devoted to challenges faced by petroleum activities in arctic regions, based on open competition.
- Gradually build up capacity at the Norwegian Petroleum Directorate's office in Harstad.

8.5 International success for the industry

The internationalisation of the Norwegian supply industry has accelerated over the last decade. The

strong international position achieved by some Norwegian supply communities is a direct result of the need to develop and apply new technology on the Norwegian Shelf. The interaction between the oil companies on the Norwegian Shelf, the Norwegian and international supply industry and the research communities has yielded good results.

A high and stabile activity level on the Norwegian Shelf is important to ensure that international oil companies and supplier firms retain a presence in Norway. This is important because these companies need goods and services from supplier firms and research communities in Norway. They contribute capital and knowledge for research and development of technology. At the same time, it is important for the Norwegian supply industry to be able to serve international markets. Through internationalisation, Norwegian companies will acquire new experience and knowledge from other petroleum provinces, which in turn provides a basis for innovation and more efficient oil and gas production on the Norwegian Continental Shelf. For many companies, access to markets in other countries provides an opportunity to grow and diversify commercial risk.

The Norwegian supply industry is primarily oriented towards the offshore markets, but also has deliveries to petroleum activities on land, particularly in the Middle East. From 1995 to 2009, the Norwegian supply industry has more than quintupled its international sales. In recent years, growth has been greatest in China, Southeast Asia and Australia. Currently, the fastest-growing market is in Brazil.

Norwegian companies serve the international markets both through exports and dedicated establishment of businesses abroad. The 2009 exports of petroleum-related goods and services amounted to about NOK 80 billion, while sales through foreign subsidiaries abroad were NOK 38 billion, which yields total foreign sales of NOK 118 billion[11].

The Norwegian Shelf will be among the largest offshore markets in the years to come. Together with the United Kingdom, the North Sea Basin is still a power centre for the oil and gas industry. This provides a good starting point for maintaining an internationally competitive supply industry in Norway.

A number of countries are attempting to develop a national industry. Several of them have not entered into binding agreements on international trade and investment, which means that Norwegian suppliers encounter demands regarding local content. This entails that the industry must compete under terms that favour domestic industry, or firms from places where bilateral trade and investment agreements exist. Therefore, it is important to work to ensure that the Norwegian oil and gas industry can compete for market access under predictable and equal terms with their competitors. This is done in part through WTO, as well as entering into free trade agreements with key trade partners.

8.5.1 INTSOK

INTSOK is a foundation established by the authorities and the industry in 1997. INTSOK's goal is to strengthen the long-term basis for value creation and employment in the Norwegian petroleum industry through focused international activity. INTSOK markets the Norwegian oil and gas industry in selected areas. The main markets are Australia, Brazil, China, Russia, the UK and the US sector of the Gulf of Mexico. INTSOK also directs its efforts to areas of technology where the Norwegian petroleum sector has cutting-edge expertise. Two of the main commitment areas are enhanced oil recovery and technology to reduce environmental and climate effects of oil and gas production.

Analyses show that internationalisation has been important for regional industry development and employment, and INTSOK makes an active contribution to this. Small and medium-sized companies derive particular benefit from interaction with larger companies, research communities and the authorities when they are working to gain a foothold in new markets abroad. Of INTSOK's approximately 200 member companies, 80 per cent are small and medium-sized businesses. INTSOK has 13 local advisors in the most important markets for the industry. INTSOK cooperates with Innovation Norway and the various outposts.

National oil companies control a large percentage of the world's oil and gas resources. These companies have increasingly opted to cooperate with the international supply industry to optimise resource utilisation. Previously, the major international oil companies were the preferred partners. This means that the Norwegian supply industry to a greater extent than previously has customers whose decision processes may be political in nature. The interaction with Norwegian authorities and INTSOK has thus become even more

[11] Source: Menon Economics

important in order to achieve access to relevant decision-makers.

The Government will:

- Together with INTSOK, contribute to Norwegian-based enterprises winning work and contracts also outside the Norwegian Shelf.
- Work to strengthen the Norwegian oil and gas industry's access to international markets, and ensure that the industry can compete on equal terms with its competitors.

8.5.2 Northern Russia – a new opportunity for Norwegian business and industry

It is expected that a significant portion of the world's undiscovered oil and gas resources will be found in the Arctic regions. Russia has defined Norway as its strategic petroleum partner in the north, and Norway can become an important mainstay as a supplier of expertise to the petroleum activities in the northern areas, and as a teammate in joint projects.

One of the clear objectives of the Government's strategy for the northern areas has been to find a solution to the border issue with Russia. In September 2010, Norway and Russia signed an agreement regarding delimitation and cooperation in the Barents Sea and the Arctic Sea, following 40 years of negotiations.

Our relationship with Russia, as neighbour and the nation with which we share the Barents Sea, is key in our northern areas policy. Several of the challenges in the northern areas, including as regards the environment and resource management, cannot be solved without Russian involvement and Norwegian-Russian cooperation. The Government assumes that Norwegian policies vis-à-vis Russia must be pragmatic and based on common interests and cooperation.

Norway has a good energy dialogue with Russia, and the dialogue regarding the northern areas is the mainstay in our energy cooperation. Ensuring political stability and sustainable development are the Government's primary goals for its northern area policy, and it is important that Norway exhibits a single, unified policy: presence and enforcement.

Development of the petroleum resources on the Russian side of the Barents Sea, and the role Norwegian enterprises can play in the offshore development in Northwest Russia could be significant for vitalisation of Northern Norwegian business and industry. Norwegian suppliers are well-regarded, with their high-tech expertise and broad-based experience from demanding conditions on the Norwegian Shelf. A petroleum industry with strong expertise in Northern Norway, proximity to the Russian market, along with experience and well-adapted technology, will represent a competitive advantage for Norwegian suppliers.

The work done by the supplier networks and industry associations to reinforce the ability of local companies to prequalify for participation in complex tender processes is important in order to promote participation by Norwegian companies in Russian petroleum activities. Statoil is already involved in the Shtokman development in the Barents Sea. Participation in the project could give Statoil a good foundation for further commitments in arctic regions, and entails a substantial opportunity for northern Norwegian business and industry.

In 2006, the Government launched the Barents 2020 grant scheme. The purpose of the scheme, managed by the Ministry of Foreign Affairs, is to realise the Government's northern areas strategy (2006) and the action plan "New building stones in the north" (2009) by stimulating increased activity, knowledge and presence in the north. Grants have already been provided to a number of projects that produce knowledge in, on and for the northern areas. Barents 2020 will also stimulate the establishment of arenas for cooperation with Norwegian and foreign groups with northern area expertise in relevant disciplines such as Norwegian-Russian energy cooperation.

The Government will:

- Conduct an active energy dialogue with Russia
- Stimulate increased cooperation with Russia as a consequence of the agreement on maritime delimitation and cooperation in the Barents Sea and the Arctic Sea.
- Facilitate partnerships between Russian and Norwegian companies, e.g. through INTSOK and Innovation Norway.

8.6 Industrial use of gas in Norway – framework and possibilities

Norway has a good starting point for developing gas-based industry. We have significant oil and gas resources on the Norwegian Shelf, and most of this gas is brought to land for processing prior to export. Therefore, there are large volumes of gas available for petrochemical activities in Nor-

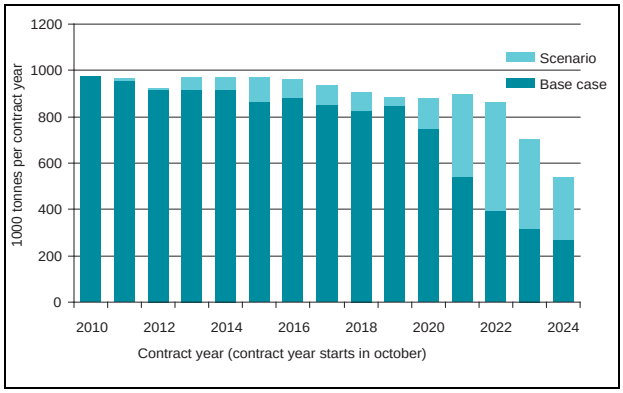

Figure 8.9 Estimated ethane production, base case and scenario volume.

Source: Gassco.

way. Furthermore, we have a well-established petrochemical industry, mainly at Rafnes and on the Herøya peninsula in Telemark county, as well as at Tjeldbergodden.

Industrial application of gas in the domestic market must be viewed in context with international development trends for the petrochemical industry. The sector has undergone significant consolidation in the last ten years, and the producers have moved production closer to the customer (mainly Asia), or where inexpensive raw materials have been available (mainly the Middle East). While the trend shows that many major new petrochemical plants will be built in the Middle East and Asia in the years to come, a very large percentage of the global petrochemical activity will still be in Europe. Substantial sums have been invested in the capacity that has been built up in Europe. Management of these assets comprises enormous values. Steadily increasing competition from other parts of the world means that Norwegian and European activities must continue to ensure efficient operation and continuously evaluate various upgrades and improvements that are necessary to address the global competition.

Division between dry gas and natural gas liquids

There is an important division between dry gas (methane) and natural gas liquids (ethane, propane, butane). Norwegian pipeline exports to Europe mainly consist of dry gas, but also contain heavier components. The lightest part of the gas; methane, is mainly used for energy for heating, or for power plants, but also functions as a raw material for production of methanol and ammonia. The price of gas for dry gas-based industry is in direct competition with alternative application of the dry gas, either through pipeline export, LNG or conversion technology as gas-to-liquid (GTL) or other domestic use.

Ethane is the most important raw material for NGL-based industry. Ethane that is not sold with the dry gas is mainly used as a raw material in the petrochemical industry, primarily in the production of ethylene. Ethane must be separated from the gas produced in the oil and gas fields, which requires significant investments in separation plants. These plants require large volumes of gas in order to produce the amount of ethane necessary for a modern processing plant (a so-called "cracker"). All gas exported as LNG or via pipelines will contain some ethane, as this is necessary for maintaining properties such as calorific value and ignition quality.

Generally speaking, ethane transport by ship only takes place in Norway and the North Sea. Ethane is processed at the separation site (where the ethane is separated from the rich gas) at all other petrochemical plants. The end price of ethane at various locations will be a function of many factors, the most important of which are the degree to which ethane is actually available in sufficient amounts over time, how much gas is exported and to which destinations, as well as whether the seller of ethane is willing to subsidise the price to ensure petrochemical investments.

8.6.1 Natural gas liquids (NGLs)

Required ethane needs for establishing NGL-based industry

Ethane-based petrochemical industry requires large volumes of gas. For example, Ineos' ethylene plant at Rafnes uses around 500 000 tonnes of ethane per year. An annual gas production of more than 10 billion scm is necessary to cover such a need for ethane[12]. This is approximately equivalent to the annual gas volume transported in the Åsgard transport pipeline, or around 10 per cent of Norway's total gas export in 2010. Modern new ethylene plants are constructed with double the production capacity, and that need twice as much ethane as the Rafnes plant.

Potential for ethane production on the Norwegian Continental Shelf

In Norway, ethane is only produced at Kårstø, where the annual production amounts to approx.

[12] Assuming that 2.5 per cent ethane remains in the sales gas

0.9 million tonnes. The amount of ethane exported in Norwegian natural gas amounts to a significantly higher volume. Around 100 billion scm of dry gas was exported in the 2009 calendar year. This gas contained about 7.7 million tonnes of ethane, of which 4 million tonnes has been onshore at either Kårstø or Kollsnes.

More ethane can be separated from Norwegian gas than is currently done. Assuming that all dry gas from the Norwegian Shelf must, on average, contain some (around 2.5 mol per cent) ethane for export, and assuming current gas export volumes, there is still a theoretical opportunity to separate around 4.4 million tonnes of ethane from the gas each year[13]. For example, it could be possible to separate 1.3 million tonnes of ethane per year from Europipe II at Kårstø, assuming that about 3.0 mol per cent ethane is retained in the gas to be exported.

Unless new, very large rich gas fields are discovered on the Norwegian Shelf, this means that assessments of new or expanded ethane production should be based on utilising ethane from the existing receiving terminals at Kårstø and Kollsnes. The potential for ethane production at Nyhamna appears to be limited. The volumes at Tjeldbergodden are negligible.

Today's ethane production takes place at Kårstø. Gassco has estimated expected future ethane production from the facility, cf. Figure 8.9. The estimate is divided between base case volume (volumes from fields that are currently producing, or where a development decision has been made) and scenario volume (volumes that are under development, but where no development decision has been made). The estimate shows that expected ethane production will fall rapidly if new gas volumes are not added. The current production level cannot be maintained for longer than a period of ten-twelve years, unless new ethane-rich gas is supplied to the Kårstø plant. Profitable long-term production of oil and gas will therefore be important in order to maintain stabile ethane production at Kårstø.

[13] Some ethane must be left in the dry gas that is exported in order to meet the calorific value specifications agreed with the dry gas buyers. To meet the calorific value and other requirements in the gas sales agreements, the gas must contain between 2 to 3 mol per cent ethane, depending on the other components in the gas, e.g. how much CO_2 the gas contains.

8.6.2 Dry gas

Around 75 per cent of the gas exported from the shelf is brought to land in Norway, at Kårstø, Kollsnes and Tjeldbergodden, for treatment prior to export.

Industry based on dry gas uses little gas compared with the gas volumes that are exported. For example, the methanol plant at Tjeldbergodden, which is Europe's largest methanol plant, uses a gas volume of about 0.7 billion scm per year. If Yara's ammonia production in Grenland used exclusively dry gas, it would have an annual gas need estimated at 0.5 billion scm per year.

Norway has a well-developed gas infrastructure that enables export to the European gas market. The alternative value of the gas is to sell it in this market. Industrial use of gas in Norway must therefore be profitable with market-based gas purchase agreements. Profitability is a major challenge for dry gas-based activity in Norway.

8.6.3 Assessments

The Ministry is of the opinion that the greatest possibility of available dry gas volumes and natural gas liquids components such as ethane in the years to come can be found at the current gas processing locations in Norway. The value of this gas will be based on prices that Norwegian gas producers can achieve in the European market. Opportunities for other new types of gas-based industry that are related to existing industry, such as the mineral and metals industry, can be located where the gas is already brought to land.

Further development and upgrades of existing facilities generally yield better economy than new establishments, as one can benefit from existing infrastructure and expertise. A further development of the dry gas-based methanol production at Tjeldbergodden is not restricted by access to natural gas. For a further development of the petrochemical industry in Grenland, more ethane can be made available by investing in increased separation at some of the landing sites, or transporting the gas to Grenland and separating the ethane there.

Locations that have no existing gas processing capacity and industry infrastructure may seem attractive, as a potential lack of export alternatives can make the gas price more competitive in relation to other, more mature areas with developed export alternatives. However, industry activity based on NGL at completely new locations will be restricted by gas volumes, unless new gas fields

are discovered that are much larger and richer in ethane than what the authorities currently believe is likely. The establishment of conventional dry gas-based industry will be demanding because the need for gas will not normally be great enough to warrant the development of new gas fields. New development and potential landing of gas will generally demand such huge gas volumes that an export solution would be necessary. With an available export solution, much of the reasoning for considering industrial development in other locations than where industrial production already takes place will disappear.

To ensure good framework conditions for further development of gas-based industry in Norway, the Government believes it is important to ensure the availability of sufficient gas over time at existing and/or new landing facilities in Norway. Long-term access to gas can best be achieved through proving and developing expected remaining gas resources, and ensuring that Norwegian processing plants are operated as efficiently as possible, so that they emerge as the best alternative when selecting future gas evacuation solutions.

The Government's assessments are based on the industry developing in an environmentally friendly direction, and within the framework of Norwegian climate policy. This applies with regard to production in the most environmentally friendly manner possible, efficient logistics and eco-friendly products. Development of infrastructure may be necessary in order to increase industrial use of gas in Norway. Any such projects must be market-based and driven by commercial interests.

The Ministry has bolstered the independent operator Gassco's mandate for evaluating comprehensive gas infrastructure solutions, which will now also include responsibility for informing relevant industry players at an early stage in the planning process. Furthermore, at the request of the Ministry, Gassco established an arena in 2009 where industry players with desires or plans to establish industrial activity linked to application of natural gas can consult with expert environments in the fields of gas transport, gas quality and gas availability in Norway.

The arena was formed on the basis of the current situation wherein, to a large extent, the same companies do not operate oil and gas activities (upstream activity) and industrial activity (downstream activity). In order for industrial companies to consider opportunities in Norway, it is important that access to information related to current gas production, gas composition, etc. is available. It is particularly important that the companies are informed about the development projects underway at any given time on the Norwegian Shelf. Opportunities and challenges related to industrial use of gas in Norway can be discussed in this arena. Two meetings were held in the industry arena context in 2009, and petrochemical analyses were a key topic in these meetings. In cooperation with gas and industry players in Norway, as well as IndustriEnergi (employee organisation) and Norsk Industri (employers' organisation), petrochemical analyses were presented and debated. One meeting was held in 2010, focusing on the sector's joint CO_2 challenges.

In 2011, Gassco's plans include conducting a study of development scenarios for gas infrastructure in the northern areas, including opportunities for industrial use of gas. The study will be partially financed by the industry arena, with input from arena participants. Through the industry arena, Gassco believes it has succeeded in creating a meeting place that is relevant for both upstream and downstream players. Gassco reports good attendance at all meetings and positive feedback. The Ministry believes it is useful to have a forum where ideas, concepts and concrete projects can be identified, analysed and discussed in order to achieve the objective of continuing and hopefully increasing investments in Norwegian gas-based industry.

The Government will:

- Facilitate increased industrial use of gas in Norway, including contributing to the industry arena as a meeting place for industrial players and oil companies.

8.7 Technology, research and expertise

The Norwegian Shelf has been characterised by major investments in new field developments. Technological development was necessary in order to make production profitable and technically feasible. Innovation has taken place in stages as the operating companies have encountered new challenges. Technological breakthroughs from the concrete structures of the 1970s to floating production facilities and subsea solutions, to horizontal drilling and multiphase transport, have taken place in an interplay between oil companies, research institutions and the supply industry. Many factors have driven this technological devel-

Box 8.7 Marine Technology Centre

Norway has top expertise within research, technology and innovation connected to the ocean. Water covers nearly 70 per cent of the earth's surface. An important element in order to operate a sustainable management and harvesting of the ocean is development of modern ocean technology.

An important Norwegian environment in the area is in Trondheim. Through establishment of experimental infrastructure in the research environments at the Marine Technology Centre in Trondheim, MARINTEK and the Norwegian University of Science and Technology have become international leaders within their fields. Upgrades are important for such research environments to be able to offer their customers, e.g. within the petroleum industry, attractive research services. This is the reason why the Government has, along with industry and technical environments, financed a pre-study which maps the need for upgrades of the research infrastructure at the Marine Technology Centre. The environments in Trondheim are working on realising a future knowledge centre connected to ocean technology in the city, the Ocean Space Centre.

opment. Large discoveries with good profitability have given the companies the financial muscle to develop new solutions. Favourable framework conditions from the authorities have given the companies incentives to do drive research and development. Development and first use of technology on the Norwegian Shelf have been important in the development of a globally competitive supply industry.

New methods, knowledge and technology will be important in finding more resources in the frontier areas on the Norwegian Shelf. New and improved methods for geophysical acquisition, processing and interpretation will yield more efficient exploration and help uncover new resources. For example, being able to "see" what lies under volcanic basalt layers on the Vøring plateau in the central part of the Norwegian Shelf poses quite a challenge, as does the identification of deeper, more complex reservoirs. Improved geological knowledge and interpretation are important in the development of new play models. Development of discoveries far from infrastructure will require new concepts for subsea systems and multiphase transport over considerable distances. High rig rates also pose a challenge for the industry, and the development of new drilling concepts is an important factor in reducing exploration costs.

As regards the mature areas on the Norwegian Shelf, a substantial commitment is necessary in order to improve recovery from existing fields. With the current plans, about half of the oil will be left in the ground. This represents a huge value potential. A single percentage point increase in the recovery rate on the Norwegian Shelf for fields currently in operation would boost oil production by about 570 million barrels, or about one year's production at today's level. However, this is urgent – new technology must be in place well before the fields are shut down and the installations removed. Advanced injection methods must be refined and tested on the fields in order to improve recovery. Faster, better reservoir modelling tools can provide better understanding of the reservoirs, and thus better resource exploitation. Together with new geophysical methods, this can allow us to place wells more accurately and contribute to optimise production. New drilling and intervention methods can contribute to more cost-effective production, and constitute an important measure in increasing recovery.

The oil and gas resources must be developed and produced in a manner that is as clean and energy-efficient as possible. This requires development of methods and technology for maximum efficiency in energy use and reduced greenhouse gas emissions, with less flaring and power generation.

The driving forces for development of new technology are the same as previously when the major field developments helped finance a number of major technology development projects. Today's situation with many small discoveries and developments makes financing new technology more demanding. Maintaining and reinforcing the impetus towards developing new technology is important if we are to achieve our petroleum policy objectives. The players on the Norwegian Shelf and the State as resource owner must therefore work together to find good solutions. A continued commitment to research, development and expertise is an important prerequisite for a competitive and future-oriented petroleum industry. The expertise developed in connection with petro-

leum activity can also be utilised in other areas, such as ICT and offshore wind power.

Oil companies and supplier firms are responsible for a significant research effort in Norway, but this research is largely aimed at short-term objectives and technologies. The public commitment contributes to promote cooperation, expertise and a long-term perspective in petroleum research, as well as to support high-risk projects.

8.7.1 Priorities within research and development

Good cooperation between industry and authorities has been important for research and development on the Norwegian Shelf. The industry is and must be an initiator, while the authorities play an important role by creating framework conditions and incentives that stimulate research and development (R&D) which will benefit the entire society. The public means are therefore directed at research and development in selected areas where the industry's efforts are not sufficient. Publicly financed research and development will contribute to trigger socio-economically profitable projects that would not otherwise have been carried out.

The authorities are dependent on advice and input for the prioritisations of the means for research and development. The Ministry e.g. has a running dialogue with the Norwegian Petroleum Directorate, the Research Council of Norway, OG21 and several industry and research players regarding such priorities.

National R&D strategy for the sector and other priorities

OG21 – oil and gas for the 21st century, is a national R&D strategy for the petroleum sector. The work with the strategy started in 2001, and was revised in 2010. The board and technology groups under OG21 represent a network of over 100 experts from the oil companies, supply industry and research environments that prepare substrategies and action plans. This work uncovers knowledge gaps and maps challenges that will be faced by the sector in the future. The Ministry takes a basis in the OG21 strategy when new guidelines are made for the PETROMAKS and DEMO2000 programs in the Research Council of Norway.

The strategy points out that the authorities have a special responsibility to maintain financing of the long-term research, and that public support should be directed at education, basic research, expertise development and long-term technology development. Short-term challenges will to a greater extent be the industry's responsibility.

The strategy has established so-called TTA groups (Technology Target Area) that are composed of a wide selection of experts and focuses on the following topics:

- Energy efficiency and environmentally-friendly, sustainable technology
- Exploration and improved recovery
- Cost-effective drilling and intervention
- Future technology production, processing and transport.

OG21 recommends that public financing of petroleum research should prioritise the following thematic areas:

- Energy-efficient technology to reduce emissions to air and discharges to sea. As regards emissions of greenhouse gases to air, this has been followed up through the agreement on the climate report between the coalition government parties and the Conservative Party, the Christian Democratic Party and the Liberal Party on 18 January 2008 (the Climate Compromise) which states that government-financed petroleum research must have a significant focus on climate issues. Through the Climate Compromise, starting from 2009, NOK 25 million per year will be earmarked for research aimed at energy efficiency and reducing greenhouse gas emissions linked with oil and gas production on the Norwegian Shelf.
- Improved oil recovery solutions and services designed to maximise the recovery rate from mature fields during the lifetime of the infrastructure. An important area will be developing drilling technology to reduce costs and environmental impact. The Åm Commission has also been mentioned, with its recommendation that public research programs in petroleum topics should prioritise improved recovery. The Commission particularly emphasises the need for further technological development within specific areas such as drilling and wells, reservoir mapping and advanced injection techniques. The Ministry has followed up these recommendations in its management of the Research Council of Norway through the 2011 allocation letter.
- Stimulate development of advanced subsea systems to maximise value creation at Norwegian offshore installations, as well as develop technology for subsea multiphase transport over considerable distances. New subsea tech-

nology can reduce the costs of new developments and contribute to developing resources located far from infrastructure, for example in the Arctic.

Cooperation with leading international research communities can help contribute to new knowledge and internationalisation of Norwegian technology. International cooperation is also important to ensure quality and strengthen Norwegian expert milieus in the international research arena. However, with the major technological challenges we face on the Norwegian Shelf today, it is essential that public funding goes to support projects that contribute to cost-effective and sustainable production of the petroleum resources on the Norwegian Shelf.

There will also be a need for a further commitment to HSE research in the petroleum activities in the years to come. It is also important that safety challenges are integrated and taken into account in connection with the strategic selection of future technology and development. OG21 will be a natural arena for this work.

Piloting

New technology and new solutions will be essential in maturing profitable new reserves and realising the considerable potential that lies in improved recovery on the Norwegian Shelf. The Norwegian State as resource owner plays an important role as initiator and facilitator to ensure optimal and efficient production of the petroleum resources on the Norwegian Shelf.

State co-funding of pilots can contribute to accelerating and realising more socio-economically profitable projects. There can often be significant transfer value from a pilot on one field to other fields. The owners of an individual field will not take this into account when they decide whether or not to implement a pilot. Substantial values are at stake here for the State as resource owner. If the market itself is not able to bring forth sufficient new technology or pilots, the authorities should initiate various measures.

Like the expert committee on improved recovery, cf. Chapter 4.5, OG21 recommends a greater commitment to piloting new technology. The strategy particularly highlights the need to ease risk and uncertainty for small and medium-sized companies. DEMO2000 will be an important policy instrument for the development of smaller prototypes and qualification of technology for the supplier firms, in cooperation with the oil companies.

Through FORCE, the NPD has taken the initiative to help bring forth more pilots on the Norwegian Shelf, as well as work to reinforce existing policy instruments such as DEMO2000. The Ministry also sees a need for mapping other potential measures, e.g. as proposed by the expert committee and OG21, to achieve more piloting on the Norwegian Shelf.

Petroleum research centres

The Research Council of Norway has established a number of Norwegian Centres of Excellence (COE) and Centres for Research-based Innovation (CRI), several of which are relevant for petroleum. NIFU (the Nordic Institute for Studies in Innovation, Research and Education) has evaluated the COE scheme as very positive, with particular mention that the centres have been especially successful in promoting recruiting and internationalisation. The scheme has also contributed to more national and international interdisciplinary cooperation.

A majority of the expert committee on improved recovery has suggested establishing a centre devoted to improved recovery. The committee points out that improved recovery measures will require more personnel and expertise, and that strong university and research communities are crucial in facilitating this effort. Such centers can also be important ways of gathering expertise and coordinating further research.

The Ministry will consider establishment of a research centre for improved recovery, but this must be viewed in context with other research centres in petroleum subjects. A significant portion of the remaining resources consist of immobile oil. A key challenge for such a centre could be researching and developing advanced recovery methods that enable profitable exploitation of the immobile oil on the Norwegian Shelf. Through such a research centre, we can build up and refine fundamental expertise and research in an important area.

The petroleum activity in the north will be demanding, requiring new knowledge and technology in connection with the activity we expect to see in the northern areas/arctic areas in the years to come. Installations and operations in dark and cold conditions in a unique natural environment place different demands on technological and operative solutions, as do development and production with potentially long distances to land and in areas where drift ice could be present during parts of the year. The potential for new discover-

Box 8.8 Research and exploration activity

New and improved geological knowledge and understanding of the Barents Sea will be crucial in order to make accurate and sound exploration models. In the PETROMAKS program, several projects are supported to improve petroleum geology understanding in the Barents Sea. These projects have received full support with about NOK 80 million from the program.

The PETROBAR project at the University of Oslo is one of these projects. The main objective of the project has been to increase understanding of the fundamental, large-scale processes that control the formation and development of sediment basins in the Barents Sea area, and how they impact the petroleum system. The new, partially quantitative understanding of basin development and the petroleum system will be utilised by the industry to reduce the exploration uncertainty in the Barents Sea, an area which offers many complex challenges. One of the research challenges in the Barents Sea is understanding the effects from the last ice ages, when the Barents Sea was elevated and lowered. During periods with elevation, several kilometre-thick layers of sediments were scraped off. The gas expanded and oil was forced out of the reservoirs.

The Ministry will evaluate the public support schemes within petroleum research in connection with the expiry of PETROMAKS in 2013, including to what degree the public funds trigger research and development in the industry and contribute to elevate expertise.

ies in the northern areas is considerable, but the geological uncertainties are significant. Better geological models and understanding will be important for more accurate exploration. These challenges require particular attention from the public authorities. An assessment will therefore be made of whether a research and expertise centre should be established with focus on research challenges for petroleum activity in arctic areas.

8.7.2 Incentives and financing of research and development

The State mainly provides incentives to research and technology development through the regulatory framework and direct allocations to the Research Council of Norway. Oil companies and supplier companies use considerable means for research and technology development. The total level of both publicly and privately financed petroleum research in Norway was about NOK 4 billion in 2007 according to Statistics Norway and NIFU STEP. For comparison, the public allocations channelled through the Research Council of Norway amounted to NOK 410 million. In addition, the basic allocations and other long-term financing to universities, colleges and research institutions are important in order to maintain the research activity within petroleum in Norway. There are no overviews of how much of this is allocated to petroleum research. A considerable percentage of the funding for research and development within petroleum originates from the oil companies and supplier companies. The public funds must therefore prioritise research and development in certain areas where the industry's own efforts are not sufficient.

The State assumes a great deal of risks and costs associated with large technology projects through a high tax rate and the SDFI ownership interests. Several large technology development projects are currently financed in the production licenses' budgets, such as Ormen Lange gas compression. This project alone has a budget totalling NOK 4.5-5 billion.

Research and development through the production licenses' accounting agreements is also facilitated. The majority of the oil companies' R&D funds are triggered through the accounting agreements. The accounting agreements are part of the licensing scheme, and the operator charges R&D expenses over the production license's accounts through these agreements. The expenses are covered over the production license's joint account, and are determined by various percentages for exploration, development and operation costs with an upper limit[14]. It must be documented that the funds will be allocated to R&D relevant to the Norwegian Shelf.

The Tax Deduction Scheme also promotes petroleum research. The scheme was launched in 2002 and is an R&D effort in industry. The

[14] For example, the operator can charge the production license for R&D costs equal to 2.5 per cent of the exploration costs, up to NOK 7.5 million.

Box 8.9 Creating interest in energy in upper secondary schools

The geo-technical students at St. Olav Upper Secondary school in Stavanger were invited to cooperate with ExxonMobil during the 2009-2010 school year. The students visited ExxonMobil and got to know the company and employees. They were introduced to the Jotun oil field and what methods are used by geologists to examine the field. Seismic Chapters of the field were handed out, and their task involved performing an analysis of the field. The students then returned to ExxonMobil and recommended where they should drill for oil. The students worked on the analysis for three months. They learned how to interpret seismic, what geologic conditions are needed to form oil, and where it is most profitable to drill in the field.

scheme applies to all companies liable for tax in Norway. It is administered by the Research Council of Norway in cooperation with Innovation Norway and the Norwegian Tax Administration. The tax deduction scheme had 381 active projects within the petroleum sector in 2010. The total budgeted volume was NOK 1 288 million and the expected tax deduction was NOK 211 million.

The publicly financed petroleum research over the State budget was about NOK 400 million in 2011. These allocations are followed up by the Research Council of Norway, e.g. through the PETROMAKS and DEMO2000 research programs. Each year, both programs contain a large amount of high-quality projects worthy of support. Due to limited available funds, a large number of projects that should receive support do not. For example, only 17 per cent of the projects received funding commitments from PETROMAKS in the announcement during the autumn of 2010. The Government therefore wants to ensure good conditions for the petroleum research, cf. Storting White Paper No. 30 (2008-2009) Research Climate (the Research White Paper).

8.7.3 Organisation of the public petroleum research

The authorities' priorities and efforts within petroleum research are followed-up by the Research Council of Norway through several policy instruments.

PETROMAKS supports a wide spectrum of projects, from strategic basic research at the universities via expertise building at the institutes to innovation projects in the industry. The objective of the program is an optimal utilisation of petroleum resources and increased value creation for society through strengthened knowledge development, industry development and international competitiveness. Since 2003, about NOK 2 billion has been allocated to 335 projects. This has triggered NOK 2.1 billion in other financing, mainly from the industry. PETROMAKS is an important policy instrument to promote long-term research and expertise development. The program finances research-oriented education, and since its start in 2003, the program has financed 291 fellowships and 136 postdoctoral positions. This is a very high number compared with similar positions supported by the oil companies and shows the significance of the public funds for long-term and basic research.

DEMO2000 is an important policy tool to qualify new technology solutions in the petroleum industry. The program' goal is to reduce costs and risks for the industry by providing support to pilot projects and demonstration. Since its start in 1999, DEMO2000 has supported 231 pilot projects. The total costs of these projects are NOK 2.7 billion, of which the authorities have contributed NOK 600 million. The program is directed at the supply industry, which does not have the same regulatory incentives to develop new technology as the oil companies. DEMO2000 also functions as a cooperative arena between oil companies, authorities and supplier companies.

PROOFNY – a subprogram under the Oceans and Coastal Areas R&D program, is directed at research on long-term effects on the sea from petroleum activities. The program's main objective is to promote high quality research on the marine environment.

PETROSAM supports sociological petroleum research, and will further develop expertise regarding societal factors as a basis for strategy and policy planning by Norwegian authorities and industry. The technical objective is increased knowledge concerning the value and management of Norwegian petroleum resources, as well as development trends in other petroleum provinces.

Strategic petroleum research mainly goes to strategic university programs (SUPs). The goal for the funds is to contribute to educating researchers at Norwegian universities and expertise development within key topics in the petro-

leum area. Furthermore, support is provided to the seabird program SEAPOP, to the Integrated Ocean Drilling Program – an international, marine-geological research program, and for a strategic effort on technology subjects.

The Norwegian Centres of Excellence (CoE) and Centres for Research-based Innovation (CRI) within petroleum have been established by the Research Council of Norway. Several of these centres are relevant for the petroleum industry. Some examples include: CIPR (Center for integrated petroleum research) at the University of Bergen is a research centre within improved recovery. FACE at Sintef/IFE will develop better models for multiphase flow, while the IO Center at the Norwegian University of Science and Technology will develop expertise and better tools for integrated operations. The main objective of the Drilling and Well Technology for Improved Recovery centre at IRIS/Sintef is to improve drilling and well technology, as well as increase the expertise required for more cost-effective and safe drilling. The support for the centres is restricted as regards time, and several of the centres will be closed in a few years. There are also other centres operating within petroleum, but not as a main topic.

8.7.4 Expertise and recruitment of labour

Within the petroleum industry in Norway, there is a great need for access to qualified labour. Good cooperation between authorities, industry and educational institutions will be important in the coming years. The industry is cyclical, but employment has grown significantly since 2000, and can offer many jobs within many different disciplines.

The average age of petroleum industry employees in Norway is increasing, despite a slight increase in the number of employees in the youngest age group (15–29 years) in recent years[15]. There is a particular need for technologists and scientists. The recruitment is challenging in parts of the country and for certain professions. At certain universities, the number of students withdrawing from science studies is great and recruitment to geology and other studies relevant to the sector is low. Currently, Norway is among the countries in Europe with the smallest percentage of students from upper secondary schools that choose scientific and technological studies in universities and colleges.

[15] Statistics Norway report: Employees in the petroleum industries (2009)

Furthermore, there is a decline in the number of Norwegians completing master's and doctorate degrees in petroleum-oriented studies at Norwegian universities and colleges. In the PETROMAKS program, about 50 per cent of the fellowships supported are from countries other than Norway. About half of the foreign students leave Norway after completing their doctoral degree according to a study by NIFU. A high percentage of students and fellowships from abroad create a basis for good international cooperation, but the fact that relatively few remain in the country is problematic as regards the further expertise development in Norway. It is therefore important that the authorities, the industry and academia work to keep the expertise in Norway, as well as increase the recruitment of Norwegian students.

There must also be targeted work with recruitment from primary school until higher education and for research. The Ministry is therefore working on mapping measures that can contribute to strengthening the recruitment to basic training and education that is relevant to the Ministry's areas of responsibility. The Ministry cooperates with the Norwegian Centre for Science Education at the University of Oslo on establishing "energy schools". The goal is for the energy schools to attract skilled students and contribute to increased recruitment to studies that are relevant for energy and petroleum at universities and colleges. In addition, the energy schools will show how scientific knowledge can be used for concrete societal challenges. This is carried out in a close cooperation between schools and companies. A model here will be the cooperation between ExxonMobil and St. Olav Upper Secondary school in Stavanger, see Box. 8.9.

The Ministry of Education and Research and the employer and employee groups have started work on a new "social contract" with the objective of e.g. increasing the number of apprenticeships. Statoil is the country's largest apprentice company, and several companies within the petroleum industry annually take on many apprentices. The Government will encourage the companies to increase the number of apprentices they take on and consider whether they can increase the number of disciplines for apprentices.

The Government will:

- Ensure good conditions for the petroleum research.
- Prioritise research within improved recovery from existing fields on the Norwegian Shelf,

including considering whether to establish a research centre within improved recovery, based on free competition.
- Consider establishing a research centre within challenges for petroleum activities in Arctic regions.
- Continue the work on qualifying and testing new technology.
- Contribute to strengthen the recruitment to scientific and technological studies in schools and higher education to ensure labour for the petroleum sector.

9 State revenues

The resources on the Norwegian Shelf belong to the greater community and provide a significant contribution towards financing our welfare system. The petroleum activities provide higher return than a normal return. These higher revenues are the main reason why the Norwegian State takes a substantial share of the revenues from the petroleum activity on the Norwegian Shelf through taxes, fees and the SDFI scheme.

The State's revenues from the petroleum sector constitute about 25 per cent of the State's total income. The cash flow from the petroleum activities is transferred in its entirety to the Government Pension Fund Global, previously known as the Norwegian Government Petroleum Fund. The purpose of the Government Pension Fund is to support government savings to finance the pension expenditure of the National Insurance scheme and long-term considerations in the spending of government petroleum revenues. Over time, the central Government structural non-oil budget deficit shall correspond to the expected real return on the Government Pension Fund Global, estimated at 4 per cent. This fiscal policy guideline is not exercised mechanically, however, and considerable emphasis is placed on stabilising economic fluctuations. The guideline thus entails a gradual increase in use of the petroleum revenues up to a level that can be sustained over the longer term, cf. Figure 9.1. The Government Pension Fund Global invests in financial assets outside Norway. The guideline and the administration of the Government Pension Fund Global is explained in more detail in the annual national budgets and in the report to the Storting on the Government Pension fund.

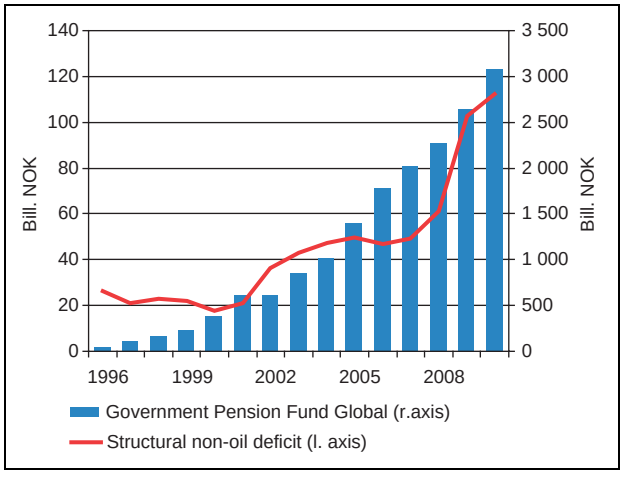

Figure 9.1 Structural non-oil adjusted budget deficit and the market value of the Government Pension Fund – Global. The non-oil adjusted budget deficit is a target for use of petroleum revenues via the fiscal budget.

Source: Ministry of Finance.

The income base from the petroleum production is undergoing considerable change. Since 2001, oil production on the Norwegian Shelf has been gradually reduced, while gas production has increased. 2010 was the first year ever in which there was more gas than oil produced and sold, measured in oil equivalents this trend is expected to continue.

The realised oil prices have been higher than realised gas prices. Cash flow from the petroleum activity is affected by the combination of reduced oil production and increased gas production, and by the lower sales value for gas compared with oil. Therefore, revenues from the sector will most likely fall faster than indicated by overall production decline alone.

The petroleum activities on the Norwegian Continental Shelf are taxed through ordinary tax on profits, special tax and various fees. Great emphasis is placed on ensuring that the tax system does not affect operational and investment related decisions on the Norwegian Shelf, i.e. that the tax system is as neutral as possible. Therefore, the Norwegian petroleum tax system currently consists of profit-based elements outside of the area fee and environmental taxes.

Net cash flow from the petroleum activities amounted to NOK 276 billion in 2010. Of this amount, ordinary tax on profits and special tax from the companies operating on the Norwegian Shelf amounted to about NOK 156 billion. As taxation is based on profit, there is a close correlation between oil and gas prices and tax revenues.

In addition to tax, the companies also pay environmental taxes and area fees,. Environmental taxes and area fees amounted to about NOK 3.6 billion in 2010.

In addition to taxes and fees, the State Direct Financial Interest (SDFI) ensures that a high percentage of the value creation on the Norwegian Shelf goes to the State. In 2010, the net cash flow from SDFI amounted to NOK 104.1 billion.

9.1 EITI

Extractive Industry Transparency Initiative (EITI) is an international initiative aimed at increasing transparency surrounding cash flows within the petroleum and mining industries (extractive industries). An estimated 3.5 billion people live in countries rich on natural resources such as oil, gas and minerals. Nevertheless, many of these countries are poor, and often troubled by war and conflicts. Greater openness regarding cash flows from companies in the petroleum and mining industries to the authorities can contribute to better governance, less corruption, and help to form a foundation for economic and social development in these countries. This is EITI's purpose.

Over many years, Norway has provided political and financial support to the EITI effort. Among other things, EITI's international secretariat is in Norway. In addition, Norway, as the only OECD country so far, has carried out the processes and measures required to be certified as an EITI country. By implementing EITI in Norway, the goal is to influence countries where there is a considerable need for openness and better governance.

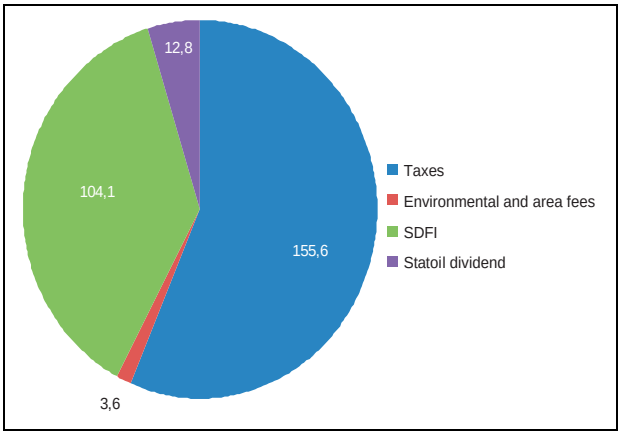

Figure 9.2 Net cash flow to the State from the petroleum activities, 2010 (billion NOK).

Source: Ministry of Finance.

In accordance with the EITI criteria's, companies and authorities are required to report paid and received amounts, respectively, to an independent unit tasked with verifying whether the reported payments correspond to the received amounts. The figures are to be published. In Norway, the consultancy firm Deloitte has been responsible for this work. The results are published in a separate report, which provides information regarding each individual company's payments of tax, CO_2 tax, NO_x tax and area fees to the State. Correspondingly, the report shows net payments from SDFI.

So far, Norway has produced EITI reports for 2008 and 2009. Since 2005, a total of 23 countries have produced similar reports. For the citizens of many of these countries, access to information regarding the state's revenues is something new, and can make a big difference. In the long term, transparency and better governance can contribute to economic and social development and a better standard of living. For Norway, the reporting and balancing has confirmed figures that are already published elsewhere, including in the State accounts. The EITI effort in Norway also aims to inform about and increase understanding of the importance of the petroleum sector in the Norwegian economy.

9.2 The petroleum tax system

Petroleum taxation is based on the rules for ordinary company taxation. Due to the extraordinary profitability associated with production of petroleum resources, a special tax is added. The ordinary tax rate is 28 per cent, as for other companies, while the special tax rate is 50 per cent.

Sales revenues for crude oil are calculated on the basis of administratively stipulated prices (norm price). The norm price shall correspond to what the oil could have been sold for between independent parties in a free market. For dry and NGL, the actual sale price is used, with the exception of propane from Kårstø, for which a norm price will be stipulated starting from the second quarter of 2011.

Investments in operations equipment can be written off according to the straight line method over six years, calculated from the year of the investment. All relevant costs can be deducted, including costs associated with exploration, research and development, financing (debt interest), operations and removal. To help ensure that the normal returns are not subject to special tax,

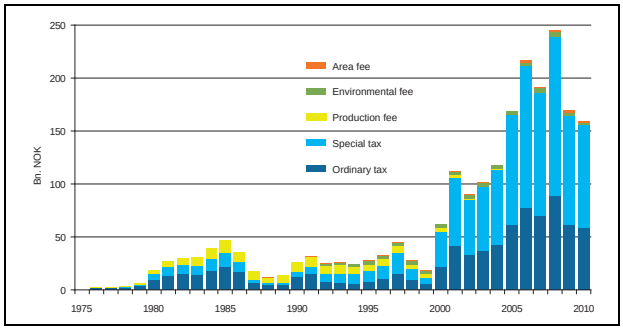

Figure 9.3 Payment of taxes and fees during the period 1976–2010.

Source: Ministry of Finance.

an extra deduction, uplift, is provided in the calculation basis for special tax. The uplift is stipulated at 7.5 per cent of the cost price of the operations equipment. The deduction is given for four years, from and including the year the investment is made.

Companies that are not in a tax position can carry forward both deficits and unused uplift with interest. In addition, companies that are not in a tax position have since 2005 been allowed to claim reimbursement of the tax value of exploration costs in the tax assessment for the year the costs are incurred.

The petroleum tax system is company-based, in contrast to field-by-field taxation. This means that the companies can deduct expenses from one field against revenue from another field. A company is therefore not taxed until it has attained an overall profit.

Tax revenues from the oil companies have been considerably higher over the last decade than previously, cf. Figure 9.3. The historically high oil and gas prices, together with a high production level, are the primary causes for this.

9.3 Fees

Area fees

The area fee is paid for holding a license to conduct exploration for and production of petroleum resources on the Norwegian Continental Shelf. The fee is paid per km^2 of awarded area. Area fees are not paid during the license's exploration period. At the end of this period the fee is escalated over a period of ten years. The area fee is deductible against taxable income. The area fee is intended to contribute towards efficient exploration of awarded areas.

CO_2 tax

The CO_2 tax was introduced in 1991 and is an environmental tax with the aim of reducing CO_2 emissions from the petroleum activities. The CO_2 tax in the petroleum industry is charged per standard cubic metre of gas combusted or emitted and per litre of petroleum combusted. For 2011 the rate is NOK 0.48 per litre of petroleum or standard cubic metre of gas. As of 2008, CO_2 emissions from the petroleum activities are also included in the quota system.

NO_X tax

Pursuant to the Gothenburg protocol of 1999, Norway is obligated to reduce its annual emissions of nitrogen oxide (NO_x). As a consequence of this, a NO_x-tax was introduced on 1. January 2007. For 2011 the rate is NOK 16.43 per kilogram of NO_x.

In 2007, an agreement was reached between a number of industry organisations regarding a temporary tax exemption for NO_x. In return, the companies covered by the agreement would allocate means to a fund set up to finance emission-reducing measures for NO_x. The parties have agreed to continue the NO_x agreement for 2011.

9.4 Dividend from Statoil ASA

The State owns 67 per cent of the shares in Statoil ASA. Statoil annually pays a cash dividend to its shareholders and the State's dividend is included in the revenue from the petroleum activities to the Government Pension Fund - Global.

In total, including buyback of shares, the State has received NOK 111.18 billion since the stock exchange listing in 2001. This includes dividend from the accounting years 2001–2010, which is disbursed and entered in the State accounts the following year.

In 2010, the company revised its dividend policy. The new dividend policy is as follows:

> «It is Statoil's ambition to grow the annual cash dividend, measured in NOK per share, in line with long-term underlying earnings. When deciding the annual dividend level, the board will take into consideration expected cash flow, capital expenditure plans, financing requirements and appropriate financial flexibility. In addition to cash dividend, Statoil may buy back shares as part of its total distribution of capital to the shareholders.»

On 19 May 2011, Statoil ASA's general meeting approved a dividend of NOK 6.25 per share for the accounting year 2010. This means that the State received a dividend of NOK 13.4 billion in 2010 for its shareholding in the company.

9.5 The State's Direct Financial Interest

The SDFI was established with effect from 1985[1]. The scheme entails that the State, just as other players on the Norwegian Shelf, pays a share of all investments and costs in projects corresponding to the direct financial interest. The State receives a corresponding share of the revenues from sale of the production and other revenues. Every year, the Storting approves the budget framework for SDFI. The net revenues are transferred directly to the Government Pension Fund - Global.

The first years were characterised by large investments and a negative net cash flow. From 1989, the net cash flow has been positive. Up to the end of 2010, SDFI has contributed a total of NOK 1 237 billion to the Treasury.

The net revenues from SDFI have increased over time as a result of more fields starting production, cf. Figure 9.4. The annual net revenues are highly correlated with product prices and investment activity.

A large and complex portfolio

The paramount long-term goal for the management of the SDFI portfolio is to maximise the State's revenues from the direct ownership on the Norwegian Shelf. It is important for the Ministry that the portfolio is managed and developed in the best possible manner.

The portfolio is composed of production licenses in the exploration phase, fields under development and fields in production. Furthermore, the State is a major owner of pipelines and onshore facilities. The State's ownership interest in Gassled is about 46 per cent. At the end of 2010,

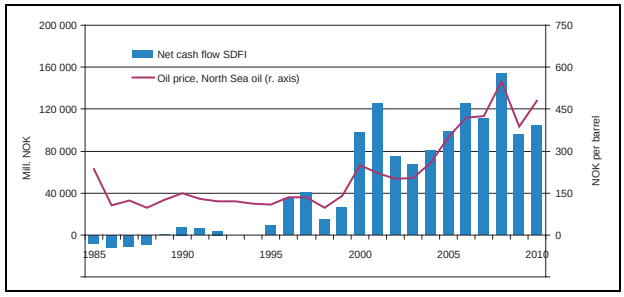

Figure 9.4 Net cash flow from SDFI and oil price (Nominal NOK).

Source: Ministry of Finance, BP, Platts, Central Bank of Norway.

the portfolio's oil, condensate, NGL and gas reserves were estimated at 6.5 billion barrels of oil equivalents. This is presumed to constitute about one third of the remaining petroleum reserves on the shelf.

The value of SDFI was calculated to be NOK 865 billion[2] as at the beginning of 2010, which was an increase of approx. NOK 150 billion since 2008. The increase is mainly due to higher future price assumptions for oil and gas.

At the beginning of the year, the State had ownership interests in 146 production licenses, as well as in 13 joint ventures for pipelines and onshore facilities. The portfolio consists of 38 producing fields, many fields under development and several production licenses in the exploration phase. The portfolio's value is centred on the North Sea, but there are also considerable values in the Norwegian Sea, cf. Figure 9.5.

In the North Sea there are SDFI interests on large fields such as Troll, Kvitebjørn, Visund, Ekofisk, Gjøa, Oseberg, Gullfaks, Snorre and Grane. In the Norwegian Sea the State has interests in the producing fields Åsgard, Ormen Lange, Heidrun, Draugen, Norne and Kristin. In the Barents Sea the State has an ownership interest in Snøhvit.

In 2010, production from the portfolio was 1,08 million barrels of o.e. per day, or about 27 per cent of the total production from the Norwegian Shelf. Liquids production accounted for 44 per cent of the total SDFI production.

There is currently a high level of activity on the Norwegian Shelf, and large investments are expected in the coming years. SDFI investments totalling about NOK 25 billion are expected in 2011. The largest investments will be for drilling

[1] The scheme was part of the so-called oil compromise in 1984, cf. Storting White Paper No. 73 (1983-1984) and Recommendation to the Storting No. 321 (1983–1984) «Concerning the organisation of the State's participation in the petroleum industry» and Storting White Paper No. 33 (1984–1985) and Recommendation to the Storting No. 87 (1984–1985) «Concerning the effect of the reorganisation of the State's participation in the petroleum industry». The oil compromise resulted in dividing Statoil's participating interest in two. Statoil kept one part and the other became SDFI.

[2] Source: Wood Mackenzie.

on Troll, Åsgard subsea compression, further development of Ormen Lange, as well as drilling and rig upgrades on Oseberg and Gullfaks. Furthermore, it is expected that investment decisions will be made on some 20 developments with an SDFI ownership over the next two years. The new, smaller fields are complex with regards to development, and are expected to be less profitable than previous, large developments.

Future portfolio developments

The Norwegian Shelf is changing, and thus, also the SDFI portfolio. The future of the SDFI portfolio depends on factors such as the development of the mature oil fields, gas marketing and new discoveries. Continued operation of the large fields is important for profitable development of many new, small discoveries.

The State has kept large ownership interests in currently profitable fields with substantial production. The majority, about 85 per cent, of the production in 2010 came from the ten fields Troll, Åsgard, Ormen Lange, Oseberg, Kvitebjørn, Gullfaks, Heidrun, Grane, Snorre and Snøhvit. It is estimated that these fields will still account for 75 per cent of production in fifteen years' time, cf. Figure 9.5.

Due to the fact that the portfolio is dominated by large ownership interests in the mature fields, the effect of expected production decline on the Norwegian Shelf will be greater for the SDFI portfolio than for the shelf in general. Many of the fields will be in their tail phase in 2025. Falling production on these fields will have a considerable effect on the total production.

Over the last decade, oil production from the portfolio has been halved, and it will continue to decline. The gas production is, however, expected to increase, so the total production will remain at the current level for the next ten years. Gas production in the SDFI portfolio is dominated by the Troll, Ormen Lange and Åsgard fields. These fields currently account for about 70 per cent of the gas production from the SDFI portfolio. In the longer term, gas production is also expected to decline. Petoro expects that the total production towards 2025 from fields currently in operation and fields under development will decline by 22 per cent for gas and 87 per cent for oil, compared to current production.

In spite of declining oil production, SDFI production will still constitute a considerable share of the total production from the Norwegian Shelf in the future. The large mature fields are expected to have long lifetimes, new fields are planned for development with direct State ownership and the State will continue to keep participation interests when awarding new production licenses. In 2025, SDFI production is still expected to be high; around 0.8 million barrels of oil equivalents per day.

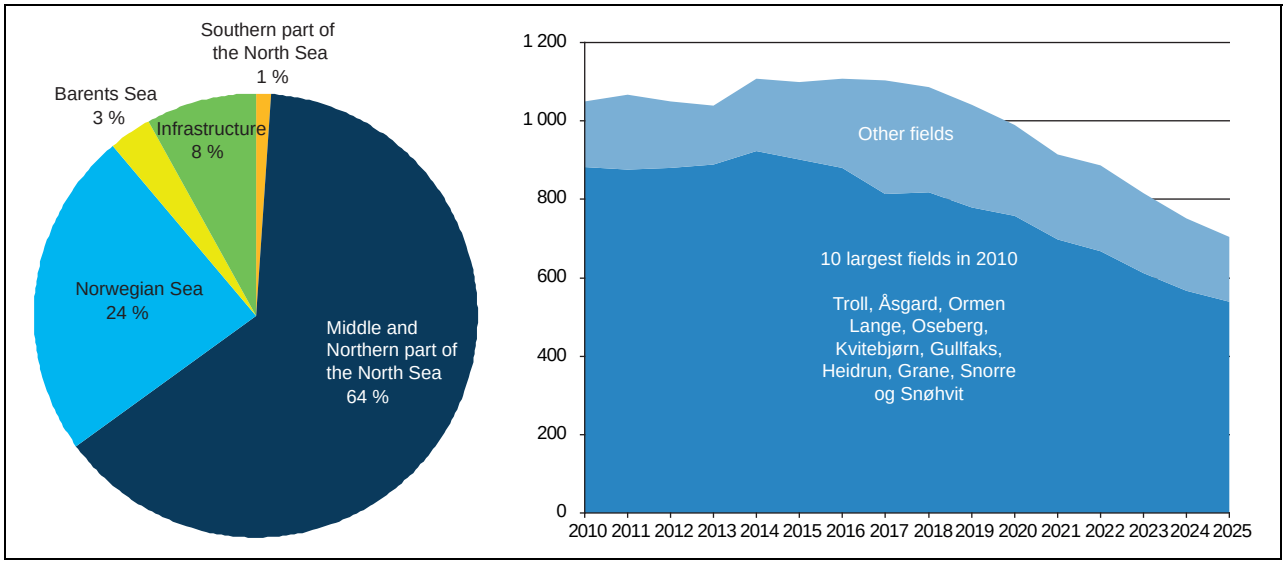

Figure 9.5 Distribution of the different geographical area's contributions to the SDFI portfolio's estimated value. Estimates of the SDFI production distributed by field in thousands of barrels of oil equivalents per day.

Source: Wood Mackenzie and Petoro AS.

Petoro AS

Since its establishment in 2001, Petoro AS has managed the SDFI on the State's behalf. Petoro is responsible for managing the business interests related to the State's direct financial participation in the petroleum activity on the Norwegian Shelf. The objective is to ensure the best possible management of the resources and the highest possible value creation. Petoro is different from other companies in the petroleum industry. The company is a licensee, but does not have ownership interests on the Norwegian Shelf. Further, the company does not act as operator.

On the basis of the framework and the guidelines for Petoro's activities that follow from Chapter 11 of the Petroleum Act, the company's articles of association and relevant Storting documents, the Ministry has defined the following primary tasks for the company:

- Management of the State's direct participating interests in all partnerships in which the State is involved at any given time.
- Monitoring of Statoil's marketing and sales of the petroleum produced from the State's direct participating interests, in line with the instruction given to Statoil by the Ministry of Petroleum and Energy.
- Financial management, including keeping accounts, for the State's direct participating interests.

As part of the State's joint ownership strategy, Statoil ASA is marketing and selling the State's petroleum together with its own. The objective of the instruction given to Statoil is to achieve the greatest possible value creation and fair distribution between Statoil and the State. The revenue generated by selling SDFI petroleum is directly allocated from Statoil to the State.

The number of production licenses in which the State has an ownership interest has increased from about 80 in 2001 to 146 as at the end of 2010. Petoro continuously prioritises which fields and production licenses that will receive particular hands-on follow-up. Challenging issues, a high level of activity and important decisions are reasons why Petoro in 2011 will pay close attention to the Heidrun, Åsgard, Ormen Lange, Troll, Gullfaks and Snorre fields, in addition to the Gassled joint venture. For other fields and production licenses, Petoro's efforts in 2011 will focus on selected issues and decisions. When deciding on which fields and production licenses to prioritise, emphasis is placed on the value potential for SDFI, as well as where the company sees issues and value creation opportunities that the company believes are not adequately addressed by other players, and where the company could have substantial influence.

Petoro has entered into business management agreements with various licensees for 14 of the fields in operation, as well as for 16 other partnerships. The bulk of these management agreements have been signed with Statoil. The business manager is authorised to act on behalf of Petoro in these production licenses. The company is still required to be involved in important decisions in the fields and production licenses that have been selected for follow-up. Petoro's use of business managers has increased, which must be seen in connection with the fact that the number of production licenses in the portfolio has increased considerably since 2001.

The company's strategy was adjusted in 2010, when a decision was made to devote more resources to further developing the mature fields, exploration and maturing of discoveries, as well as further development of the gas value chain. In 2011, Petoro has adapted the organisation to strengthen execution accordingly.

Realising the potential in and around mature fields

There are still significant remaining reserves in existing fields. As the State has considerable ownership interests in mature fields, it is important for Petoro to work actively to implement measures that can, primarily, ensure recovery of these reserves and, secondarily, increase the rate of recovery, reduce costs and extend the lifetime of aging facilities. The large, mature fields are now facing several important decisions, for example recovery strategy, new wells, rig upgrades and long-term infrastructure development, decisions which have a considerable impact on how much can be produced from the fields. The economic lifetime is challenged by the fields' age, lower production and increasing costs. Furthermore, projects are time-critical if available process and transport capacity is to be utilised within the facility's lifetime.

The oil production in 2010 from the six largest fields in the portfolio (Troll, Åsgard, Heidrun, Oseberg, Gullfaks and Snorre) constituted approx. 60 per cent of the total oil production from the SDFI portfolio. It is estimated that about 20 per cent of the oil reserves in these fields is yet to be produced To realise remaining reserves and additional resources, a considerable effort is

required on the part of the licensees. At the end of 2010, remaining reserves in the fields are estimated at approx. 240 million scm of oil. Furthermore, work is underway in the partnerships on maturing additional resources totalling 287 million scm, where about 155 million scm is considered probable. If all the additional resources are matured and realised, this will, according to Petoro, increase the recovery rate for these fields from about 46 per cent to about 54 per cent. An increased recovery rate will result in a considerable increase in values for the State.

Petoro's efforts to realising the potential in and around large fields are directed towards extending the lifetime of prioritised facilities through technology choices, effective drainage methods and an increased drilling rate to complete more wells per year. The company strives to achieve \comprehensive area solutions through prioritising selected facilities for field centres and timely phase-in of discoveries. Reference is also made to Chapter 4 concerning improved recovery.

Further development of the gas value chain

The relative importance of gas for the value creation potential in the portfolio is increasing.

Understanding the global market for natural gas, production and sales strategy, proving and phasing in gas discoveries, as well as increased production flexibility on the fields adapted to the business opportunities in the gas market will have a considerable impact on the opportunity to realise the value potential in the SDFI portfolio. Statoil's and the State's gas portfolios are different and thus develop differently. It is therefore important for Petoro to safeguard the State's interests. Furthermore, the company plays an important part within infrastructure development as the largest participant in Gassled. Expected production development and the facilities' technical integrity will entail important decisions associated with the process facilities in Gassled over the coming years. The scope and complexity of these decision processes will require thorough technical work by Petoro.

Seeking business opportunities in Barents Sea South and Vøring

The southern parts of the Barents Sea and Vøring stand out as the most important frontier areas in the SDFI portfolio. To ensure an optimal development of these areas, there is need for parallel exploration and maturing of resources in an area perspective. Petoro will work to ensure continued high exploration activity and the maturing of resources through prioritisation of exploration rigs.

9.5.1 SDFI interests in the licensing rounds

The production licenses on the Norwegian Shelf are normally awarded through numbered licensing rounds or through awards in predefined areas (APA), cf. Chapter 5. Based on applications received, the Ministry awards production licenses to individual companies or to a group of companies. It is normal for the State to keep ownership interests in certain production licenses. Primarily, the State will keep ownership interests in production licenses that, based on information available at the time of award, have high expected profitability, and in production licenses with a high volume upside. The State will also participate in additional awards of production licenses where the SDFI already has interests. In the most recent APA rounds, the State has, in accordance with the criteria, retained ownership interests of between 13 and 26 per cent of the production licenses. In the 20th and 21st licensing rounds, the resulting SDFI interests were 30 per cent and 29 per cent of the awarded licenses respectively. In the latest licensing rounds, the State has kept smaller ownership interests than previously due to fewer production licenses with a large expected present value and/or volume upside having been made available.

9.5.2 The Ministry's assessment

Managing an increasing number of production licenses, as well as the further development of multiple fields in production requires considerable work on Petoro's part. Since the establishment of Petoro in 2001, the number of production licenses in the SDFI portfolio has increased by 82 per cent; from 80 to 146 production licenses. The number of producing fields has increased by 23 per cent, from 31 to 38.

The scope and complexity of the issues, for example related to improved recovery from the mature fields, require Petoro to have the resources and the expertise needed to be able to contribute effectively with tangible input to the partnerships. Petoro's estimates indicate that an efficient execution of measures on the mature fields will be of considerable importance for the positive development of the States value. An

assessment made by The Norwegian Petroleum Directorate's supports this.

To follow up these challenges in an efficient manner, particularly on the mature fields, the company requires adequate resources for carrying out independent analysis, establishing alternative suggestions, quality-assurance of the operators' work and carrying out its own work associated with selected strategic issues.

The Ministry assumes that Petoro will continue to have an efficient organisation. The company's role and mandate are unchanged. It will continue to contribute to the highest possible values from the State's direct ownership interests on the Norwegian Shelf, through active participation in the partnerships. Within this framework, the Ministry will assess the use of resources to ensure the most efficient follow-up of the SDFI portfolio.

The Government will:

- Ensure the greatest possible value-creation through efficient management of the SDFI portfolio.
- Strengthen Petoro's competence in following up of mature fields.
- Reserve participation interests when awarding new production licenses.

The Ministry of Petroleum and Energy

r e c o m m e n d s :

Recommendation from the Ministry of Petroleum and Energy of 24 June 2011 regarding an industry for the future – concerning the petroleum activities will be submitted to the Storting.

Sources

Asplan Viak

Asplan Viak is a multi-disciplinary consultancy and analysis company particularly focusing on change and adaptation processes. The company has more than 600 employees and is located several places in Norway.

Econ Pöyry

Econ Pöyry is an international consultancy company that works in the interface between market, technology and politics.

IEA

The International Energy Agency (IEA) was founded in 1973–1974 and currently has 27 member countries and a headquarter in Paris. IEA's goal is to contribute to security of supply for the participating countries and promote more sustainable energy use. IEA also prepares analyses of and gathers data for the energy markets, and is important in setting the terms for the discussions regarding global energy and climate challenges.

IHS CERA

IHS CERA is an international consultancy company which was established in 1983. In 2004, CERA was purchased by the respected information company IHS. The company is headquartered in the US. IHS CERA has more than 4500 employees and delivers knowledge and insight regarding global and regional energy markets, geopolitics and industry trends.

IRIS

The International Research Institute of Stavanger (IRIS) is an independent research institute owned by the University of Stavanger and the Rogaland Research foundation. IRIS was established in 2006 and currently has 220 employees. The most important research areas are petroleum, integrated marine environment, social science and business development, as well as gas and new sources of energy.

MENON Business Economics

MENON Business Economics is a consultancy and analysis company located in Oslo. MENON has customers in the private and public sectors and carries out consultancy work and studies.

Petro Arctic

Petro Arctic is a supplier network for businesses associated with development projects in Northern Norway and the Barents Sea. The foundation was established in 1997 and is financed by Statoil ASA, Eni Norge AS and its foundation members. The foundation cooperates with industry businesses as well as regional and municipal authorities. Its purpose is to qualify the member companies for supplying field developments and operations in the north, including Russia.

PIRA Energy Group

PIRA Energy Group is an international consultancy company established in 1976 and which is headquartered in the US. PIRA prepares analyses and communicates news regarding the global energy markets, including the oil, gas, coal and carbon markets. PIRA prepares price forecasts for oil and gas in the short and long term.

Ramm Energy Partner

Ramm Energy Partner (previously Ramm Kommunikasjon) is an independent enterprise within petroleum consultancy which is run by Nils Henrik Ramm. Ramm's background includes journalism and he has been a state secretary in the Ministry of Petroleum and Energy, as well as a political advisor in the Ministry of Finance.

SSB

Statistics Norway (SSB) is the central agency for collecting, preparing and communicating official statistics in Norge. SSB was established as a separate institution in 1876 and is a professionally independent institution, reporting administratively to the Ministry of Finance. The agency's tasks are stipulated in the Statistics Act of 16 June 1989 No. 54. Statistics Norway has wide-ranging research activity in addition to the statistics activity.

Wood Mackenzie Ltd.

Wood Mackenzie is a commercial research and consultancy company, established in 1970 with headquarter in Scotland. The company has more than 600 employees in more than 20 countries. Wood Mackenzie offers services within energy and mining and performs valuation of assets and companies all over the world. The company also delivers market analyses.

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