

# petoro

*perspective*



## Prospects for the NCS

Oil production is declining swiftly on the Norwegian continental shelf. Petoro sees two main challenges: discovering more in new areas, and optimising recovery from mature fields.

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## Committed to the Barents Sea

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## Turn up the gas taps

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## More diversity off Norway

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Photo: Tom Haga

## The energy challenge

**GLOBAL ENERGY DEMAND** is set to rise by 50 per cent up to 2030, according to the International Energy Agency (IEA). Coal, oil and gas will still account for about 80 per cent of supplies in that year. To meet such an increase, world petroleum production must increase every year by more than Norway's current daily output.

**MEETING WORLD ENERGY** needs accordingly represents a formidable task – and one which must be accomplished at a time when nation states are taking greater operational control of their resources and the environmental impact of high global energy consumption has become more visible. Many considerations suggest that a different trend in global energy use might have been desirable. But who has the right to tell people in developing countries on the verge of a better life that they must manage without the energy which formed the basis for growth and prosperity in the industrial nations?

**ONE TOPIC AT** the World Petroleum Congress in Madrid during June was the shift in the player picture from big international oil companies (IOCs) towards national oil companies (NOCs). With much capital and great expertise built up over generations, the IOCs are struggling to secure equity interests in countries where the NOCs and their state owners sit on large petroleum resources. What has changed is the financial strength and growing in-house expertise of the NOCs, combined with a well-developed service and supplies industry.

**DISPUTES BETWEEN** states and international companies on rights and apportionment could also mean that resources discovered are not developed quickly enough to meet the growth in demand. That would help to drive oil prices sky-high.

**THE SOLUTION** must lie along the axis of co-operation, respect and equitable apportionment. Each petroleum nation must find their own way of organising the business. But I can well understand that many are showing a growing interest in the Norwegian model, which secures 90 per cent of the value creation for the state while successfully attracting and retaining the expertise, technology and capital of the international companies.

**THE OTHER** great issue for our industry is environmental protection. Fossil energy sources have been identified as one of the main problems related to the release of carbon dioxide and other greenhouse gases. Although Norway's production is more environment-friendly than in other petroleum provinces, its oil and supplies industries are important players in finding even better solutions. This sector must apply its expertise to solve environmental challenges aggressively and innovatively.

**WHETHER WE** like it or not, the environment will be one of the principal criteria for activity on the NCS. The faster we accustom ourselves to this mindset, the faster we will come up with solutions. We must become clearer in our communication about what we can deliver in an industrial activity which will always be subject to the unexpected. Nor should we forget, in our eagerness to get better, that solutions must reflect the fact that several of the environmental challenges are global in nature and must be overcome in the most cost-effective manner.

**ENERGY FOR** one world is the main theme for this year's ONS exhibition and conference in Stavanger. The international aspect of energy consumption and supply is becoming stronger and more important. The world's largest consumer nations must use energy in a completely different manner in the future. Internationalisation is a reminder to Norway and the other petroleum nations of our duty to supply an energy-hungry world. We can do that by optimising recovery from our mature areas while simultaneously pursuing active, safe and environmentally acceptable exploration and production in new areas.

**PETORO WANTS** to participate in this work by being a competent and constructive challenger over the further development of the NCS.

Kjell Pedersen  
President and CEO, Petoro

## Petoro manages value for the community

**The Norwegian government has been involved as an owner from the early days of the country's oil adventure – through Statoil and Hydro. And from 1985 also through the State's Direct Financial Interest (SDFI).**

Petoro AS was created in connection with the partial privatisation of Statoil in 2001 to manage the SDFI and to ensure that these assets yield the highest possible return to the government.

At 31 December 2007, the SDFI accounted for 34.5 per cent of total reserves on the NCS. This means that Petoro manages Norway's largest portfolio of remaining oil and gas – even after last year's Statoil-Hydro merger. Cash flow to the state totalled NOK 112 billion in 2007 and exceeded NOK 80 billion after the first six months of this year.

### Licensee

"We're one among many licensees on the NCS," explains Sveinung Sletten,



**POSITIVE MESSAGES:** Sveinung Sletten, vice president external affairs at Petoro, has had good news to communicate in recent years.

Petoro's vice president for external affairs. "We operate commercially, and have the same rights and duties as other licensees."

The Norwegian government awards each production licence (PL) to several

companies organised in a joint venture which takes the major decisions on exploration and on possible development and operation should a discovery be made. One partner is named by the government to act as operator, responsible for day-to-day activity.

Generous awards and the later mergers of Norwegian oil companies Statoil, Hydro and Saga have left StatoilHydro as the dominant operator on the NCS. It plays this role for 80 per cent of Norwegian production and 90 per cent of Petoro's portfolio.

"We're not an operator for any field, but the biggest partner on the NCS," says Mr Sletten. "Our aim in that role is to be a competent and constructive challenger – not least to the dominant operator."

### Active

The individual PL is the principal arena for Petoro's business. It participates actively with the other players in efforts to maximise value, but exercises no form of regulatory authority.

In addition to following up individual

### FACTS | Petoro

- SDFI oil and gas reserves at 31 Dec 07: 7.7 bn barrels of oil equivalent
- Share of NCS reserves: 34.5 per cent
- Licences with SDFI holding: 122
- Producing fields: 36
- Cash flow to the state in 2007: NOK 112.3 bn
- Cash flow per each person in Norway: NOK 24 000

PLs, Petoro has developed a strategy based its broad and heavyweight position. Area development occupies a key place here.

"We're very well placed to take a more unified view of developments on the NCS than most other players," says Mr Sletten. "This involves thinking in terms of area development, maturing reserves and rapid adoption of new technology."

Petoros hovedoppgave er å skape størst mulig verdi av den største porteføljen av olje- og gassreserver på norsk sokkel. Statens direkte økonomiske engasjement (SDØE). Porteføljen gav i 2007 et årsresultat på 112,6 milliarder kroner. Petoro har i dag om lag 60 ansatte.

**KOMPETANSE, DJERVHET OG NYTENKING**  
Petoro kombinerer kompetanse, djervhet og nytenking for å nå sine mål. Selskapet vil være en kompetent og konstruktiv utfordrer. Til det trenger vi dyktige og engasjerte medarbeidere.

**+**

**PORTEFØLJE**  
Selskapet forvalter den største porteføljen av olje- og gassreserver. Arbeid i Petoro gir oversikt og innsikt som setter oss i stand til å tenke helhetlig og se områdeløsninger.

**=**

**VERDISKAPING**  
Målet for Petoros virksomhet er å maksimere verdien av SDØE. Det gjør vi ved å opptre profesjonelt og forretningsmessig, men også ved å bygge gode relasjoner og samhandle med andre aktører.

## PETORO SKAL STYRKES!

Langt mer olje og gass kan utvinnes fra norsk sokkel enn det som er produsert de siste 37 årene. Petroleumsvirksomheten vil være en drivkraft i norsk økonomi og næringsliv i mange tiår fremover.

Samtidig står virksomheten overfor nye utfordringer: Kostnadene øker, oljeproduksjonen faller, funnene blir mindre og vi har fått én dominerende operatør. Petoro må som rettighetshaver i en slik situasjon bidra med mer selvstendig teknisk og kommersielt arbeid.

Både mulighetene og utfordringene byr på spennende oppgaver.

Vi trenger derfor flere medarbeidere med utdanning på mastergradsnivå. Vi inviterer deg som er engasjert og følger godt med innen faget ditt til å søke på ledige stillinger. For å gjøre en god jobb i Petoro er det viktig å være nysgjerrig og søkende, djerv og nytenkende. Du må selv kunne identifisere og drive frem nye aktiviteter – både internt i selskapet, eksternt på lisensarenaen og sammen med andre selskaper.

Petoro tilbyr spennende, tverrfaglige oppgaver, et inspirerende fagmiljø og konkurransedyktige betingelser. Vi er opptatt av mangfold og oppfordrer kvalifiserte kandidater til å søke, uansett alder, kjønn og kulturell bakgrunn. Arbeidssted er Stavanger.

Les om og søk på ledige stillinger via [www.petoro.no](http://www.petoro.no) – legg ved CV.

[www.petoro.no](http://www.petoro.no)



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# New finds and more from mature fields

**MATURE FIELD:** Oseberg came on stream in 1988. Improving recovery from mature fields in one of the most important challenges in maintaining oil and gas output on the NCS in coming years.

Photo: Terje S Knudsen, StatoilHydro

**Despite record exploration activity on the NCS, oil production from these waters has fallen by 30 per cent since 2001. Further discoveries and improved recovery are needed to avoid an even steeper decline. Petoro sees the need for continued diversity in licences, and is gearing up to be a competent and constructive challenger.**



**RESOURCE MANAGER:** Tor Rasmus Skjærpe is responsible for day-to-day follow-up of Petoro's many licence holdings on the NCS.

"We're doing well today in relation to the optimistic scenario outlined by the government a few years ago," says Tor Rasmus Skjærpe. "That's thanks to rising gas production. But overall output is set to decline from 2015."

Mr Skjærpe is Petoro's vice president for licence management, and thereby responsible for following up the SDFI as the largest portfolio of oil and gas reserves on the NCS.

"If we're going to have additional oil and gas resources in production by 2015-20, the discoveries must be made now," he emphasises.

He is gratified over ambitions to drill 30-40 wells in 2008, including more than half with Petoro's involvement. Halfway through the year, however, no big finds have been made for the company while delays and postponements have also occurred.

Mr Skjærpe fears that high oil prices and huge revenues may blind decision-makers, both in the industry and in the

government. The result could be that action needed to maintain the highest possible level of future output is not taken in time.

He is worried that many fail to appreciate the consequences of adopting a wait-and-see approach, and notes that 90 per cent of the value created on the NCS accrues to the government. Both state and community would lose out from a reduction in activity.

"To maintain production and safeguard big revenues in coming decades, we must optimise resource recovery from the mature fields, drill close to existing installations while they are still in production, and explore in new areas which have already been opened.

"Where the far north is concerned, it's important to ensure developments which rank as sustainable in industrial, social

and environmental terms."

Mr Skjærpe highlights the importance of maintaining activity at a sufficiently high and stable level to retain the expertise and technology needed to recover remaining oil and gas.

"We've produced the most easily accessible barrels, and now have to get out the more difficult ones. That makes big demands on us. But it also provides exciting challenges and jobs for tomorrow's engineers, geologists, economists and others with the right expertise."

## Ambitious

Petoro has set the ambitious target of increasing SDFI reserves by two billion barrels in 2007-15, he notes.

"We've contributed by committing NOK 10 billion to the acquisition of four new drilling rigs over the next five years. That's based on the part of our three-pronged strategy we call reserve maturation. The other components are helping to make a larger proportion of the overall resources profitable through area development, and early application of technology."

Thinking in an integrated way about developing more discoveries and fields in an area has increased in importance as the size of finds declines.

Improved recovery and more efficient operation of mature oil fields are high up today's agenda. Integrated operational modes alone could boost value creation by NOK 300 billion over the next decade, according to calculations from the Nor-

wegian Oil Industry Association (OLF).

With StatoilHydro operating 90 per cent of SDFI production, Petoro must be a competent and constructive challenger and help to ensure that a diversity of ideas, experience and technology continues to benefit Norwegian discoveries and fields. The company is accordingly reinforcing its own expertise, particularly in sub-surface work and commercial negotiations.

## Responsibility

Mr Skjærpe says that the oil industry has already accepted responsibility for the environment, and notes that per-barrel greenhouses gas emissions from Norwegian production are only about a third of the average level worldwide.

"But a sharper environmental focus and new challenges mean in practice that we must strengthen our commitment in this area. We're roughly on target for reducing discharges to the sea, but not for emissions to the air. The industry will be taking this challenge seriously."

Norwegian exploration activity has revived sharply since it bottomed out three-four years ago. Encouraged by the government, a large number of small and medium-sized oil companies have joined the fight for the remaining petroleum resources. Mr Skjærpe believes that this diversity is important.

## Vacuuming

"The new players make a particular contribution to vacuuming the mature

areas, but go beyond these as well," he adds. "Experience shows that small companies are often better than the big players at setting priorities and making little fields profitable."

He nevertheless observes that the new companies have a very limited presence in the large mature fields. The 10 largest producers in Petoro's portfolio account for 75 per cent of its output.

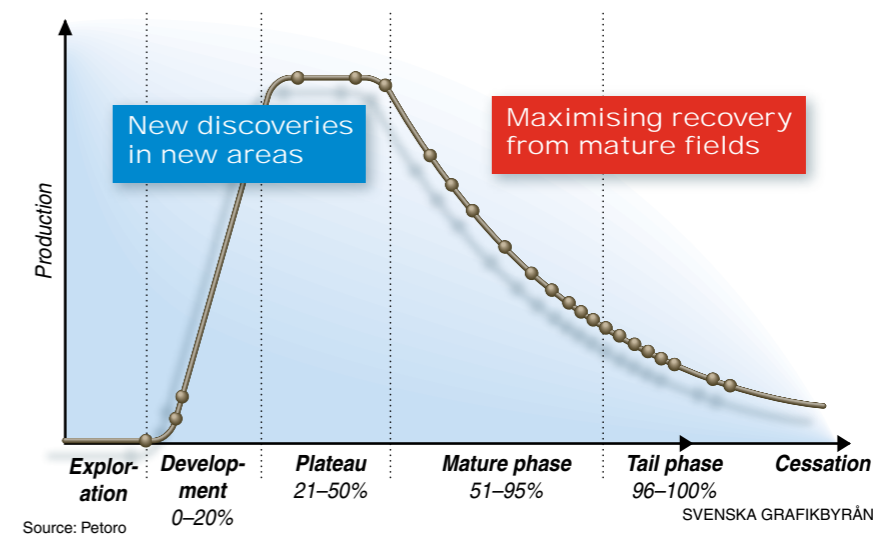
"Along with the major international

companies, we have a big responsibility for optimising recovery from these fields by applying a diversity of ideas, experience and technology," Mr Skjærpe says.

"The world will depend on hydrocarbons for many decades to come. Our job is to help ensure profitable recovery of the largest possible proportion of Norway's resources. That'll benefit everyone, and we're gearing up to do this." □

**A TYPICAL LIFE-CYCLE** curve for a field, where the proportion of recoverable reserves already produced from Petoro's most important fields is plotted in. A growing number of Norwegian fields have moved into a mature phase, while the list of big new development candidates has shortened. Petoro regards making additional discoveries in new areas while optimising recovery from existing fields as a key challenge.

## Two main challenges





# Activity up in the Barents Sea

The Barents Sea represents major opportunities for future oil and gas production. Petoro will seek cooperation with other players to secure an additional rig for these waters, and thereby contribute to a substantial rise in the future level of activity there.

"The area we're talking about is known as Barents Sea South, and has already been opened for oil and gas operations," explains Jan Rosnes, Petoro's vice president for projects and strategy. He draws a frame measuring 400 by 400 kilometres directly above northern Norway.

Much of the recent exploration effort has been devoted to finding more gas as a basis for expanding the Snøhvit terminal at Melkøya outside Hammerfest with a second process train.

"The results of this hunt have been disappointing, and we believe that drilling must now be extended beyond the immediate vicinity of Snøhvit," says Mr Rosnes.

"An assessment of relevant areas to explore for more Snøhvit-related gas indicates that an extra drilling rig could be required. We're ready to join forces in helping to get such a unit in place."

To ensure that gas discoveries in an expanded area can be made available to the liquefaction plant on Melkøya, the industry must consider developing technology which allows unprocessed oil and gas wellstreams to be piped over distances of 100 kilometres.

## Demanding

The huge Barents Sea South area could conceal big oil and gas resources, but



**TERMINAL:** The plant at Melkøya in northern Norway became operational in 2007.

Illustration: StatoilHydro



**JAN ROSNES:** Petoro's vice president for projects and strategy.

Photo: Tom Haga

finding and recovering them is a demanding business. Several conditions make these waters a complicated area for exploration and production.

"We can't expect a high recovery factor from reservoirs there," says Mr Rosnes. "That reflects both formation pressure and geology."

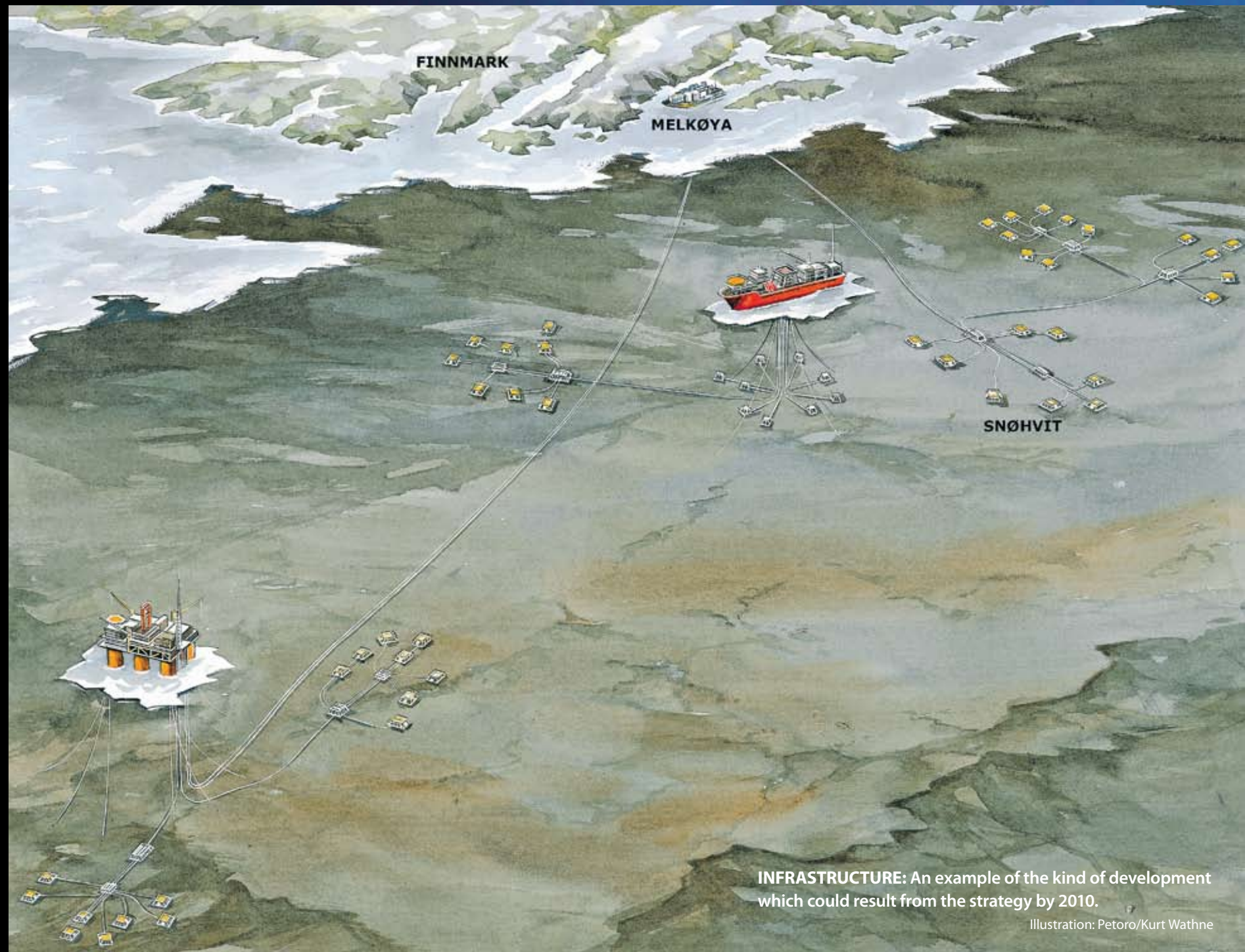
But experience has been gained with such conditions. Other problems are more specific to the Barents Sea.

"We don't expect large finds capable of bearing field and infrastructure development costs alone," Mr Rosnes observes. "The area is also so large that discoveries could lie far apart and make the need for unified thinking even more pressing."

## Risky

Uncertainties related to geological and technological factors, costs and petroleum prices make Barents Sea exploration risky. Petoro has constructed scenarios to illustrate the range of possible outcomes for the area. These projections are based on the Norwegian Petroleum Directorate's resource estimates and Petoro's own assessments.

Dubbed full speed ahead, the most optimistic scenario combines high oil



**INFRASTRUCTURE:** An example of the kind of development which could result from the strategy by 2010.

Illustration: Petoro/Kurt Wathne

prices with large discoveries and associated high value creation. The most pessimistic projection is called bleak prospects, where low oil prices are married with few discoveries. Possible outcomes for recoverable resources range from one to eight billion barrels of oil equivalent, so the profitability range is large.

"This is obviously very simplified," Mr Rosnes emphasises. "Scenario-building is based on a number of de-

velopment drivers – technological, political and economic. The Barents Sea is environmentally sensitive, for instance, and that naturally affects opportunities for profitable resource utilisation."

## Optimise

"Our job is to optimise developments in Barents Sea South," Mr Rosnes notes. "In such uncertain conditions, we must create a basis for decisions. Scenarios are useful tools in this context."

He believes today's commitment in these waters appears appropriate and robust should the most pessimistic scenario prevail.

"If the outcome proves more positive, however, we need a bigger effort to seize the opportunities and maximise profitability. That calls for a stronger focus on securing an early realisation of asset values and installing infrastructure which strengthens the competitiveness of the area."

Mr Rosnes says that one ambition for 2020 could be to bring several new oil and gas fields on stream, in part via an expanded Melkøya facility. That calls for broad exploration at an early stage, paralleled by preparatory development activity and followed by rapid appraisal and harnessing of discoveries. The figure above shows an example of the kind of development such a strategy could yield by 2020.



# Barents Sea scenarios

The Arctic has moved higher up the agenda for supplying an energy-hungry world with oil and gas. After Norway's latest licensing round, Petoro has secured a new and substantial position in Barents Sea South – that part of these waters opened for exploration. The company recently produced four scenarios in order to secure a better understanding of the potential, risks and range of possible outcomes for this area. They are based on various assumptions concerning prices and available resources, on the Norwegian Petroleum Directorate's scenarios and resource analyses for the whole Barents Sea, and on Petoro's knowledge of the area as a licensee. The four scenarios for Barents Sea South in 2040 are summarised below.

Illustrations: Petoro/Kurt Wathne



## FULL SPEED AHEAD

Barents Sea South is a substantial area for both oil and gas production in 2040, thanks to high energy demand, large discoveries in the area and the development of advanced technology. This rests on early and broad access to acreage in Barents Sea South and on favourable geological conditions, with a number of major prospects proving to contain oil. Technological progress has yielded good environmental solutions, reduced development costs, permitted long-distance transport and improved recovery. Subsea solutions have dominated development of the area.



## DEMANDING GAS

Large gas discoveries in Barents Sea South have made the province a substantial supplier of liquefied natural gas to a global market in 2040, despite generally low international gas prices. This results from gradual access to more acreage in Barents Sea South. Exploration activity has been restricted by low prices but encouraged by the positive results. Low prices have boosted the need to unitise small discoveries before development. Technology advances permit long-distance transport of multiphase wellstreams.



## PRECIOUS PETROLEUM

High crude prices, the staged opening of other areas in the far north, collaboration with the Russians and the application of advanced technology make a Barents Sea South commitment attractive in 2040 within a broader context, despite relatively few and small discoveries in the actual area. This projection assumes relatively early and good access to acreage, but disappointing exploration results. A number of separate small discoveries rather than large finds which can stand alone make effective co-ordination and new technology essential for realising developments in the area.



## BLEAK PROSPECTS

In this downside scenario, a stringent greenhouse gas regime has resulted in low global demand for oil and gas. Combined with few and small discoveries, this means a modest level of petroleum activity in Barents Sea South in 2040. The scenario assumes a very restrictive attitude from the start by the authorities on opening new areas, while the discoveries made are small. A substantial oil spill in the area also helps to turn public opinion against offshore activity. Finds made have been developed as stand-alone projects.



# New technology for new times

Challenges faced on the NCS have changed, observe Roy Ruså and Ivar Sløveren, vice president for technology and senior adviser respectively at Petoro. Much of the technology available is either inadequate for exploiting the value potential or demanding to use.

The technical and financial problems presented by developing large oil and gas fields on the NCS have been important drivers in coming up with groundbreaking technology.

That has earned the Norwegian industry an international reputation for its ability to try new solutions and, as a big licensee on the NCS, Petoro wants to build on this position.

“But we can’t rest on our past laurels, because today’s challenges are pretty different and call for a wide range of technological innovations,” says Mr Ruså.

He considers it important to become even quicker at adopting such advances, perhaps first and foremost through a faster process from successful pilot trials to broad application.

Simply identifying new technology is not enough, Mr Ruså notes: “It’s only after implementation on a broad front that we can reap big results. We’re talking here about systematic identification of improvement opportunities, standardisation of work processes, training and cooperation between many players.”

## Opportunities

Mr Sløveren points out that Petoro has been concerned for several years to see the industry take advantage of the opportunities offered by the fibreoptic network in the North Sea. This would allow stronger integration of organisations on land and offshore in order to expand production and operate more efficiently.



**ROY RUSÅ:** Vice president for technology and ICT at Petoro and an enthusiastic advocate of integrated operation (IO).

“If we succeed with this, the benefits will be considerable,” Mr Sløveren says. “The Norwegian Oil Industry Association (OLF) has estimated that integrated operation (IO) could help to boost the value of the NCS by more than NOK 300 billion through higher reserves, increased output and lower costs.”

The key lies in enhanced communication and in making large volumes of real-time data available from well monitoring and plant operation. This information could be used by people with different relevant expertise regardless of whether they are offshore, on land or at an external contractor.

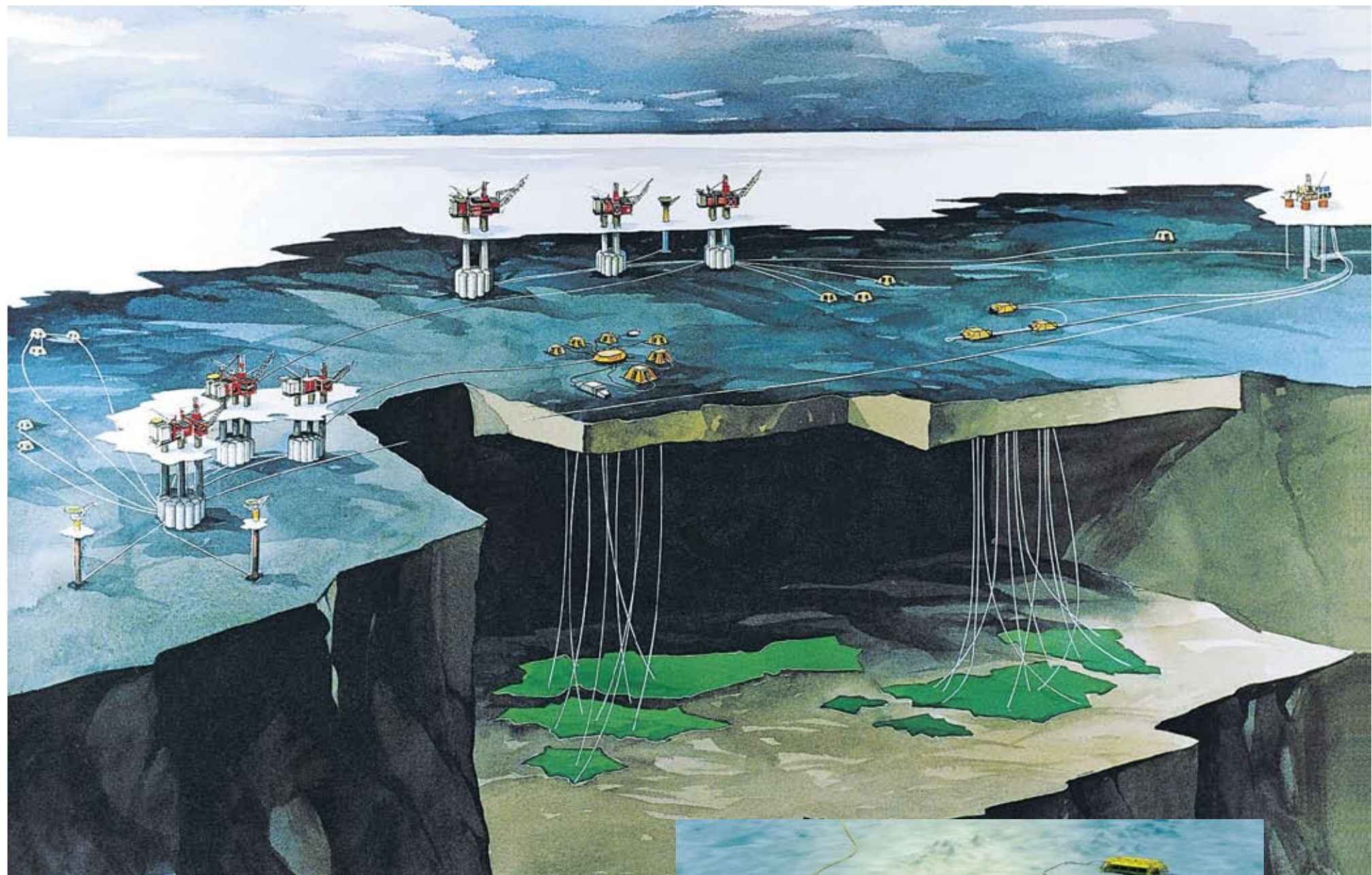
“That would strengthen cooperation between sea and shore and equip us better to manage wells, optimise production, and make maintenance and operation more efficient and reliable,” says Mr Sløveren.

Oil companies and contractors have acquired substantial IO experience in recent years through a number of pilot projects, contributing to the emergence of new work processes for reservoir management, well operations, and production and maintenance.



**EXTRACTING WATER AND SAND:** Subsea separation of water and sand from the wellstream on Tordis helps to relieve limited processing capacity on Gullfaks, and allows the first of these fields to produce more oil and gas. The water and sand are injected in a nearby formation.

Illustration: StatoilHydro



**IMPROVED RECOVERY:** The Tampen area of the North Sea illustrates how technological advances can help to improve recovery from mature fields. Efficient wells are among the most effective tools in that respect, and exciting developments are taking place in this area – including wireless communication with downhole equipment of various kinds. Subsea solutions for processes currently conducted on the surface represent another important element in operating fields more efficiently and profitably.

Illustration: StatoilHydro

Early retirement of a number of employees as a result of the StatoilHydro merger and the general shortage of leading-edge expertise in the industry strengthen the need for changes in working methods. Petoro believes that the merged company could become a world leader if it succeeds in building on the best from both its predecessors.

Mr Ruså notes that clear management and employee involvement and commitment, both offshore and on land, are critical for making such changes. It is also important that these are experienced as general improvements and, not least, that they yield operational and financial results.

## Models

“New technology, including faster computers and improved simulation mod-

els, must be developed if we’re going to make even better use of the overwhelming data flow,” says Mr Ruså. “Such advances are needed sub-surface and in drilling, production, maintenance and logistics.”

As an example, he points out that faster processing now makes it possible to run reservoir simulations directly in the geology model. That could revolutionise sub-surface understanding.

He sees a need for new technical solutions in many areas, including subsea gas compression. “If we achieve that on a large scale, new fields can be developed on the basis of subsea solutions combined with transport over much greater distances than today. Production life could also be extended for mature reservoirs tied back to other fields.”

Wells are the most important means



**UNDER PRESSURE:** A pilot plant to test subsea gas compression is to be installed on Ormen Lange in the Norwegian Sea. This could eliminate the need to build a new platform and help to boost profitability.

Illustration: StatoilHydro

of improving recovery, he points out. Very interesting developments are taking place in this area, including wireless communication with downhole equipment of various kinds. That opens the way to improved monitoring and control as the basis for better regularity and increased output.

Mr Sløveren also finds it highly interesting that a number of small contrac-

tors now seem to be more active in developing new technology, and that other parts of the world show a growing degree of innovation.

“As players on a mature continental shelf, we must be able to follow what’s going on out there. It’s actually more important that we succeed in adopting new technology than that we develop it ourselves.”



# Squeezing out more oil

Half the oil originally in place on the NCS – with a gross value of NOK 20 000 billion – will be left behind under current plans. A combination of water/gas injection with nanotechnology could help reservoir engineers to drive out the last drops. One concern is that scientists are focused on other issues.

“The recovery factor could be boosted to 70 per cent on many fields if the companies applied existing technology and were also willing to adopt new solutions,” says Erik Søndena at Petoro. An expert in reservoir physics, he knows a great deal about teasing more oil and gas out of the rocks on the NCS.

“Current oil prices make it worth thinking more ingeniously,” he notes. “A one per cent improvement in recovery amounts to 600 million



**ERIK SØNDENA:** Wants to tease more oil and gas out of the rocks on the NCS.

barrels, with a gross value of more than NOK 400 billion at today’s prices.”

Reservoir technology and im-

proved oil recovery (IOR) are among Petoro’s priorities for the future, he adds.

A combination of pressure and mobility is needed to drive petroleum resources out of the ground. The pressure is needed to push oil and gas towards the production wells. But only moveable crude gets that far. IOR measures accordingly focus both on maintaining reservoir pressure and on making the oil more mobile.

“Injecting seawater and gas is the traditional IOR technique,” explains Mr Søndena. “Water helps to maintain pressure by pushing the oil ahead of itself through the permeable rocks, while the gas has the advantage that it can loosen and draw with it additional oil.”

But Petoro will nevertheless be concentrating on the water-based solutions, he says. “Water’s cheap and readily available. And a lot is happening on the technological front to make it even more interesting.”

## Spread

A key challenge is to distribute injected water to as much of the reservoir as possible. Following the line of least resistance, it creates channels through the rock. The result is that ever more water and decreasing volumes of oil reach the wells.

“Think of waterflooding in the reservoir as a bulldozer shoving the oil ahead of itself,” Mr Søndena explains. “It finds the quickest route to its destination, and usually follows the ‘motorway’ through the reservoir. As that

popcorn – and block the flow of water. This is then forced to find new paths. With the aid of temperature differences in the reservoir, the nanoparticles can be guided to “pop” in exactly the right place.

## Wetter

Seawater is used for injection on the NCS, but a reduced salt content has turned out to be more effective, says Mr Søndena. “Fresh water is ‘wetter’ than salty, so that more oil will loosen from rock surfaces wetted by it.”

The same applies if detergent is blended with the water. Just as washing-up liquid dissolves the fat in a frying pan, this loosens oil stuck to rock pores. The problem with the method is its environmental impact.

“Detergent-like substances, or tensides, can pose a problem for the environment,” explains Mr Søndena. “It’s important that we don’t get them topside together with the oil, which makes the future potential of these techniques uncertain.”

## Mobile

The Norwegian Petroleum Directorate has estimated mobile oil not covered by recovery plans on the NCS at 13.5 billion barrels. In addition come 14.5 billion barrels which are not mobile. It is hard to say how much oil could be retrieved from the reservoirs with new methods. Technology might increase reserves by two-eight per cent, which would put Petoro well on its way to achieving its target of an additional two billion barrels up to 2015.

**“We envisage that 60 per cent of this increase will derive from IOR. Each percentage point represents huge assets.”**

Erik Søndena

passage is cleared of oil, the water flows more and more easily through until it forms almost the whole well-stream.

“We also want this ‘liquid bulldozer’ to travel along the side roads through the reservoir, where lots of oil can still be pushed out. So we’re setting up barriers on the motorway which force the water aside.”

An example of a new technology which has captured Petoro’s interest is smart water. Trademarked as Bright Water™, it has been developed by BP and Chevron with specialist Naclor. Nano-sized particles are mixed with the water. As these heat up in the reservoir, they “pop” – roughly like

“We envisage that 60 per cent of this increase will derive from IOR,” says Mr Søndena. “Each percentage point represents huge assets. Our job will be to involve the licences in devoting leading-edge expertise to this area.”

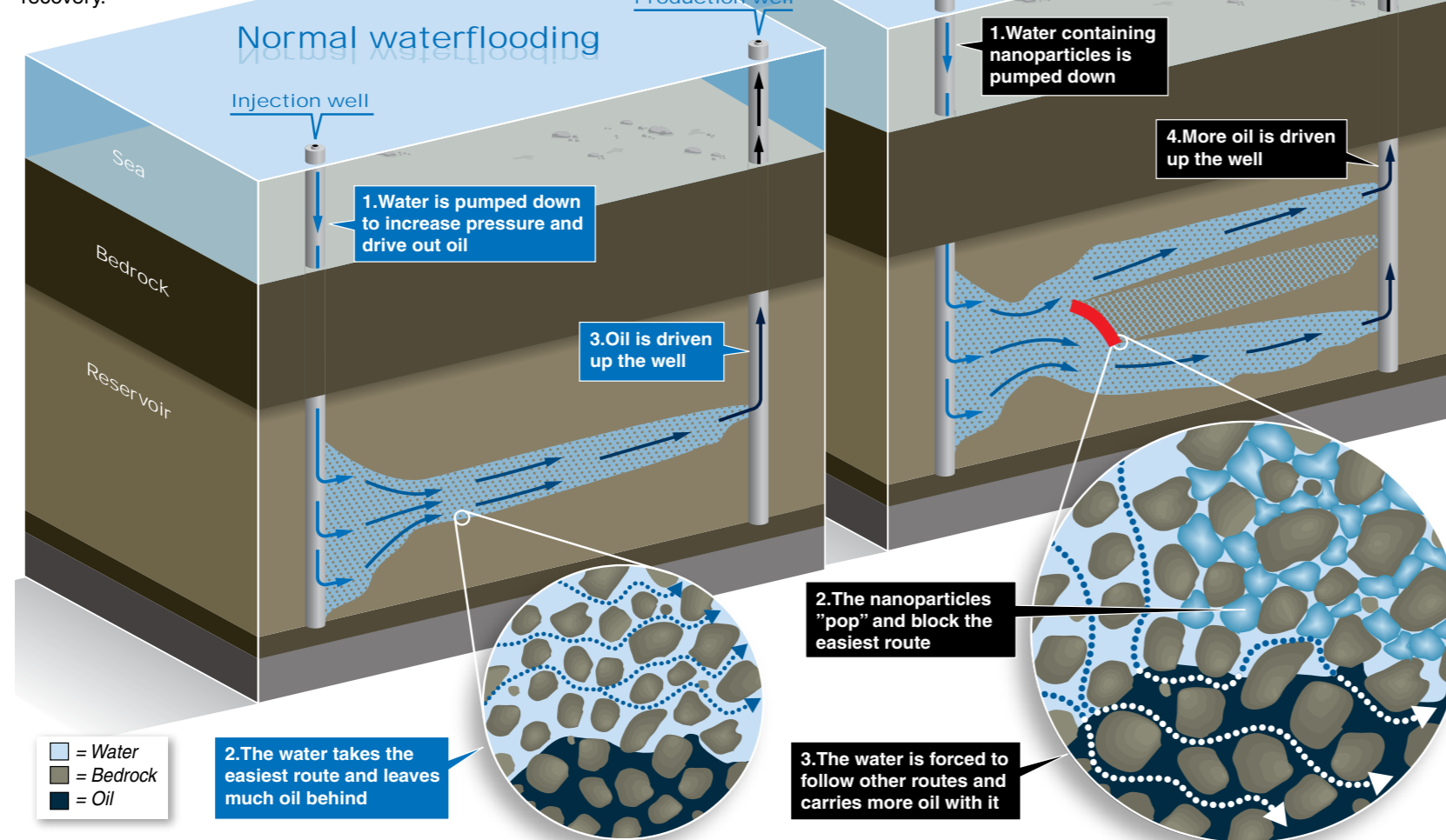
He also wants to see a stronger and more accurate focus on new recovery methods. A shortage of petroleum scientists represents the biggest bottleneck. His worry is that part of the oil-related research done will be tied to international issues which are less relevant for the NCS.



**GULLFAKS:** Located in the Tampen area of the North Sea. Came on stream in 1986. Petoro has a 30 per cent interest. StatoilHydro is the operator. Photo: Øyvind Hagen, StatoilHydro

## Smart water yields more oil

The figure is a schematic diagram which shows that water injected into a reservoir during normal waterflooding takes the easiest route to the production wells. A good deal of oil which it never comes into contact with is left behind. Using nanoparticles which “pop” to many times their original size can block the easiest route and force the water into other parts of the reservoir. That will improve oil recovery.





## Responding to change

Chief financial officer Marion Svihus is responsible for Petoro's commercial operations as well as its financial management. The altered player picture in the wake of the Statoil-Hydro merger means that more duties have fallen to the state-owned company, which can no longer play two competing sets of specialists against each other.

"The role of chief negotiator for the joint ventures will fall more often to us," she notes. "That could involve phasing in new fields to existing infrastructure, for instance, and the commercial models associated with such operations. Our job is to act objectively and neutrally as a chief negotiator – while simultaneously safeguarding the government's interests."

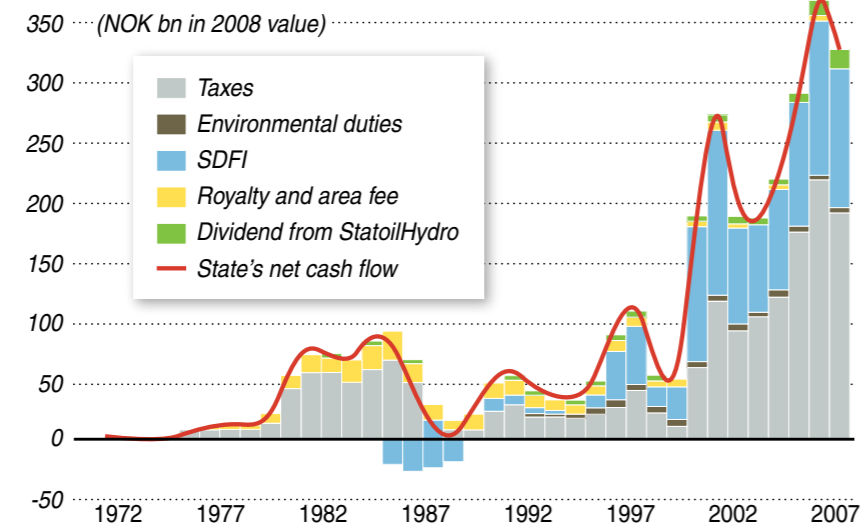
She believes that Petoro's long experience on the NCS and detailed knowledge of the existing infrastructure makes it the right body for this role. The company is accordingly expanding its workforce and commercial capacity.

"We're a business-oriented player – not an instrument for sectoral policy purposes," observes Ms Svihus. "We're concerned with protecting the state's assets and, like everyone else, with value creation. That is and will remain our job on the NCS."

# Huge value creation – more risk

**The SDFI under Petoro's management transferred no less than NOK 112 billion in revenues to the Norwegian government in 2007. That represented 35 per cent of total state income from the oil industry.**

## Net cash flow to the Norwegian state from petroleum operations



Source: National accounts and accounting figures for the SDFI

"Government revenues were NOK 1 032 billion in 2007," notes chief financial officer Marion Svihus at Petoro. "So every 10th krone it received came from the SDFI and us."

Conservative estimates for oil price trends indicate similar figures for 2008. Petoro has its own price forecasts, but Ms Svihus will not reveal the exact figures.

"However, it would be true to say that they lie well below today's level," she says, and recalls that realised oil prices in 2007 were a little over USD 70 per barrel.

"Put simply, a one-dollar increase in the price of a barrel of oil adds NOK 1 billion to revenues, all other things being equal."

### Perspective

These figures give some perspective to the significance of the oil and gas business for the Norwegian economy. Farsighted politicians ensured at an early stage that large assets remained in state ownership, to the benefit of government coffers. In addition come big tax revenues and a relatively smaller sum in the form of dividend from StatoilHydro.

"Norway retains 90 per cent of all value created on the NCS," says Ms Svihus. "That's unique in a global context."

### Worry

With oil prices rising and revenues shooting up, it is hard to imagine that the oil business can have anything to worry about. But Ms Svihus rejects the idea that the horizon is cloudless, because the other side of the picture is de-

clining production and rising costs. And nobody knows where oil prices are headed.

"It's important to remember that prices have fluctuated sharply," she says. "In 1980, they stood at almost USD 100 per barrel when adjusted for inflation. By 1998-99 they were down to just under USD 17 in today's money – and below USD 10 in nominal value. So it's hard to predict the future."

The concern is that sharply rising costs are helping to make the NCS vulnerable to an oil price slump. Rig rates have risen by over 50 per cent from 2005. Development charges for certain fields could have more than doubled. That means higher additional investment to recover all the reserves from producing fields.

"These increases make the industry more vulnerable," says Ms Svihus. "At the same time, Norway sees its oil revenues rising sharply because prices are at record levels. We're worried that the country will become accustomed to what looks like a robust revenue stream. Nobody was prepared for oil prices sinking like a stone in 1998, and it came as a shock."

She adds that no immediate decline is likely – and certainly not to the 1998 level. But even a fall to USD 50 per barrel would be dramatic in relation to current levels. And it is not long since USD 50 was regarded as a very high price.

### Awards

Ms Svihus is concerned that the government maintains the pace of new licence awards to the industry. The latest discoveries are small and require access to existing infrastructure to become commercial.

"If the rate of awarding new licences declines, there is a risk that infrastructure could be run down too quickly and lose us substantial resources," she says, and adds that the reserve position has also changed.

"We've seen production curves before which show a fall within relatively few years, so that's not frightening in itself. The difference today is that a number of large discoveries are no longer awaiting development. Candidates exist, but the largest of them is no more than a 10th of Gullfaks.

"Production is dropping faster than I thought it would, and no heirs are standing by to take over from the former giants."



**CFO:** Marion Svihus channels billions of kroner into the government's coffers.

Photo: Kjetil Alsvik



# Effective energy use and more gas exports

**The world will depend on fossil fuels for several decades to come. One forecast indicates a 50 per cent rise in demand up to 2030. At the same time, environmental challenges are growing. The question is how Norway's petroleum industry will respond to these trends.**

"We must demonstrate that we deserve a continued licence to operate," says Lars Arne Ryssdal, director of industry and the environment at the Norwegian Oil Industry Association (OLF). "The growing focus on climate and emission issues in recent years has attracted ever greater attention to the oil industry. That's quite natural, but we can point to good results."

## Early

He notes that the Norwegian government took early steps to make the oil industry more environment-friendly. A carbon tax was introduced as far back as 1991, and calculations by the Norwegian Petroleum Directorate show that this levy alone has reduced carbon emissions by two million tonnes per annum. Other measures, such as a ban on flaring, more efficient operation and even carbon deposition below ground, have also helped to cut emissions.

"Norway has the world's most environment-friendly oil and gas production," observes Mr Ryssdal. "Our greenhouse gas emissions are a third of the average for the world's petroleum producers."

He adds that the country has also made big strides in cutting discharges to the sea. "The figure for chemicals is down by 99.99 per cent, and the industry has in practice reached its target of zero discharges."

Although accidental spills still occur, the risk is low. Mr Ryssdal also points out that no damage to the environment has been established even after Statoil-Hydro's much-publicised oil leak from Statfjord A last December.

## Improvements

But Mr Ryssdal emphasises that the industry cannot rest on its laurels. It must constantly seek further improvements in cutting emissions to the air and reducing the risk of discharges.

He believes that this is not least important when the industry comes to operate in the far north, where the challenges already faced further south are supplemented by distinctive problems related to marine life and associated activities as well as to winter darkness and icing. He says that co-existence with the fishing sector is essential, and sees a good dialogue with people in the

far north as important for the industry's own improvement efforts and for ensuring that the necessary concern for the environment and other social and economic interests is shown.

"That said, I believe the industry is ready for the task and can operate acceptably in exploring for and producing petroleum in far northern waters – including the coastal areas off the Lofoten and Vesterålen islands," comments Mr Ryssdal.

Given what is known today, he identifies Nordland VI/VII as the areas with probably the best chance for independent oil or gas projects in the time to come. Even limited developments would create big spin-offs and help to prolong Norway's oil age. It would also be a big advantage for both region and industry to secure a continuous pattern of development between the Barents and Norwegian Seas.

"We must be aware of the conflicts

**"The most effective measure to reduce carbon emissions is increased gas production and exports."**



LARS ARNE RYSSDAL



JAN ROSNES

which could arise, such as clashes between fishing, environmental and petroleum interests," Mr Ryssdal says. "Early dialogue is important both in seeking to avoid conflict and for handling disagreements in the best possible way should they nevertheless arise. We need to show respect and take account of others here."

## Commitment

As Petoro's vice president for projects and strategy, Jan Rosnes is concerned to see an increased commitment to environmental work in the industry.

While appreciating that priorities must be set, he emphasises that the environment represents a major industry challenge. It defines the terms both for current production and for future development.

"A lot's been achieved, but more needs to be done," he says. "The crucial consideration will be to apply measures where they have the biggest effect. That's particularly important at a time when both expertise and other input factors are in short supply."

## Compromise

The Kyoto protocol commits Norway to reducing its carbon emissions by about nine million tonnes up to 2020, and measures have been or are being implemented by the petroleum industry to achieve that target. With the climate compromise, this was raised to 15-17 million tonnes for 2020 – an increase which demands action and could make it necessary to consider carbon capture and storage at land-based plants. Transmitting electricity from land to eliminate gas-fired power generation

on offshore installations is also often mentioned.

"Electricity transmission from land is a possible measure close to shore," agrees Mr Ryssdal, but has doubts about large-scale projects of this kind. The costs would be huge without the effects being sufficiently well documented.

"We can also build very efficient combined heat and power plants fuelled by gas offshore," he notes. "It's not certain that this would be a poor environmental solution."

## Effective

Both he and Mr Rosnes agree on what would have the biggest impact on carbon emissions. "The most effective measure is increased gas production and exports," says the latter. "Calculations show that we can cut carbon emissions by 95 million tonnes if European coal is replaced with Norwegian gas."

"We also aim to work for even more efficient energy use on the NCS. That applies particularly to the work we do to improve offshore recovery. Although we already have the world's most energy-efficient production, more may remain to be gained here."

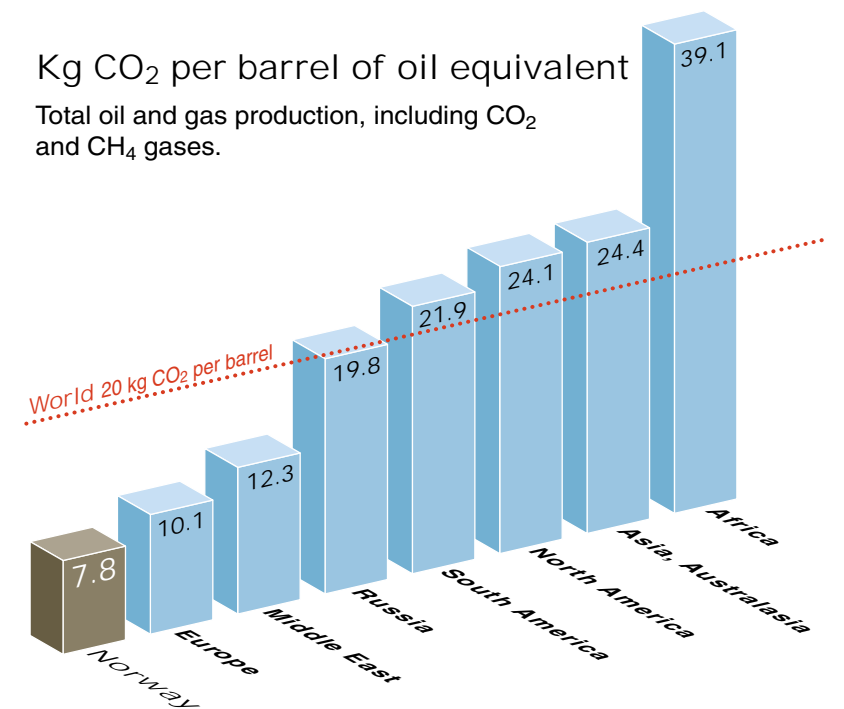
Mr Rosnes also believes that opportunities for utilising wind and hydro power should be explored, which would call in turn for an expansion in grid capacity. This is a complex area, he notes, and adds that Petoro's commitment will be governed at all times by its primary task of maximising the value of the SDFI portfolio.



## ENVIRONMENT-FRIENDLY GAS-FIRED POWER:

Replacing coal with gas is the most effective way of helping to reduce carbon emissions, say Jan Rosnes and Lars Arne Ryssdal. The Kårstø gas processing terminal stands north of Stavanger.

Photo: Dag Magne Søyland





# Turn up the gas taps

**Exporting more gas to Europe would be one of Norway's best contributions to the environment, says Ann Kristin Sjøtveit in Norway's KonKraft organisation.**

*Norway as an energy nation*, the first in a series of six KonKraft reports, identifies the main elements in the petroleum industry's contribution to Norwegian prosperity so far. The document makes it clear that global energy requirements will continue grow in line with rising living standards in coming years. Oil and gas will retain an important role.

## Reduction

Increased gas exports from Norway could cut European coal consumption, the report also states. Such a reduction is essential if the EU is to reach its climate targets.

"There's a direct and indisputable relationship between higher Norwegian gas exports and lower greenhouse gas emissions in Europe overall," says Ms Sjøtveit.

Norway is one of the world's cleanest petroleum producers, and its gas occupies a class of its own, she notes. From an environmental perspective, therefore, it is clear who should be a preferred energy supplier.

"The outlook is fairly complex," Ms Sjøtveit admits. "The petroleum



**ANN KRISTIN SJØTVEIT:** Wants to increase Norwegian gas exports.

Photo: Johannes Worsøe Berg

industry currently contributes about a third of government revenues as well as 220 000 jobs. To maintain good progress, this sector depends on making large new discoveries. There have been few of these over the past decade."

The industry is accordingly concerned to see regular licensing rounds and access to new areas of the NCS. Nordland VI and VII appear to contain the most promising acreage for new discoveries.

"In addition to continued work on the NCS, Norway must also commit to developing renewable sources such as hydropower, wind power and solar energy," says Ms Sjøtveit. "We have good opportunities to hold our own here."

## Predictability

The biggest challenges relate to timing and predictability, she notes.

"This industry works constantly in a long-term perspective. It takes about 15 years from the award of a licence

## FACTS | *KonKraft reports*

Work on the KonKraft reports was initiated last year by then petroleum and energy minister Odd Roger Enoksen. These studies are intended to allow players in Norwegian industry and petroleum production to present suggestions and recommendations on future strategy for the NCS.

KonKraft is an arena for collaboration between the Norwegian Confederation of Trade Unions (LO), the Federation of Norwegian Industries, the Norwegian Shipowners Association and the Norwegian Oil Industry Association.

### KonKraft reports:

- *Norway as an energy nation*
- *Production trends on the NCS*
- *Internationalisation*
- *Petroleum industry and climate issues*
- *Oil and gas activity in the far north*
- *Spin-offs from petroleum operations*

The Ministry of Petroleum and Energy is also pursuing a separate project concerning structural changes on the NCS.

until production can begin. Our future as a substantial energy supplier will be determined by political decisions taken today." □





**FRESH AIR.** "We and many other players have brought a breath of fresh air to the NCS," says president Anders Mørland at Dong E&P Norge AS.

Foto: Kjetil Alsвик

# New diversity on the NCS

**The player picture on the NCS has changed considerably in the space of a few years. StatoilHydro is the dominant operator, while Petoro represents a major partner. Meanwhile, the role of the big international companies is reduced and the number of small and medium-sized participants has exploded. What does this mean for developments?**

"Greater diversity on the NCS was sought by the Norwegian authorities, and that's what they've got," says Anders Mørland, president of Dong E&P Norge AS. "Today's player picture is adequate for meeting the development needs on the NCS. In my view, the government has secured a good result from its efforts."

Partly state-owned, Danish Dong has long experience of offshore operations in its domestic sector of the North Sea. Mr Mørland says that the company is well equipped to take on an interesting role in Norway. The roughly 60 employees in Stavanger already account for an annual turnover of about NOK 5 billion, while Dong operates four licences and has holdings in more than 30. It is due to drill two wells as operator in 2008.

## Exploration

A majority of Dong's licences are in the exploration phase, while production is under way on six of the fields in which it is a partner. The Oselvar discovery operated by the company is ready for



NCS: Sunset on Statford A.

Photo: Øyvind Hagen, StatoilHydro

development, as is the Trym find where Dong has taken over the operatorship from Shell.

"We and many other players have brought a breath of fresh air to the NCS," says Mr Mørland. At the same time, he emphasises the importance of

part than before.

"We see that its role may be affected by what's happened. Even though it doesn't have a large technical organisation, the company is now the other big player. An active and committed Petoro provides good support."

**"Within a decade, we'll be a much bigger player on the NCS than at present."**

Anders Mørland

its Norwegian operations to the parent company.

"As a neighbour to Denmark, Norway is a natural place for us to continue our development. And the prospects are unquestionably interesting."

He adds that the company is ready to join the move northwards and is keen to become involved in the Barents Sea if the opportunity arises.

## Different

Mr Mørland does not believe that the Statoil-Hydro merger will have any crucial influence on NCS operations, but admits that conditions are indisputably different.

"Before, of course, we had two large players who balanced each other out and had different views at times. That's now changed, but I don't think it'll have any decisive consequences. Having a number of players is important for the business as a whole, and that's what we've got, after all."

He also believes that Petoro could play a more significant

## Experience

Dong can draw on a varied range of experience. In addition to pursuing exploration for and production of oil and gas, it is heavily involved in producing alternative energy and in delivering energy on land.

"Here in Norway, our offshore presence is supplemented by an active involvement in energy deliveries," says Mr Mørland. "That includes construction, ownership and operation of the gas-fired combined heat and power station at Mongstad near Bergen. We're also involved in the test facility for carbon capture there. Big equity interests are held in Norwegian hydropower and wind energy, too, and we see big future opportunities in that segment."

Dong is an exciting company widely involved in the broader energy field, notes Mr Mørland, and sounds an optimistic note. "Within a decade, we'll be a much bigger player on the NCS than at present."

# Changed player picture

The player picture on the NCS has changed from a few years ago. StatoilHydro is the dominant operator and Petoro a major partner. While the position of the international companies has declined relative to the first two decades, the number of new medium-sized and fairly small players has exploded over the past two-three years. We have asked some participants for their response to the following question:

**"What expectations and/or possible concerns do you have about the new player picture on the NCS, and how would you describe your company's contribution to diversity in these waters?"**

## Haakon Haaland, E.ON Ruhrgas

As one of Europe's largest gas buyers, E.ON Ruhrgas has collaborated with Norwegian gas producers for many years. This has been a mutually fruitful relationship, where the partners have complemented each other. We believe the new player picture and the greater diversity it brings will be positive for the NCS and for our company.



E.ON Ruhrgas Norge is an operator and player on the NCS with a long-term perspective. Our primary focus is to find, produce and commercialise gas, but also oil. To do this, we will participate all along the value chain. We are active in exploration, new projects such as Skarv and as a partner in further development of fields such as Njord. Our contribution to the diverse picture is expertise and good links with the markets.

We have made a heavy commitment to the latter, with a big staff of very highly qualified personnel working on exploration and maturing discoveries.

Noreco contributes an organisation characterised by a high tempo and great decisiveness combined with expertise. We are based on quality, and want that to find clear expression through our work in-house and in cooperation with the Norwegian authorities, our partners and investors.



## Trygve Pedersen, Rocksource

To start with, I believe that developments in the player picture on the NCS in recent years have been fantastically positive. New participants account today for a growing share of activity, and thereby contribute to value creation on the NCS. This is the result of a conscious and very successful policy by the Norwegian government. I am confident it remains a desired development, so that the established frame conditions will show long-term stability and players will get access to new acreage. This is an extremely long-term industry, and short-term changes can be destructive for the player picture and thereby for value creation which benefits the whole community.

Rocksource is a company which gives great weight to research and development. We have developed technology and tools to improve the success rate of exploration drilling. In our view, this can help to enhance the efficiency of such work on the NCS through more effective use of rig capacity, and provide resource which can ensure a longer production life for infrastructure as well as the development of new area solutions. We differ in many respects from a traditional oil company in that our ambition is to be right in the forefront of technological progress, and not simply to coast on the experience we have acquired with previous employers.



## Patrice de Viviés, Total

We believe in diversity to strengthen value creation, and accordingly welcome all new players. Since 80 per cent of production is now operated by StatoilHydro, the consequences of this merger represent a challenge to diversity and competition on the NCS.

Total has the technical expertise and resources to contribute to genuine diversity and competition. Through a broad portfolio, it has made an active contribution to enhanced value creation on the NCS, and takes the view that greater competition over operator assignments will be crucial in realising the long-term potential for value creation in these waters.



## Scott Kerr, Noreco

In our view, the new player picture on the NCS will help to bring a larger number of mature areas into production and boost total resource utilisation. This enhanced value creation is important, and imposes great demands on company expertise – particularly for exploration.