

Oil and Gas Supply: The Perpetual Enigma

Forecasters always seem unable to predict oil supply with any degree of accuracy. The experience of the last decade has been no exception when the strength of the oil supply response from a very wide range of countries was unforeseen from both within and outside the industry. Even in more recent years it has proven difficult to predict non-OPEC oil supply. After many years of systematic underestimation, the experience of 1996 was also one of inaccuracy – but forecasters generally overcompensated and began to overestimate the strength of incremental supply. It is too soon to assess 1997 yet. However, the first indications are that some institutions have overestimated non-OPEC supply growth again, as in 1996.

Forecasting gas has, to some degree, been a different challenge. Market conditions are as important as upstream developments. However, the time between discovery and first production is often longer and even less predictable than that for oil and many projects have required complex contractual negotiations before progressing.

In light of the importance of the topic we have decided to establish a new series in the *IAEE Newsletter* with the specific aim of increasing understanding of world oil and gas supply developments. As a result, we will invite well informed analysts and practitioners to write brief articles on the latest developments in the provinces where they have particular expertise and insight. In this first edition we have focused on three *hot spots*: Norway, the United Kingdom and Angola. In future editions we will focus on additional areas, one at a time.

Readers are invited to open a correspondence with either the editors of the newsletter (IAEE@IAEE.org) or myself (daviespa@bp.com). Suggestions as to which provinces we should cover in future editions are welcomed.

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Perspective on Oil and Gas Developments on the Norwegian Continental Shelf

*By Arild N. Nystad**

Norway is the second largest oil exporter and the sixth largest oil producer in the world. Norway will supply Western Europe with significant amounts of its gas demand and gas imports. The Norwegian Continental Shelf will continue to be a significant and long term supplier of oil and gas.

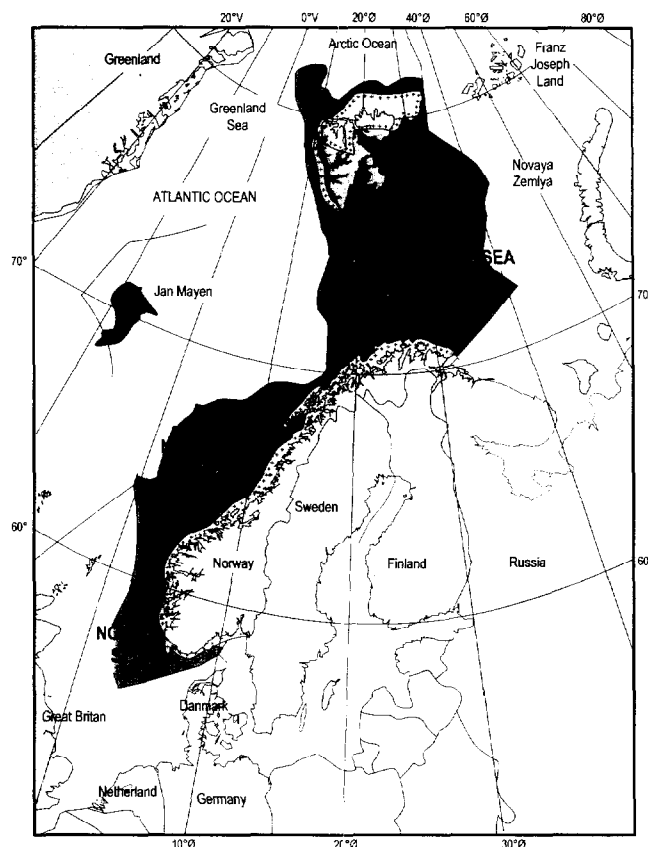
I will give three important observations in order to underline this: the first one relates to the geography and sedimentary areas, the second one relates to the petroleum stocks and the assets, and the third one relates to the production levels and production forecasts.

The areas with sedimentary rocks on the Norwegian Continental Shelf (See Figure 1) makes up 1.1 million km².

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So far about 55 percent of these areas are opened up for commercial prospecting and petroleum activities. Only 6 percent (60,000 km²) is currently in active licenses. There is still a multitude of possibilities and options for future prospecting in Norwegian waters.

Figure 1
Sedimentary Basins on the Norwegian Shelf



Let me review the three major areas on the Norwegian shelf.

In the North Sea we have had exploration activities for the last 30 years and have drilled about 700 exploration wells in an area covering 140,000 km². The major activities on the Norwegian Continental Shelf during these years have been concentrated in the North Sea. These areas still have very interesting resource potential.

In the Norwegian Sea areas, outside mid Norway, the total exploration areas were increased recently from 70,000 km² to 240,000 km². These areas contain deep water challenges in water depths between 1000 and 2000 m. One hundred twenty-five exploration wells have been drilled during the last 17 years in the Norwegian Sea. The very first exploration well in the newly opened deep waters is currently being drilled. The Norwegian Seas have an exciting future resource potential.

In the Barents Sea we have had exploration activities since 1980 and 50 exploration wells have been drilled in an area covering 235,000 km². So far there has been no commercial success in this vast area. The petroleum industry, however, has embarked on a renewed exploration effort.

Total Norwegian petroleum assets are now, according to the recent estimate from the Norwegian Petroleum Directorate, approximately 80 billion bbl o.e. (oil equivalent) oil and

gas. The distribution between oil and gas is about 50/50 – a little bit more oil, however, than gas. These numbers include the accumulated production of 13 billion bbl. o.e. oil and gas which means that only 17 percent of the total assets have been produced the last 25 years. The total number also includes an estimate of 22 billion bbl. o.e. undiscovered resources and 7.5 billion bbl. o.e. improved recovery in proven fields and discoveries. There are, of course, uncertainties attached to these numbers. Total assets are thus estimated to be between 60 billion and 100 billion bbl o.e.

Oil production from the Norwegian shelf is currently 3.2 million bbl/day plus 200,000 bbl/day condensate and NGL. This makes Norway the sixth largest oil-producer and the second largest oil-exporter in the world. The latest forecast suggests that oil production will reach some 3.7 million bbl/day just after the turn of the millennium. The production forecast uncertainties range from 3.2 to 4.2 million bbl/day.

Gas exports to Europe are currently 38 billion Sm³ annually and are expected to double to approximately 70 billion Sm³ within 5 years. This will represent a significant share of Europe's gas demand and gas imports. Even with these export levels the total stock of gas resources on the Norwegian shelf is expected to last for another 80-90 years. Gas planners within the major oil and gas companies, as well as within governmental bodies, discuss export levels between 80 and 90 billion Sm³ in their scenarios.

With gas exports of 70 billion Sm³, total gas production will reach 110 billion Sm³. Within 5 years we will increase gas injection into oil and condensate reservoirs from today's level of 16 billion to about 35 billion Sm³ in order to obtain improved oil and condensate production. Almost 40 percent of total gas production on the Norwegian shelf will be reinjected in the future. This reinjected gas will later be reproduced and exported. This means that there are close links and relations between the management of gas resources and the management of oil and condensate reservoirs on the Norwegian Continental Shelf. This fact significantly improves the total asset value of oil and gas on the Norwegian Continental Shelf to all participants.

Since the first licensing round in 1965, the Norwegian Continental Shelf has developed into one of the leading petroleum provinces in the world. At the same time the Norwegian oil and gas industry has been transformed into an important international position. The offshore challenges, and specifically the deep water challenges, are shared with provinces such as the West of Shetland, the Gulf of Mexico, offshore West of Africa and Brazil, as well as offshore areas in South East Asia. The technology developed in any of these areas is available on the global market for offshore technology.

During the last 25 years we have used about US\$200 billion (1996 prices) in exploration, investments and operational costs on the Norwegian Shelf. 50 percent or US\$100 billion of these are directly related to investments in field developments and transportation systems.

According to the forecast and scenarios for the next 25 years another US\$200 billion in exploration, investments and operational costs is expected. The relative share between investments in new installations and operational costs will be shifted towards relatively more operational cost elements. This also indicates a high level of activity in the Norwegian petroleum sector in the future.

But there are additional challenges related to a mature province like the North Sea where we will experience a shift from oil fields either on build-up or peak towards oil fields in decline, from a production based primarily on oil towards a more equal production between gas and oil, from huge fields of 2-3 billion bbl to a multitude of many smaller fields of 30-60-90 million bbl o.e. and even smaller. All these elements introduce new challenges that have to be solved.

The CRINE project on the UK shelf and the parallel NORSOK project on the Norwegian shelf are significant contributors to reduce costs and increase economic efficiency. In addition to these projects, there are additional cooperative projects between the oil companies and the authorities in order to create win-win situations between the different participants. Projects like DISKOS on data management, FORCE on improved recovery and FIND on improved exploration technologies are all good examples of constructive cooperative efforts to obtain commercial synergies.

The significant increase in oil production on the Norwegian shelf the last 10 years is to a large extent the result of a technology-driven process to improve recovery rates. The average recovery rate of oil fields has increased from 34 percent to 41 percent the last 10 years. We still believe it is possible to further improve this towards 50 percent within the coming 10 years. This is due to the combined effect of seismic technology and improved reservoir description, drilling technology and extended and horizontal wells and injection strategies of water, gas and WAG. All these improvements and additional oil volumes are equivalent to the introduction of a significant new oil province. These technology applications could also be envisaged in other provinces in the world.

We have produced 13 billion bbl o.e. (oil and gas) over the last 25 years of which oil makes up 75 percent. The next 25 years we expect to produce another 30 billion bbl o.e. of which oil will still have the major share of approximately 70 percent. From about the year 2020 the remaining stock for further production is estimated to 35 billion bbl o.e. But at this point of time, gas is expected to make up 75 percent of the assets. The production period from the Norwegian shelf is uncertain but Norway will most probably be a significant oil and gas producer far beyond the year 2050.

The Norwegian Continental Shelf still has a vast multitude of exploration targets and possibilities in all the major areas in the North Sea in the south, in the Norwegian Sea offshore mid Norway and in the Barents Sea in the very north.

There are high expectations for the new deepwater areas in the Møre and Vøring basins in the Norwegian Sea. All the major oil companies active on the Norwegian shelf have shown significant commercial interest in these new areas which were the target for the 15th concession round last year. The water depths vary from 800 m to 1400 m in these very promising licenses.

The existence of huge Tertiary and Cretaceous structures in the Norwegian Sea has been known since the late 1970s. Improved seismic data in the 1980s demonstrated high quality seismic hydrocarbon indicators in several of the major structures. The validity of these indicators was improved by seabottom seismic. Hence even if reservoir quality and source rock is unknown, the industry has great expectations for discovering petroleum in this frontier area. The challeng-

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Norwegian Continental Shelf (continued from page 5)

ing uncertainty is the amount of oil in addition to gas.

A new era of Norwegian exploration commenced in April when BP spudded the first of the Norwegian Sea deepwater wells on the Nyk High in the Vøring plateau. The well is in 1275 m of water, more than twice the previous record in Norwegian waters, and is the first of five wells planned in the next year to test licenses awarded in the 15th licensing round.

Following the BP well on Nyk High, we then expect, later on this year, new exploration wells on the Ormen Lange by Norsk Hydro as operator, on the Vema Dome by Statoil as operator and on the Helland Hansen by Shell as operator. Saga will drill the Gjallar Ridge in 1998.

There are, in addition, several other important licenses held by other operators. The initially explored licenses are independent and will open up for additional exploration in the adjoining areas.

We are talking here about several world class prospects. All the pre-drilling information available with the best technologies within seismic such as the seismic definition of accumulations, flat spots and direct hydrocarbon indicators and others suggests promising results. Success in the Norwegian Sea can add substantial reserves to the Norwegian reserve base.

When it comes to later field developments in these areas we expect to draw significantly on deep-water experiences from the Gulf of Mexico and deep-water developments in UK waters west of Shetland. Different types of Tension Leg Platforms (TLP) will be candidates. Further, floater concepts in general in combination with sub-sea installations, the Aker Spar concept and other solutions will be evaluated.

The international petroleum industry in Norway will face interesting and rewarding opportunities in the years to come and Norway will continue to be a major oil and gas producer far into the next century. The Norwegian Continental Shelf will, together with other important petroleum provinces like the Gulf of Mexico, continue to be important areas in the world for the development of new technologies and efficient ways to manage exploration and exploitation of hydrocarbons.

UK Oil Production - A Positive Outlook

By James Dyer*

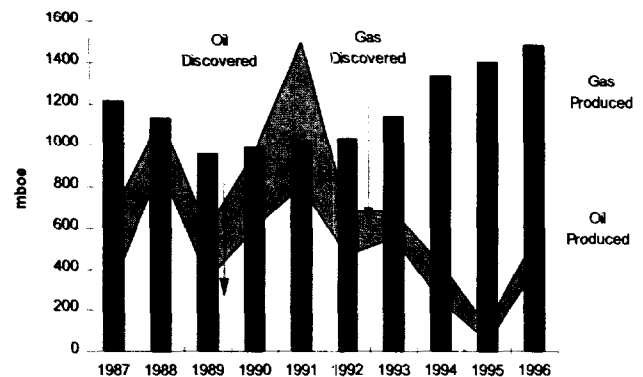
History

Offshore production from the UK Continental Shelf (UKCS) began in 1967 from the West Sole gas field. First oil production followed seven years later from the Argyll field located in the central North Sea. Since this time around 16 billion barrels of oil have been produced and some 8 billion barrels of oil (of reserves already discovered) remain to be produced. There are currently nearly 125 oil fields onstream on the UKCS which are estimated to produce 2.7 million barrels of oil per day in 1997.

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As Figure 2 highlights, for the last five years the volume of oil produced has not been replaced by new oil discoveries (at least those announced). However, there are now other less developed plays on the UKCS such as the West of Shetlands and Rockall Trough where exploration activity has recently been refocused. This has led to a number of significant oil and gas discoveries, with the first development, the BP-operated Foinaven field, due onstream in the second half of 1997.

Figure 2
UK Continental Shelf Production and Discovery Rates
(1987-1996)



Business Environment

The future production from UKCS is governed by the business environment in place now and in the future. For new reserves to be discovered there must be an incentive to drill. For reserves already discovered to be brought onstream, there must also be an incentive to develop. These incentives are influenced by both factors specific to the UK and those that are applied externally.

Incentives to drill include the prospectivity of the target province (the chance of finding hydrocarbons). Although the majority of the UKCS' oil and gas provinces are mature there is still geological potential. Of the 83 exploration wells completed in 1996, 17 (or 20 percent) found oil, gas or condensate. Although not a vintage year for exploration success, this compares to a 30 percent average for the UKCS since 1965. Indeed, the disclosure of further discoveries will increase this percentage.

The key area of interest during the most recent UKCS license round was West of the Shetlands where there have been a number of significant oil and gas discoveries. Recently BP announced the discovery of the Suilven oil field which is estimated to contain some 150 million barrels. This is the largest oil discovery since BP found the Schiehallion field, likewise located in the West of Shetlands. The size of the discoveries in this area highlights its importance as a new province and attracts companies requiring significant finds to replace reserves produced.

In so far as the UKCS offers some geological potential, there will be competition for E&A funds between regional divisions of international companies. Other hydrocarbon-bearing regions may offer greater prospectivity; the decision to invest in the UK as opposed to elsewhere will, in part, be influenced by the companies' reserve replacement strategy. Some companies may focus their E&A activity outside the UK.