MINISTRY OF ENVIRONMENT AND ENERGY
Danish Energy Agency

Oil and Gas Production in Denmark 1994

The Danish Energy Agency was established by law in 1976, and handles technical and administrative functions within the energy area for the Ministry of Environment and Energy. The Danish Energy Agency advises the Minister for Environment and Energy, the Government and the other ministries on energy matters.

On behalf of the Danish State, the Danish Energy Agency is to ensure the sound, safe and suitable development of Danish energy production, supply and consumption with due consideration for society, as well as safety and the environment.

The Danish Energy Agency prepares and administers energy legislation, hears appeals against local decisions made under the provisions of the Danish Electricity and Heat Supply Act, administers various subsidy schemes, and supervises the activities of the licence holders in the North Sea.

The Danish Energy Agency collects and systematizes data regarding energy production, supply and consumption, distributed on relevant sectors and ultimate use. The Agency performs analyses and evaluations of the development within the energy area, makes assessments and prepares forecasts for Danish oil and gas resources, and also performs follow-up work on 'Energy 2000, a Plan of Action for Sustainable Development'.

The Danish Energy Agency works closely with local, regional and national authorities, energy distribution companies and licence holders, etc. At the same time, the Danish Energy Agency maintains relations with international partners in the energy area, including the EU, IEA, as well as the Nordic Council of Ministers.

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Foreword

This is the Danish Energy Agency's 1994 report on the development in exploration and production of oil and natural gas in Denmark.

As in previous years, the report includes the Danish Energy Agency's most recent five-year and twenty-year forecasts of Danish oil and natural gas production, as well as an assessment of Danish oil and natural gas reserves at January 1, 1995.

Activities in the oil and gas sector remain at a high level, and a number of extensive development projects have been initiated, both for new and old fields. Investments in new wells and production facilities are expected to peak in 1995 in an amount approaching DKK 6 billion.

These substantial investments form the basis for the continued favourable development in Danish oil production. The Danish Energy Agency expects that this development, combined with the expected increase in production and export of natural gas, will make Denmark fully self-sufficient in energy, and presumably also a net exporter, from the end of this decade.

The Fourth Licensing Round in Denmark was opened in July 1994 and closed with the awarding of nine new exploration and production licences, indicating that oil companies continue to be highly interested in exploration in Denmark. As a result, exploration activity will increase substantially in the years to come.

As in 1993, exploration activity was moderate in 1994, and no new discoveries were made. However, the Amerada Hess group drilled a new well in the South Arne accumulation, thus renewing optimism about the discovery.

The environmental impact of the oil and gas activities, particularly the issue of reducing the emission of greenhouse gases from the production facilities in the North Sea, are dealt with in a special section of the report this year.

Copenhagen, June 1995

Ib Larsen, Director

Conversion Factors

Conversion Factors

1 m^3 Crude Oil = 0.858 tonne ≈ 36.7 GJ

1 m^3 Motor Gasoline = 0.75 tonne ≈ 32.9 GJ

1 m^3 Middle Distillate = 0.84 tonne ≈ 35.9 GJ

1 m^3 Heavy Fuel Oil = 0.98 tonne ≈ 39.6 GJ

1 barrel = 0.159 m^3

1 t.o.e. = 41.868 GJ

1 t.o.e. ≈ 1.141 m^3 Crude Oil

1 t.o.e. ≈ 1,074 Nm^3 Natural Gas

1,000 Nm^3 Natural Gas = 37,239 scf ≈ 39.0 GJ

1 Nm^3 Natural Gas = 1.057 Sm^3

1 tonne Steam Coal ≈ 25.7 GJ

1 tonne Coal (other) ≈ 26.5 GJ

Nm^3 (normal cubic metre), at 0°C, 101.325 kPa

Sm^3 (standard cubic metre), at 15°C, 101.325 kPa

scf (standard cubic foot), at 15.6°C, 101.56 kPa

Contents

1. Licensing

Fourth Licensing Round

Licence Terms

In July 1994, the Fourth Licensing Round was opened. In contrast to the three previous licensing rounds in Danish territory, only part of the unlicensed Danish area was offered for licensing. Based on the exploration experience gained to date and the interest displayed by oil companies, the area west of 6° 15' east longitude in the Danish sector of the North Sea was offered for licensing. This area comprises the Central Graben and is delimited towards the east by the potential extension of hydrocarbons generated in the Central Graben.

The financial terms of the licences were relaxed considerably in conjunction with the Third Licensing Round in 1989 in order to make it attractive for the oil companies to invest in exploration in the Danish area. This relaxation should be viewed in light of the competition from other countries for the oil companies' investments, as well as the relatively low oil prices.

The Fourth Licensing Round was based on the following main terms:

- No requirement for a mix of applications for high- and low-risk areas.
- No requirement for an option for the state to buy oil and natural gas under the new licences.
- No requirement for agreements about research, development and training in relation to the new licences.
- Compulsory 20% state participation, but without a carried interest for the state-owned company DOPAS. No sliding scale that could increase the state-owned company's share in step with increasing production.
- A flexible form of licensing, making it possible for groups of companies and individual companies to submit applications. Applications for operatorships to be made separately.

When the time limit for submitting applications expired on January 2, 1995, 12 applications had been received from applicants representing 17 companies.

Licences Awarded

Following negotiations with the applicants, the Minister for Environment and Energy issued nine new licences in May 1995. The new licences concern 32 blocks out of the total 92 whole or part blocks for which applications could be submitted. The licences cover an area of about 4,250 km^2 out of a total area offered for licensing of about 15,600 km^2. Three of the licences cover areas east of the Central Graben.

The licensees foresee that their potential discoveries will range from a yield of a few million barrels oil equivalent to about 1,100 barrels oil equivalent.

The combined work programmes provide for the drilling of six unconditional wells (wells that licensees are obligated to drill) and eight conditional wells (wells that are to be drilled under more closely defined circumstances). In addition, the licensees are obliged to perform seismic surveys, including 3D seismic surveys. As a main rule, the conditional drilling obligations under the work programme for a licence take the form of a so-called *drill or drop* obligation. This means that if the well is not drilled, the licence is to be relinquished, in whole or in part, within a specific time limit before the expiry of the general six-year term of an exploration licence.

The investments to be made in connection with the unconditional commitments under the work programmes agreed upon are estimated at approx. DKK 600 million. The conditional work programmes will require investments of approx. DKK 750 million.

The composition of the groups of companies that have been awarded licences appears from Appendix B, while the geographical location of the licence areas is shown by Fig. 1.1.

The Amerada/Premier group has been granted a licence (1/95) in the southwestern corner of the area offered for licensing, while the Amerada group has been awarded a licence (2/95) for two areas adjoining licence 8/89. The work programme under licence 2/95 can either be performed within the area covered by that licence or by licence 8/89. Amerada Hess is operator for licence 1/95, while DANOP is operator for licence 2/95.

In autumn 1994, Amerada Hess acquired Norsk Hydro's exploration company in Denmark and thus obtained a share in licences 7/89 and 8/89. Premier has not previously held any licences in the Danish area.

The Statoil/DANOP group has been granted a licence

(3/95) in the northeastern part of the area offered for licensing, comprising two areas adjoining the group's existing licence area (2/90). The work programme under the licence may either be performed in the area covered by the new licence or that covered by licence 2/90. DANOP is operator.

The Mobil/RWE-DEA group has been granted a licence (4/95) in the northeastern part of the area offered for licensing. DANOP will act as operator for exploration under the licence. The companies Mobil and EWE have not previously held licences in the Danish area.

The Phillips group has been awarded a licence (5/95) for an area in the northwestern corner of the area offered for licensing. Phillips is operator under the licence. Phillips has previously held licences in Denmark, while Pelican is a new company in Danish territory.

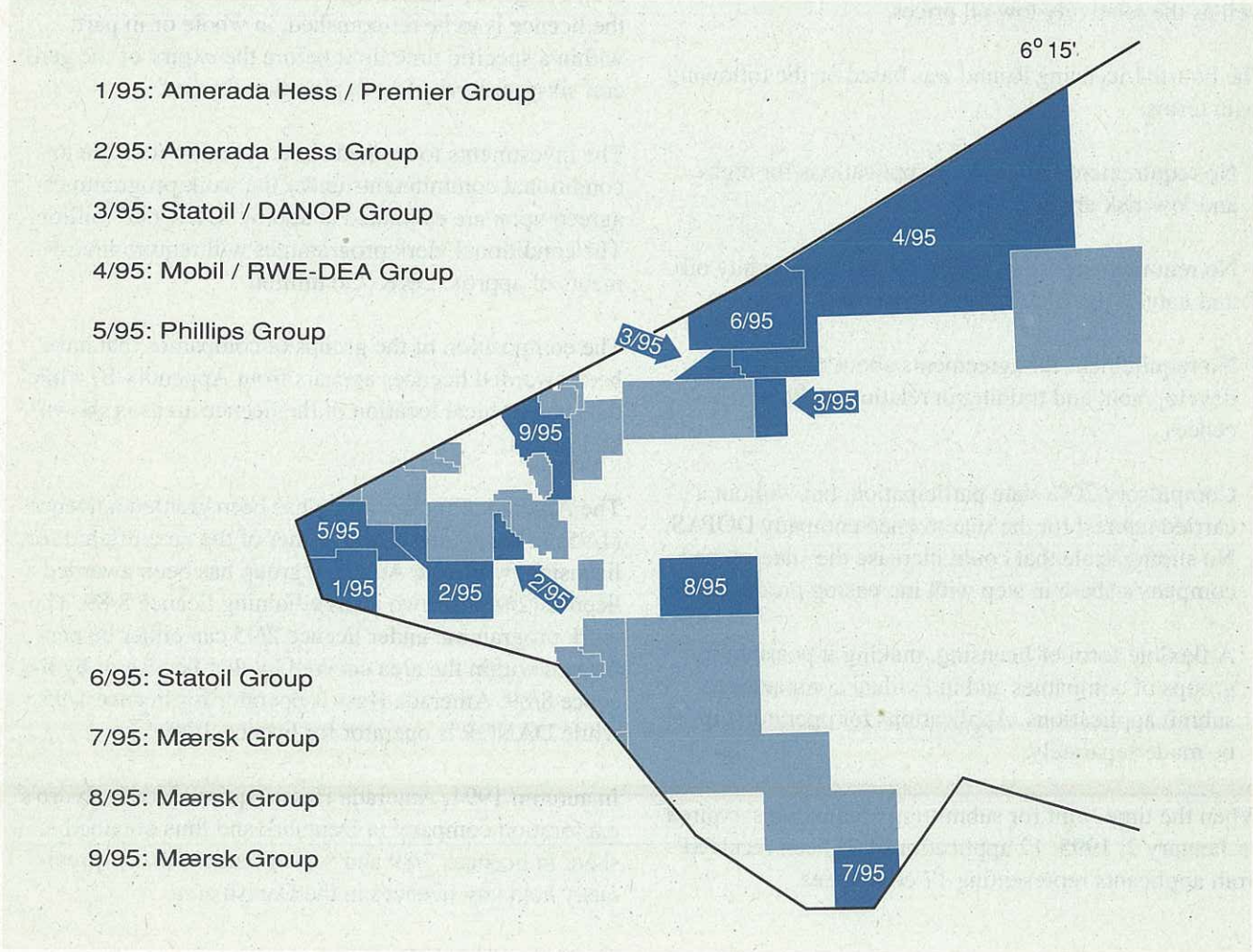
The Statoil group has been granted a licence (6/95) in the northeastern part of the area offered for licensing. Statoil is operator under the licence.

The Mærsk group has been awarded three licences (7/95, 8/95 and 9/95) in areas bordering on the area covered by the 1962 Sole Concession. Mærsk Olie og Gas AS is operator.

A number of the applications submitted in the Fourth Licensing Round reflected the fact that new experience gained from exploration abroad has made certain parts of the area offered particularly attractive. This is true of the area comprised by the Amerada Hess/Premier licence that borders on the UK continental shelf. This is the first time that this area has been licensed since licensing rounds were introduced in 1983.

On the UK side of the continental shelf, Amerada Hess is operator under a licence for the Fife Field and the de-

Fig. 1.1 Licences Granted in the Fourth Licensing Round



pleted Angus Field. Experience from other countries has also had significance for the northeastern area comprised by the Statoil licence.

As mentioned above, applications could be submitted by groups of companies as well as individual companies. Likewise, it was possible to apply for shares of licences of less than 100% (80%, when the share held by the state-owned company DOPAS is deducted). Therefore, separate applications had to be filed for operatorships under the licences.

Several groups indicated that they requested a share of a licence or that they were prepared to include other companies in the group. Thus, two of the groups holding new licences have been established by combining several applications. This is the case for the Phillips licence and the Mobil/RWE-DEA licence.

This licensing form has resulted in greater exploration activity than if the option to apply for shares of licences had not existed.

All the applications for operatorships received were filed as part of an application for a whole licence or a share of a licence. Thus, no applications for operatorships completely independent of the groups formed were received. Only in the cases when new groups were formed by combining several applications was it necessary to elect an operator from among the applicants. In these situations, the election was made following negotiation with the groups involved.

Given the lower oil prices and the modest results of exploration in the previous rounds, the overall outcome of the Fourth Licensing Round is highly satisfactory.

Revision of the Subsoil Act

In 1994, work on revising the Danish Subsoil Act was commenced. The Bill was tabled in the Danish Parliament on January 18, 1995, and was adopted on April 25, 1995. The main objective of the revision is to implement the Licensing Directive, which lays down common rules for the granting of oil/gas licences, necessitating a number of amendments to Danish legislation in this respect. The Directive must have been implemented by the member states not later than July 1, 1995.

Another objective in revising the Act is to create a legal basis for a more flexible procedure for awarding oil and gas licences through the introduction of the so-called *open door* procedure.

In addition, the implementation of the Licensing Directive is an essential prerequisite for the approval of Denmark's application for permission for Danish licensees to employ the administratively simpler procurement procedure according to Article 3 in the Procurement Directive. In 1995, the Danish Energy Agency will draw up the regulations required so that the Commission can approve such an exemption from the purchasing procedures.

The European Energy Charter

The Charter was signed by 50 countries in December 1991 as a policy statement for the energy sector. In promoting this cooperation, the first part of a legally binding Treaty and a Protocol about energy efficiency were signed by 46 countries at a conference of Ministers in Lisbon on December 17, 1994.

Once the Treaty is ratified, the parties are obligated to comply with a number of fundamental market economy principles with a view to promoting privatization in the energy sector, primarily in the Eastern European countries, the main target group of the cooperation. The cooperation focuses on non-discrimination, trading and competition regulations, access to markets, transit, expropriation, tax regulations, etc.

2. Exploration

As expected, the scope of exploration activities was limited in 1994. Thus, only two wells were spudded in 1994: one as part of the appraisal of the Tyra Southeast accumulation, the other as part of the continued exploration in the areas awarded in the Third Licensing Round.

An outline of the companies that hold licences for exploration and production in Danish territory is shown in Appendix B. The outline has been updated on the basis of the licences most recently granted in the Fourth Licensing Round. The map of licence areas at the back of the report shows the geographic coverage of licences awarded. A more detailed map of licences in the western part of the area is contained in the section on *Licensing*.

Exploratory Surveys

In total, 1,352 km of seismic surveying data were collected in 1994. As appears from Fig. 2.1, the activity declined markedly in relation to previous years. While a vast amount of 3D seismic surveying data have been collected in recent years, this type of survey was not made in 1994. However, the amount of new 2D seismic data collected reached the same level as in previous years.

Fig. 2.1 Annual Seismic Surveying Activities

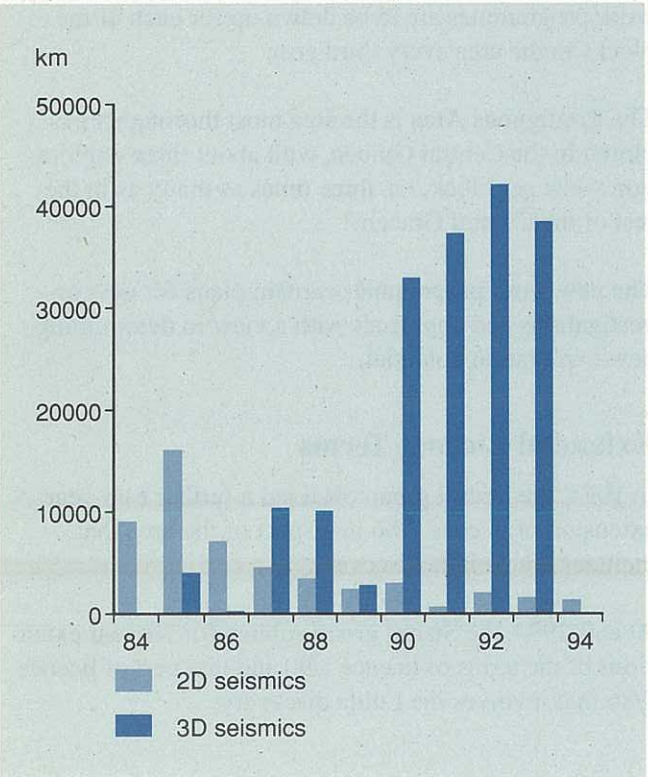
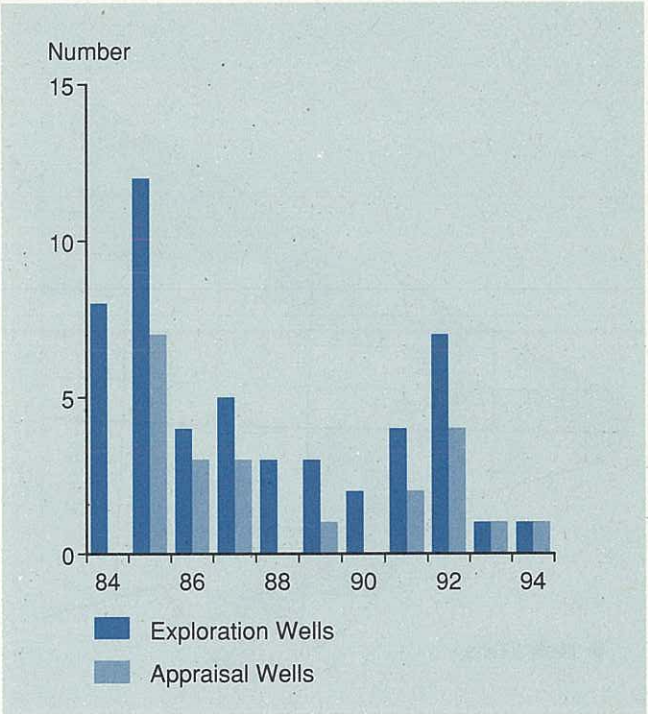


Fig. 2.2 Exploration and Appraisal Wells



The decline in 3D activities is due, in part, to the completion by DUC in 1993 of a major 3D seismic programme that extended over several years in the so-called Contiguous Area. Thus, the majority of DUC's areas are covered by up-to-date 3D seismic surveying data.

Drilling Activities

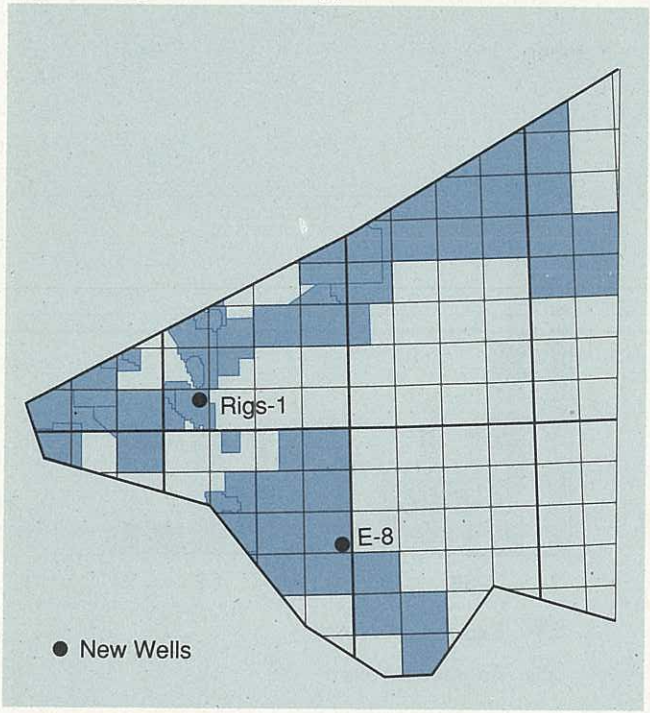
In 1994, the following two exploration and appraisal wells were spudded in the Danish area, both in the Central Graben (see Fig. 2.3). The level of activity corresponds to the 1993 level (see Fig. 2.2).

Rigs-1 (5604/29-4)

Amerada Hess, which became operator in the Danish area in 1994 after taking over Norsk Hydro Udforskning a.s. in Denmark, spudded the Rigs-1 well at end-1994 under licence 7/89. The well, which was drilled with the objective of appraising the South Arne discovery and exploring for hydrocarbons in deeper layers, terminated at a depth of 3,050 metres below sea level in Early Cretaceous layers.

The South Arne discovery, which consists of deposits in chalk layers of Early Tertiary/Late Cretaceous age, was originally made by DUC in a well drilled in 1969. In the Third Licensing Round, the then Norsk Hydro group was granted an exploration licence for the area, and the Baron-2 well drilled by the group in 1991 confirmed the

Fig. 2.3 Exploration and Appraisal Wells in 1994



presence of hydrocarbons in the southwestern part of the structure.

The Rigs-1 well established that the reservoir in the northern part of the structure has good production properties, as oil was produced from the chalk at satisfactory production rates in a production test.

The Amerada Hess group now plans to acquire 3D seismic data over the structure.

E-8 (5504/12-7)

In connection with delineating the southeastern part of the Tyra Field, Mærsk Olie og Gas AS drilled the E-8 well in the second quarter of 1994. The well confirmed the presence of hydrocarbons, and a production test was carried out.

Appraisal Activities

Lulita

At end-1994, the Statoil group completed the appraisal programme for the Lulita discovery, and based on the appraisal made, it was ascertained that the accumulation is commercially exploitable.

In the Danish area, the Lulita discovery also straddles DUC's licence area at the Harald Field. Before production can be initiated, an agreement will have to be made between the licensees that have a right to the discovery.

The Lulita oil discovery was made in Jurassic sandstone layers at a depth of approx. 3,750 metres. These sandstone layers form part of the Middle Jurassic Bryne Formation, which also incorporates the reservoir in the Harald West gas accumulation.

Amalie

The Statoil group is also continuing its appraisal of the Amalie discovery with a view to clarifying whether there is a basis for commercial exploitation of the discovery, which was made in the Amalie-1 well drilled in 1991.

Skjold Flank

Based on appraisals of the Skjold Flank, DUC has concluded that at present there is no basis for initiating production in this area. The discovery was made by DUC with the Skjold Flank-1 well in 1991.

New DUC Work Programmes

In 1994, the Danish Energy Agency approved new work programmes for the blocks in DUC's Contiguous Area. Under the 1981 Agreement with A.P. Møller, six-year work programmes are to be drawn up for each of the blocks in the area every third year.

The Contiguous Area is the area most thoroughly explored in the Central Graben, with about three exploration wells per block, i.e. three times as many as in the rest of the Central Graben.

The new work programmes contain plans for new investigations and appraisals with a view to determining new exploration potential.

Extended Licence Terms

In 1994, the Statoil group obtained a further two-year extension of licence 7/86 in respect of the area that includes the Amalie discovery.

At end-1994, the Statoil group applied for 30-year extensions of the terms of licence 1/90 and that part of licence 7/86 that involves the Lulita discovery.

Relinquishments

In 1994, two licences were relinquished, viz. licences 9/89 and 11/89 from the Third Licensing Round. In addition, part of the area comprised by licence 7/86 was relinquished.

The RWE-DEA group's 11/89 licence, which covered an area in the Central Graben, expired in May 1994.

In December 1994, the Jordan group's 9/89 licence for an area near Give in Jutland expired. Under this licence, the exploration well Jelling-1 was drilled in 1992, without encountering traces of hydrocarbons.

In connection with the extension of the Statoil group's 7/86 licence, part of the original licence area was relinquished.

Released Well Data

Generally, data collected under licences granted in pursuance of the Danish Subsoil Act are protected by a five-year confidentiality clause.

However, the confidentiality period is limited to two years for licences which expire or are relinquished.

In 1994, data regarding the following exploration well in Jutland were released:

Jelling-1	5509/10-1	DANOP

All information about released well data, including seismic surveying data, etc. collected in connection with exploration and appraisal activities, is provided by the Geological Survey of Denmark.

3. Production

In 1994, Danish oil and gas production took place in nine fields, Dan, Gorm, Skjold, Rolf, Tyra, Kraka, Dagmar, Regnar and Valdemar. Dansk Undergrunds Consortium, DUC, is in charge of recovery from all these fields. The operator is Mærsk Olie og Gas AS.

All the fields are situated in the Contiguous Area in the southern region of the Central Graben.

Oil and Gas Production

Total oil and condensate production in 1994 amounted to 10.73 million m^3, equal to 9.22 million tonnes, a 10% increase as compared to 1993.

Gas production amounted to 6.27 billion Nm^3 (normal cubic metres), almost equal to the production in 1993. Of this amount, 3.65 billion Nm^3 was extracted from the Tyra Field, while the balance was associated gas produced in conjunction with oil in the other fields. Of the gas produced, 4.33 billion Nm^3 (69%) was supplied to Dansk Naturgas A/S, while 1.45 billion Nm^3 (23%) was reinjected into the Gorm and Tyra Fields. The rest of the gas produced was consumed or flared on the platforms.

Fig. 3.1 shows the development of Danish oil and gas production in the period from 1984 to 1994. Gas production comprises gas supplied to Dansk Naturgas A/S and gas utilized on the platforms.

Fig. 3.1 Production of Oil and Natural Gas

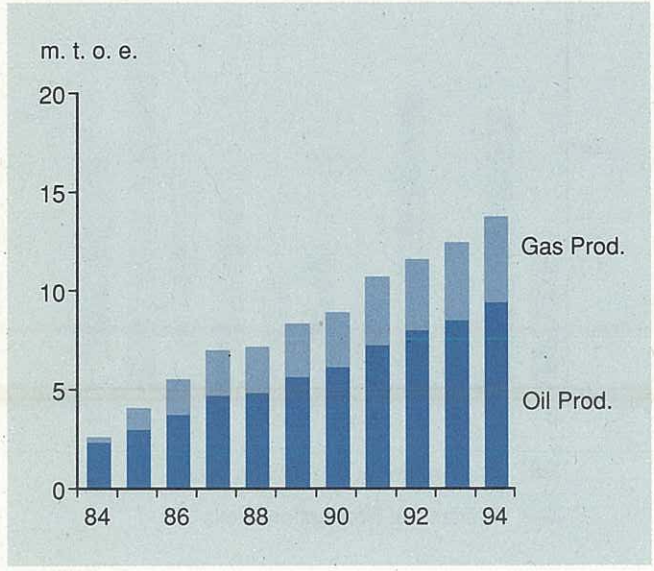


Fig. 3.2 shows the development in gas supplies to Dansk Naturgas A/S since the start of gas production in 1984, broken down by field.

The annual oil and gas production figures for the period from 1972 to 1994 are shown in Appendix E, together with an outline of gas sales from 1984 to 1994, distributed on individual fields. Appendix E also provides an outline of monthly production of oil and gas for 1994.

Gas Flaring

A fraction of the gas produced (4.8%) is used for energy supplies to the platforms in the North Sea, while a slightly smaller amount (3.1%) had to be flared, and thus was not utilized. In 1994, the amount of gas used for energy supplies (as fuel) constituted 299 million Nm^3.

The gas not utilized (flared) in 1994 amounted to a total of 196 million Nm^3, of which 8 million Nm^3 was sour gas (i.e. containing hydrogen sulphide) from the Dagmar Field. The gas produced in the Dagmar Field is flared due to the problems connected with utilizing the poisonous gas from the field.

Developments in 1994 in General

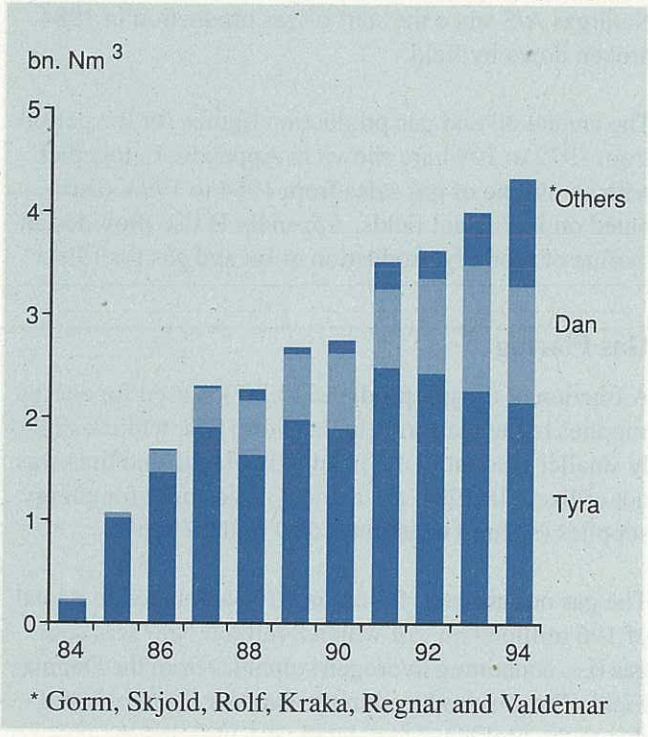
In 1994, the development of the four major fields, Dan, Gorm, Skjold, and Tyra, was continued. In the smaller Kraka and Valdemar Fields, production was commenced from new wells.

The two new platforms in the Skjold Field were hooked up and commissioned in summer and autumn 1994. At the Dan and Gorm Centres, the water-injection capacity has been expanded following the commissioning of new facilities. For the Dan and Gorm Fields, this meant that the amount of injected water more than doubled in 1994 in relation to the year before.

In accordance with the approved plans, the development of the Dan, Kraka and Valdemar Fields was completed in the course of the year. An application for approval of a minor development plan for the Valdemar Field was submitted in October. In the Dan Field, only the conversion of the last wells into water-injection wells is outstanding.

In May, a development plan for the minor Alma gas field was submitted, proposing that it be developed as an unmanned satellite to Dan F. This field is to be brought on stream in 2003. The plan was approved by the Danish Energy Agency in March 1995.

Fig. 3.2 Natural Gas Supplies Broken down by Field



* Gorm, Skjold, Rolf, Kraka, Regnar and Valdemar

In December, the Danish Energy Agency approved the establishment of wellhead compression at the Gorm Centre, which will help enhance and accelerate recovery from Gorm, Skjold and Rolf. The wellhead compression facilities will be placed on a future fourth deck on the Gorm F platform and are expected to be commissioned in 1997.

In February 1995, DUC submitted a plan to the Danish Energy Agency for further development of the Dan Field. The plan involves a substantial increase of production from the Dan Field, and proposes that the water-injection (secondary recovery) project be expanded to include the whole field. The plan provides for a substantial expansion of the production facilities in the field, including a new wellhead and processing platform, Dan FF, to be connected to the Dan F facilities.

The high production rates achieved at end-1993 were maintained throughout 1994, excepting the summer period, when the seasonal fluctuations in gas sales, combined with commissioning and maintenance operations in the fields, resulted in a decline in production.

Production Wells

In 1994, 19 new horizontal production and injection wells were completed in connection with developing the Danish fields in the North Sea. The figure has fallen somewhat in comparison to the 1993 calendar year, when development activities in the Danish fields reached a record high with the completion of 28 new wells.

The number of horizontal wells in operation in the Danish area has now been brought up to a total of 84, of which 70 are production wells and fourteen are water-injection wells, while the number of wells in operation has now reached a total of 201.

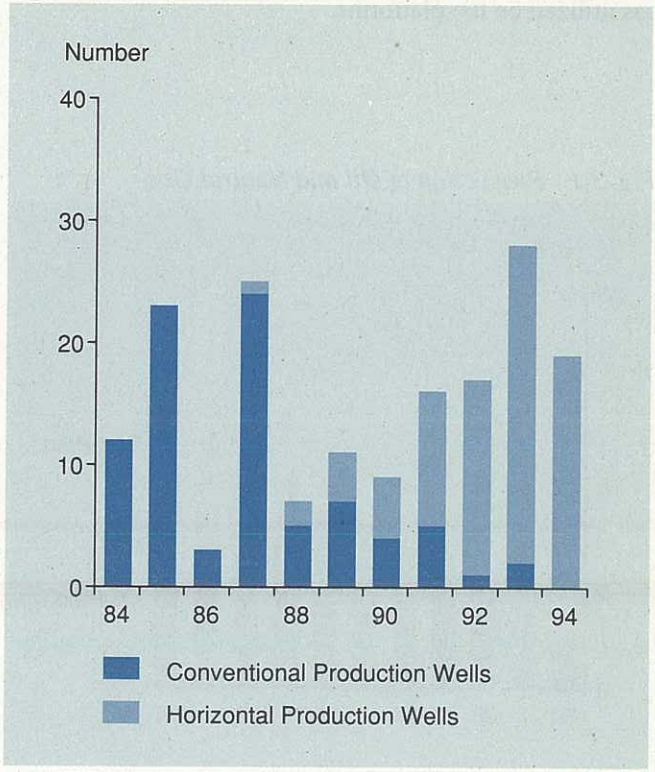
The development in the number of production wells completed in the period from 1984 to 1994 is shown in Fig. 3.3.

The new production wells completed in 1994 are distributed as follows: six wells in the Dan Field, five in the Tyra Field, five in the Gorm Field, two in the Kraka Field and one in the Valdemar Field.

New Drilling Technique

In 1994, one of the most important tools for the operation of measuring equipment and sliding side-doors in horizontal wells was given a new application, viz. drilling. The tool in question is *coiled tubing*, i.e. 2" steel piping wound on a big drum, which can be moved in and

Fig. 3.3 Production Wells



out of the well through a system of packers and valves, while the well is producing. The drill bit is rotated by a turbo-engine driven by the fluid pumped down through the approx. 4 km long tubing. The return flow is processed at the surface, where the cuttings are analyzed, and the oil and gas are conveyed to the ordinary processing facilities on the platform.

This method allows drilling without the use of a conventional rig, and makes it possible to deepen or add well fingers to existing wells without dismantling any of the production equipment mounted in the well.

The new drilling technique has been used three times in Danish fields, most recently without a drilling rig, thus making it possible to achieve quite substantial savings.

Mærsk Olie og Gas AS first used the coiled tubing drilling technique in the Gorm Field, where the company set a world record by drilling N-49, a 1,000 metre horizontal well in chalk. From the outset, the objective of this well was to test the technique, as opposed to the next well, Kraka A-5, where the innovation consisted in drilling through the production string and the casing, approximately halfway through the horizontal section of the well. In this case, the new well finger was lined with approx. 300 metres of perforated tubing.

The most recent example of drilling with coiled tubing is the extension of an existing well, MFB-22, in the Dan Field by approx. 400 metres, in order to exploit the very thin oil zone at the flank of the field.

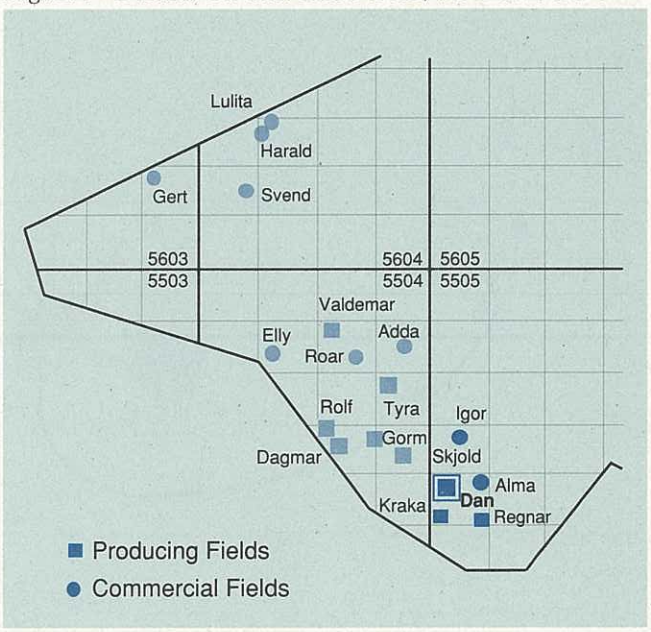
Producing Fields

The Danish producing oil and gas fields are grouped round three processing centres, the Dan, Gorm and Tyra Centres. The following description of the nine fields is based on this grouping of fields.

Figs. 3.4, 3.7 and 3.10 show the present status and location of Danish commercial oil and gas fields, while existing and approved production and pipeline facilities for oil and gas appear from Figs. 3.5, 3.8 and 3.11. Installations under construction at the beginning of 1995 are distinguishable by their colour.

Appendix G provides an outline - with supplementary data - of producing fields, field developments in progress as well as new field developments.

Fig. 3.4 Danish Oil and Gas Fields, the Dan Centre



The Dan Centre

This centre is composed of the Dan Field with the adjacent satellite fields, Kraka and Regnar. The Igor and Alma Fields, as yet undeveloped, are also to be developed as satellites to Dan. The development in oil production from the fields at the Dan Centre is shown in Fig. 3.6.

Total gas production from the fields at the Dan Centre amounted to 1.41 billion Nm^3 in 1994, of which 1.28 billion Nm^3 was transported to shore via the Tyra Centre. The rest of the gas was used as fuel or flared.

Dan

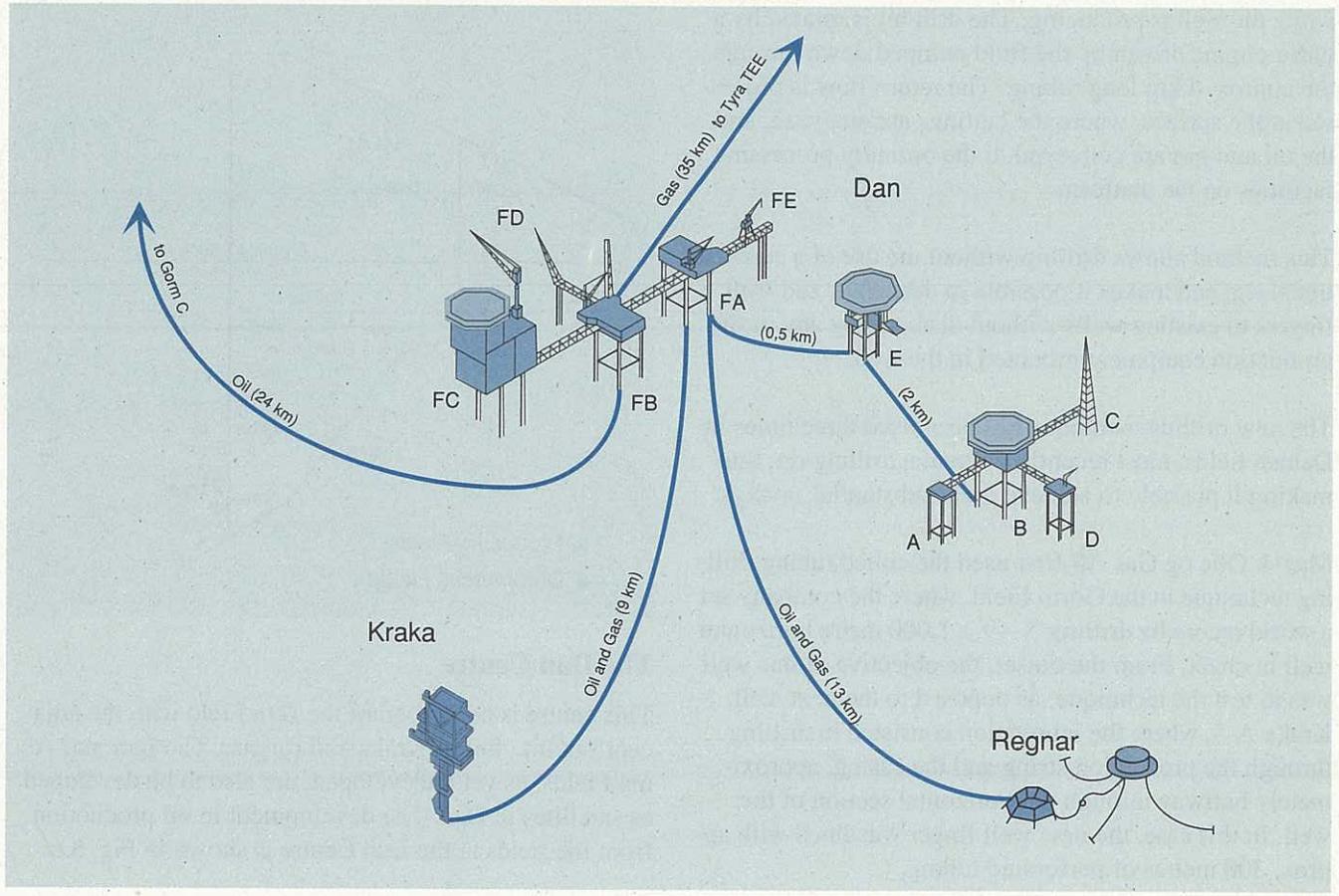
Dan is an oil field with a gas cap. Production was initiated in 1972.

After processing at Dan FC, oil and gas are transported to shore through the Gorm and Tyra Centres, respectively.

The field was developed in phases through the 1970s, and the Dan F project, consisting of a new production centre with 24 wells, was implemented in 1987. Since then, primary recovery has been enhanced in several phases, and in parts of the field, secondary recovery through water injection has been initiated. Following the completion in 1994 of the most recent development plan from 1991, the number of wells has now been brought up to a total of 78, of which 40 are horizontal.

The Dan water-injection project provides for a total of 27 water-injection wells, of which 20 wells were

Fig. 3.5 Production Facilities in the North Sea, 1995, the Dan Centre



existing wells that had been converted into water-injection wells by the end of 1994.

In addition, pilot projects providing for high-rate water injection have been implemented, a means of fracturing the reservoir, aimed at displacing the oil more efficiently.

In connection with implementing the plans now completed, extensive experience has been provided for subsequently extending the secondary oil recovery technique to the other parts of the field, the southeastern flank of the field in particular, and to the area under the gas cap. An application in this respect was submitted for the Danish Energy Agency's approval in February 1995. Among other things, the plan involves a considerable expansion of the production facilities at the Dan Centre, including the establishment of a new wellhead and processing platform, and the drilling of up to 42 new wells.

In the period from 1989 to end-1994, a total of 6.65 million m^3 of water was injected into the Dan Field. In 1994, 3.81 million m^3 of water was injected against 1.53 million m^3 in 1993.

In the course of 1994, five horizontal wells were completed in the field, one of them being an existing conventional well that was sidetracked. This figure is considerably lower than in 1993, when 13 wells were completed. With the implementation of the 1991 development plan, the existing capacity of the wellhead platforms in the Dan Field had been fully utilized by end-1994.

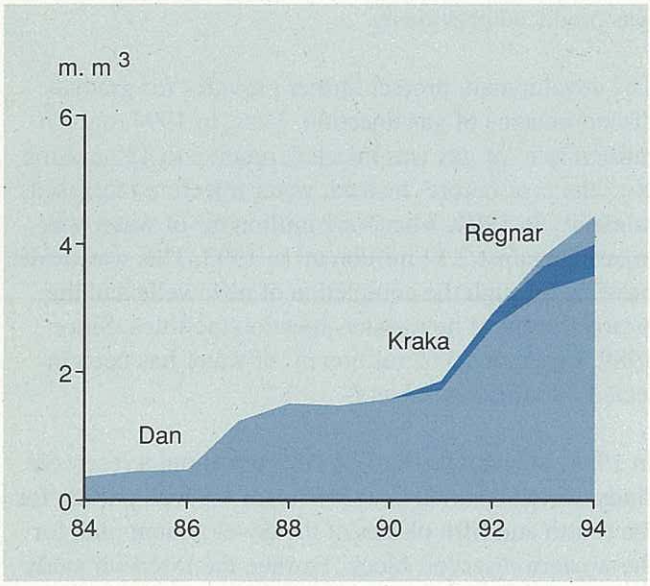
In 1994, Dan produced 3.50 million m^3 of oil compared to 3.26 million m^3 in 1993. Gas production amounted to 1.26 billion Nm^3.

Kraka

Kraka is an oil field with a gas cap. The field, which is located approx. 7 km southwest of the Dan Field in the Contiguous Area, has been developed as a satellite to the Dan Field. Production from the field was initiated in 1991.

The first phase of the field development consists of the drilling of six horizontal wells, of which the last three commenced producing in 1993/94. Production experi-

Fig. 3.6 Oil Production from the Fields at the Dan Centre



ence from the last three wells, in particular, is encouraging, and expectations for future recovery from the field have grown considerably.

According to the Ministry of Energy's approval of May 11, 1994, DUC is to submit a plan for the second phase of the further development of the field by July 1, 1996, at the latest.

In 1994, 0.49 million m^3 of oil was produced at the Kraka Field, as compared to 0.39 million m^3 in 1993.

Regnar

The Regnar Field is an oil field situated approx. 13 km southeast of the Dan Field in the Contiguous Area. The field was developed as a satellite to the Dan Field and was brought on stream in 1993. Production takes place from a subsea-completed well. The subsea production system is remotely controlled from Dan FC. Oil is produced from a single well of the conventional type.

The field consists of a small accumulation of oil in a heavily fractured chalk reservoir, with the same characteristics as other Danish fields such as Skjold, Rolf and Dagmar.

As was the case for these fields, it is difficult to anticipate how much oil can be recovered from Regnar. Based on the production experience gained to date, the period of production is expected to be fairly short.

In 1994, 0.43 million m^3 of oil was produced at the Regnar Field, as compared to 0.15 million m^3 in 1993, when the field only produced for about three months, however.

The Gorm Centre

This Centre is composed of the Gorm Field and the adjacent satellite fields, Skjold, Rolf and Dagmar. The pipeline owned by DORAS leads from the Gorm Centre, conveying oil and condensate from the Danish fields in the North Sea to the west coast of Jutland, and from there to the terminal facilities near Fredericia on the east coast.

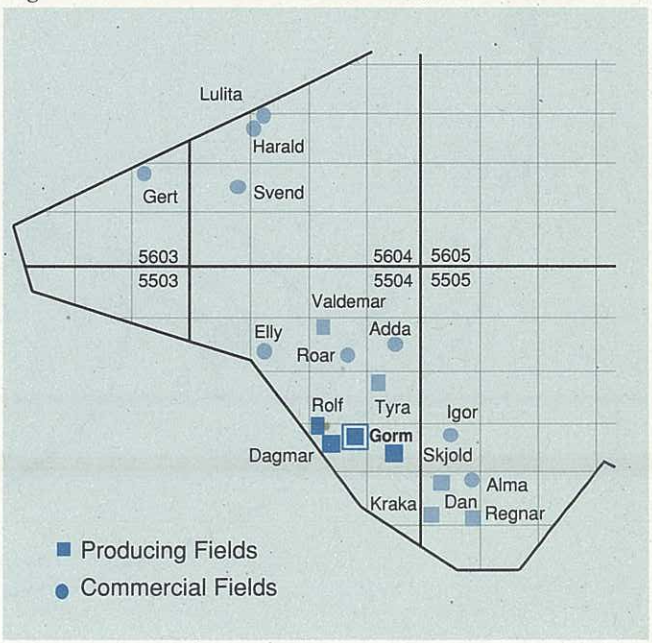
The development in oil production from the fields at the Gorm Centre is shown in Fig. 3.9.

1994 production totalled 1.12 billion Nm^3 of gas in the fields connected to the Gorm Centre. Of this amount, 0.86 billion Nm^3 of gas was supplied to Dansk Naturgas A/S via the Tyra Centre. Thus, gas exports from the Gorm Centre increased by 130% in relation to 1993, which reflects the changed production strategy in the Gorm Field, where gas injection is being replaced by water injection.

Gorm

Gorm is an oil field situated 27 km northwest of the Dan Field. The field was brought on stream in 1981.

Fig. 3.7 Danish Oil and Gas Fields, the Gorm Centre



The reservoir consists of two separate reservoir blocks with different reservoir characteristics, divided by a major fault. In connection with drilling one of the long horizontal wells in 1993, it was ascertained that another minor fault containing hydrocarbons is situated to the west of the western reservoir block. This part of the Gorm Field is still being appraised.

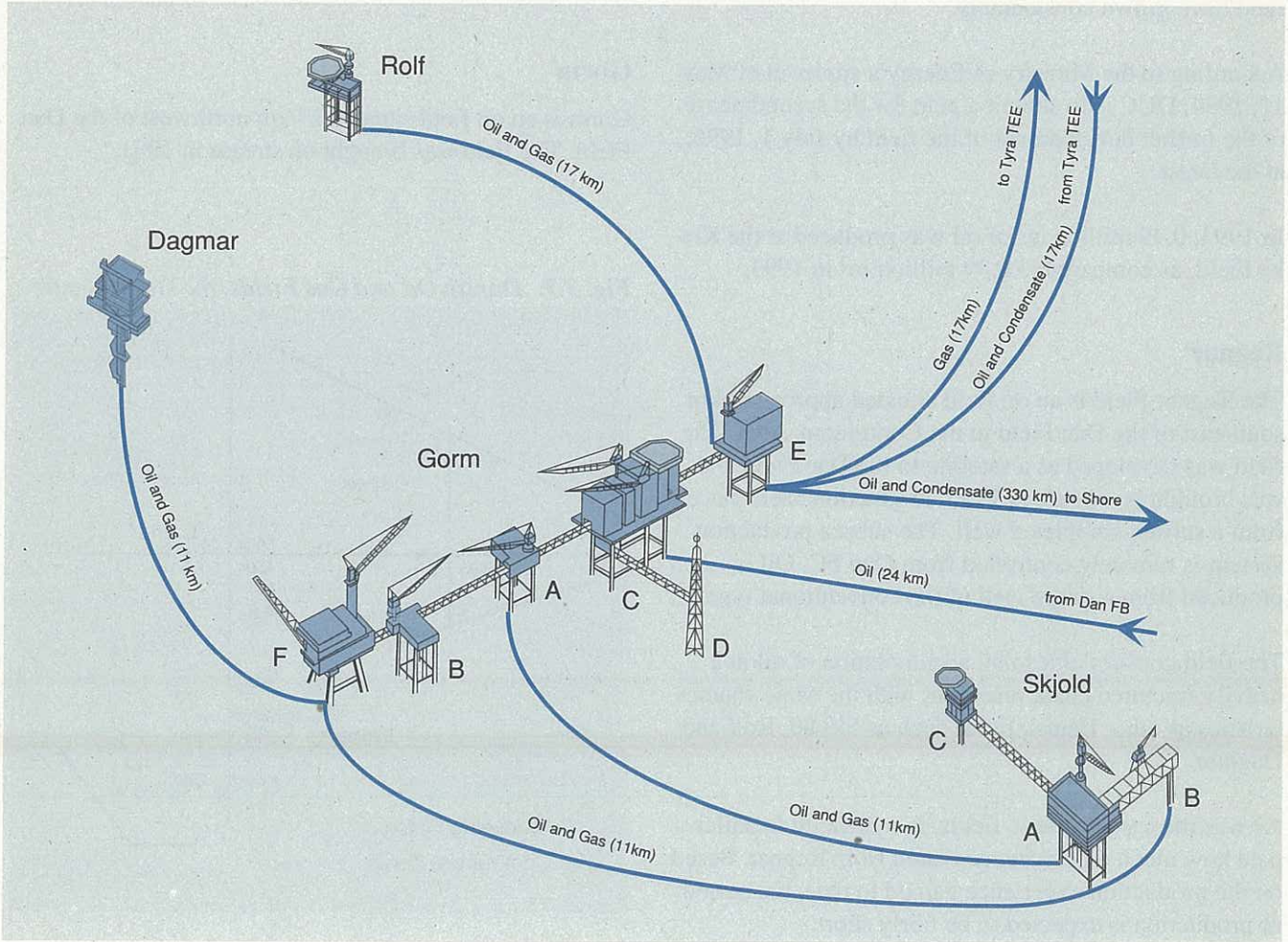
In 1989/90, the initial phases of a water-injection project were implemented in selected areas of the two main reservoir blocks. The experience gained from this water-injection project formed the basis for the ongoing field development, which was approved by the Ministry of Energy in 1992. The approved development project is based on water injection in the whole field.

The field development project involves flooding the western reservoir block with water in order to improve the recovery factor. Initially, oil will be recovered from mid-flank areas of the reservoir, with simultaneous water injection in the flanks. In a later phase, recovery will be moved towards the crest of the structure, while water injection will be initiated in the areas where oil was produced previously.

The development project further provides for gradual discontinuance of gas injection. Thus, in 1994, only 70 million Nm^3 of gas was injected, relative to 420 million Nm^3 the year before. Instead, water injection increased markedly in 1994, when 4.61 million m^3 of water was injected against 2.14 million m^3 in 1993. This was made possible through the completion of new wells and the establishment of new water-injection facilities. Since 1989, a total of 10.62 million m^3 of water has been injected into the Gorm Field.

In 1994, Mærsk Olie og Gas AS carried out a reservoir study, which resulted in a revision of the well pattern for the fourth and fifth phases of the development plan for the western reservoir block. Further, the reservoir study has led to increased estimates of the recovery factor achievable.

Fig. 3.8 Production Facilities in the North Sea, 1995, the Gorm Centre



The development of production from the eastern reservoir block involves the establishment of water injection under the oil zone, at the same time as increasing the number of production wells, particularly at the crest of the structure.

The ongoing development of the Gorm Field based on water injection, which was initiated in 1992, continued in 1994 with the drilling of four horizontal wells, of which three are water-injection wells. In addition, it was necessary to sidetrack the horizontal well conduit of a water-injection well that was damaged during its completion in 1993 due to an earthquake along the major fault of the field. Under the development plan, a total of 14 wells had been drilled at the end of 1994, five of which were production wells and nine water-injection wells.

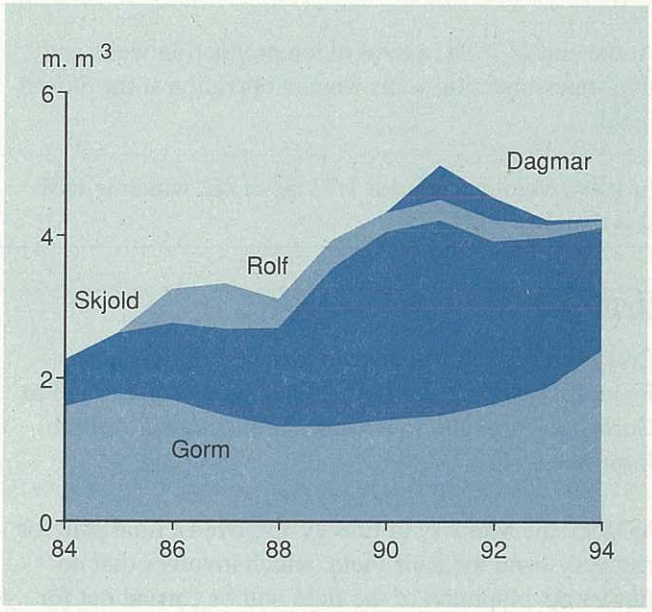
The actual development deviates somewhat from the projected development. Thus, horizontal wells have been drilled on a much larger scale than originally planned. According to the 1992 development plan for the Gorm Field, the only outstanding work is the drilling of four wells: three production wells and one water-injection well.

In 1995, the installation of a third deck on the Gorm F platform is envisaged. This deck is to accommodate part of the planned extensions of the processing facilities for handling production from the fields connected to the Gorm Centre. Further, the Danish Energy Agency has approved yet another project providing for an extension of the Gorm F platform. Thus, on a fourth deck, wellhead compression facilities and a new test separator will be installed. According to plan, this extension of the facilities is to be completed in 1997.

The establishment of wellhead compression serves several purposes. For one thing, the whole initial processing of production from Gorm and Skjold will take place at Gorm F. For another, wellhead compression will involve enhanced recovery from Gorm, Skjold and Rolf. This will have particularly great importance for recovery from the wells where there is a high degree of water penetration. Combined, this results in an increase in the production of oil from the three fields of about 2 million m^3 until the year 2012.

At the same time, the extension of the processing facilities in the Gorm Field means that as from 1997, all flaring of gas from the processing facilities at Gorm is to take place from the Gorm D flare stack, as the existing flare stack on Gorm F will be removed.

Fig. 3.9 Oil Production from the Fields at the Gorm Centre



In 1994, the Gorm Field produced 2.42 million m^3 of oil, a 28% increase over 1993.

Skjold

Skjold is an oil field located 10 km southeast of the Gorm Field. The oil produced is conveyed in multiphase flow to the Gorm Field for processing, and the Skjold wells are supplied with lift gas and injection water from the Gorm Field. In 1994, two new platforms in the Skjold Field were commissioned: a new wellhead platform hosting seven wells and an accommodation platform. The three platforms in the field are connected by bridges. At the same time, the transport capacity for production from Skjold has been expanded, as a supplementary pipeline between Skjold and Gorm F has been put into operation.

Production was initiated in 1982. In 1986, water injection in the reservoir commenced. In 1994, 3.44 million m^3 of water was injected into the Skjold Field, relative to 2.84 million m^3 in 1993. Since 1986, a total of 21.64 million m^3 of water has been injected into the field.

The end-1993 status of the ongoing development was that five of the new wells had been drilled. No more wells were drilled in the Skjold Field in 1994, as the completion of the new installations in the field was being awaited. At the turn of the year 1994/95, the drilling of the remaining wells was initiated.

The ongoing and planned extension of the processing facilities on the Gorm F platform will make it possible to

render the Skjold operations more efficient, for one thing because the requirement for lift gas will be reduced.

At the end of 1994, a total of ten production wells and five water-injection wells were in operation at the Skjold Field.

In 1994, Skjold produced 1.72 m^3 of oil, which is 18% less than in 1993.

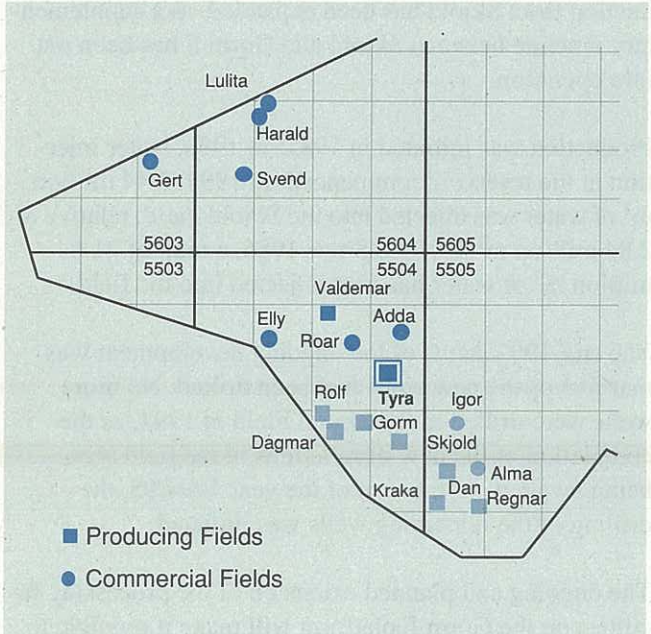
Rolf

Rolf is an oil field situated 15 km west of the Gorm Field. In 1986, the field, developed as a satellite field to Gorm, was brought on stream. Production takes place from two wells.

In 1993, the Ministry of Energy approved a final plan for recovery from the Rolf Field, which involves that no further development of the field will be carried out for the time being. After a period of continued monitoring of the production properties in the field, DUC is to submit an updated evaluation of the reservoir not later than 1997, in order that they can be reviewed by the Danish Energy Agency.

The planned establishment of wellhead compression at Gorm F in 1997, which allows better utilization of the lift gas at the Gorm Centre, will result in a minor increase of recovery from the Rolf Field. The production from the field will continue to be processed at Gorm C's facilities.

Fig. 3.10 Danish Oil and Gas Fields, the Tyra Centre



In 1994, the field produced 0.09 million m^3 of oil.

Dagmar

Dagmar is an oil field situated 10 km west of the Gorm Field. The field, which has been developed as a satellite to Gorm, was brought on stream in 1991. Production takes place from two wells.

Due to the high content of hydrogen sulphide in the associated gas, the production from Dagmar is processed by special facilities on the Gorm F platform. The poisonous gas from the field is flared without being utilized.

Therefore, based on the production experience to date, the original recovery estimates for the Dagmar Field have had to be written down considerably, and plans for further development of the field have so far been suspended.

In 1994, the processing facilities at Gorm F for handling production from Dagmar were modified. This made it possible to carry on production from the Dagmar wells at a lower pressure, thus allowing a slight increase of production.

In 1994, the Dagmar Field produced 0.03 million m^3 of oil. Gas production amounted to 8 million Nm^3, which was flared.

The Tyra Centre

This centre is so far composed of the Tyra Field and the satellite field, Valdemar, which was brought on stream in 1993.

The development in oil and condensate production from the fields at the Tyra Centre is shown in Fig. 3.12.

In accordance with the 1992 development plan, the Tyra Field installations will be expanded substantially in the years to come. One reason for this expansion is the considerable increase of gas supplies to Dansk Naturgas A/S as from 1997, and another is the planned connection of a number of new satellite fields. Thus, the Svend and Roar Fields will be connected in 1996, and Harald in 1997.

Later, the small future satellite fields, Adda, Elly and Tyra Southeast, are expected to be hooked up to the Tyra Field installations.

Fig. 3.11 Production Facilities in the North Sea, 1995, the Tyra Centre and the Northern Area

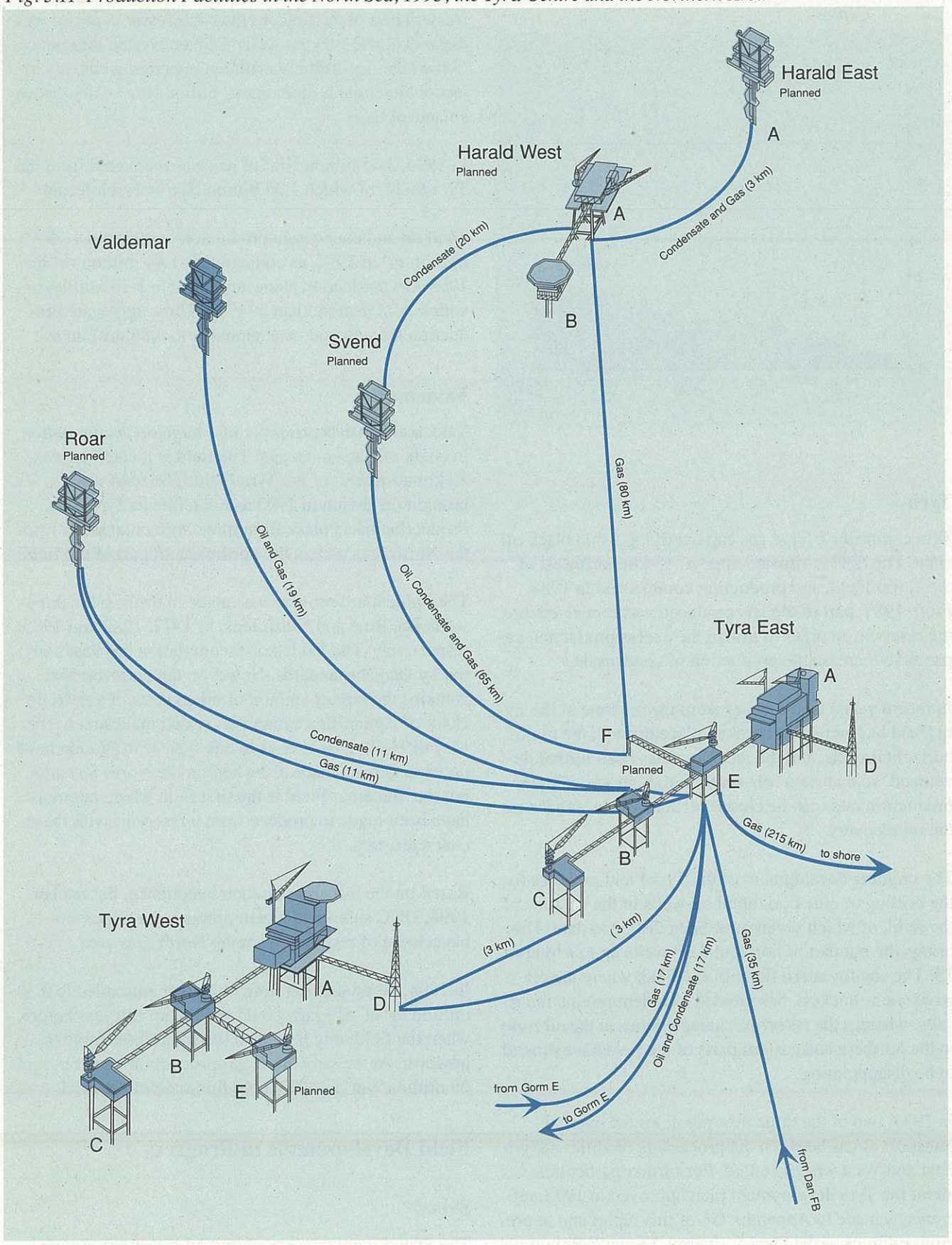
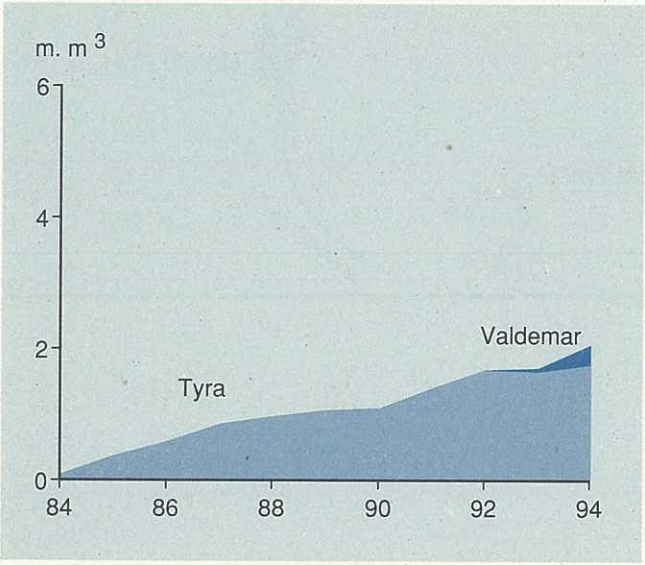


Fig. 3.12 Oil and Condensate Production at the Tyra Centre



Tyra

Tyra comprises a large gas cap overlying a thin black oil zone. The field is situated approx. 15 km northwest of the Gorm Field, and production commenced in 1984. From 1987, part of the gas produced was reinjected into the reservoir in order to utilize the excess production capacity to increase the production of condensate.

In recent years, the recovery from the oil zone in the Tyra Field has increasingly taken place through the use of horizontal wells, and the technique has been further developed, so that reservoir zones with high gas or water production rates can be closed off selectively, enhancing the oil recovery.

The ongoing development of the Tyra Field provides for the drilling of nine horizontal oil wells in the oil zone of the field, of which seven have been drilled to date. This brings the number of horizontal oil wells up to a total of 15. The southwestern flank of the field, where the oil pay zone is thickest, has yielded excellent production results, whereas the reservoir characteristics in the oil zone in the northern and eastern parts of the field have proved to be disappointing.

In 1994, two of the three new pipelines for internal transport of gas between the processing facilities at Tyra East and West were installed. For further particulars about the Tyra development plan approved in 1993, reference is made to Appendix G1 of this report and to previous editions of the Danish Energy Agency's Report on Oil and Gas Exploration and Production in Denmark.

In the course of 1994, gas injection was increased in the western part of the field, as the compressor capacity was expanded, and two gas wells were converted into injection wells. Accordingly, with ten injection wells, the injection potential is more than 2 billion Nm^3 of dry gas on an annual basis.

In 1994, 3.65 billion Nm^3 of gas was recovered from the Tyra Field, of which 1.38 billion Nm^3 was reinjected.

Total oil and condensate production constituted 1.75 million m^3 in 1994, as compared to 1.64 million m^3 in 1993. Oil production alone amounted to 1.19 million m^3, which is 21% more than in 1993. Thus, aggregate production from the oil zone amounts to 4.86 million m^3.

Valdemar

Valdemar consists primarily of a large oil accumulation in chalk of Barremian age. The field is located approx. 20 km northwest of the Tyra Field. The field was brought on stream in 1993 as a satellite to Tyra East. Production takes place from three horizontal wells from the North Jens area in the northwestern part of the field.

The Valdemar discovery was made in drilling the three wells Bo, Boje and North Jens, in 1977, 1982 and 1985, respectively. The Valdemar accumulation has vast potential by Danish standards. However, the reservoir that contains the largest amount of oil consists of very tight chalk of Aptian/Barremian age, which makes recovery very difficult. Discoveries in this type of formation have previously been made elsewhere in the North Sea area, but the Valdemar Field is the first field where attempts have been made to produce from a reservoir with these characteristics.

Based on the initial production experience, in October 1994, DUC submitted a plan proposing a minor enhancement of recovery from the North Jens area.

In 1994, oil production from Valdemar amounted to 0.30 million m^3 of oil against 0.05 million m^3 the year before, when the field only produced for about three months, however. At the same time, gas production went up from 29 million Nm^3 in 1993 to 96 million Nm^3 in 1994.

Field Developments in Progress

Svend

The Svend Field consists of two oil reservoirs situated 60 km northwest of the Tyra Field: a northern reservoir

called North Arne, which was discovered in 1975, and a southern reservoir called Otto, discovered in 1982.

The field is being developed as a satellite to the Tyra Field. Production is expected to be initiated on April 1, 1996, from two horizontal wells, one in each of the two reservoirs.

An unmanned wellhead platform of the STAR type that is specially designed for larger water depths will be installed in the field. The oil produced will be transported to Tyra East through the section of the Harald-Tyra oil pipeline laid in the first phase of the project.

Roar

Like the Tyra Field, Roar comprises a gas cap overlying a thin black oil zone. The field is situated approx. 10 km northwest of the Tyra Field in the Contiguous Area.

The Roar accumulation was discovered in 1968, and the field is being developed as a satellite to the Tyra Field. Production is expected to be initiated on October 1, 1996 from two horizontal wells. An unmanned wellhead platform of the STAR type will be installed in the field. Gas and liquid will be separated in the field and conveyed in two pipelines to the new reception facilities at Tyra East.

Harald

Harald consists of two gas accumulations 80 km north of Tyra, just south of the border between the Norwegian and Danish sectors. The Harald Field comprises the following discoveries: Lulu from 1980 and West Lulu from 1983.

In 1990, the Ministry of Energy approved a development plan for Harald, including a time schedule for the development. According to this approval, the field was to be brought on stream as and when necessary in order to ensure the reliability of gas supplies.

Following the conclusion of the gas sales contract with Dansk Naturgas A/S in 1993, the Harald Field is now being developed, and production is expected to commence on October 1, 1997 from three wells in the western accumulation of the field, Harald West. Production from the eastern accumulation, Harald East, is expected to be initiated on October 1, 1998 from two wells.

At Harald West, one four-leg processing and wellhead platform will be installed, connected by a bridge to a STAR platform with accommodation sections for operational and maintenance personnel. Under normal conditions, the Harald installations will be controlled remotely from the Tyra Field.

A STAR wellhead platform specially adapted to the larger water depths will be installed at Harald East.

On the Harald processing platform, production will be separated into a gas flow, to be transported through a gas pipeline, owned by Dansk Naturgas A/S, via Tyra East to the Danish natural gas network, and a condensate flow, to be conveyed to the extension of the 16" oil and condensate pipeline that will transport the Svend production to the Tyra East reception facilities from 1996.

The platform will be designed to allow for possible further expansion with a view to converting it into an actual processing centre for the northern area. This would also allow for the future hook-up of the Gert and Lulita Fields.

Other Fields

Appendix G contains an outline with key figures of the fields for which development plans have been submitted, primarily the Adda and Igor Fields, whose development was approved in 1990, and the Elly and Alma Fields, for which the Danish Energy Agency approved plans for development and production at the beginning of 1995. In addition, a development plan was submitted for the Gert Field in 1991, but no decision has been made as yet. A development plan for the Lulita Field is not yet available.

For further particulars, reference is made to the previous editions of the Danish Energy Agency's Report on Oil and Gas Exploration and Production in Denmark.

Natural Gas Storage Facilities

Dansk Naturgas A/S has two natural gas storage facilities at its disposal, one at Lille Torup near Viborg in Jutland, and one at Stenlille on Zealand. Both facilities are currently being expanded.

The Stenlille storage facility, based on the injection of natural gas into a sandstone structure filled with water, was officially inaugurated on November 1, 1994. At the end of 1994, a volume of 400 million Nm^3 had been injected into the storage facility. Had any major interruptions of natural gas supplies occurred, it would have been possible to extract up to 140 million Nm^3 of natural gas from the storage facility in the winter of 1994/95.

Production

The injection of gas into the storage facility will continue until the total amount injected has reached 800 million Nm^3, equal to an extraction capacity of 300 million Nm^3 of natural gas.

At Lille Torup, six caverns have been established in a subterranean salt dome with a total extraction capacity of 300 million Nm^3 of natural gas. At present, this storage facility is being expanded by a seventh cavern that will bring up total capacity to 375 million Nm^3 of natural gas in mid-1997.

4. Reserves

Assessment of Reserves

An assessment of Danish oil and gas reserves is made annually by the Danish Energy Agency.

The assessment made by the Danish Energy Agency at January 1, 1995 shows an increase in oil reserves of 7% and a decline in gas reserves of 11%.

Compared to last year's assessment, total expected oil and condensate reserves have been written up by 26 million m^3. Production in 1994, which reached the highest figure so far, amounted to almost 11 million m^3. Thus, the increase in oil reserves totals 15 million m^3. The amount of reserves assessed implies that it will be possible to sustain oil production at the 1994 level for the next 21 years.

The reserves reflect the amounts of oil and gas that can be recovered by means of known technology under the prevailing economic conditions. The method used by the Danish Energy Agency in calculating the reserves and preparing the production forecasts is described at the end of this section.

The reserves are illustrated by Fig. 4.1., where the relative size of the individual categories reflects the recovery of oil and condensate, and Table 4.1 shows the Danish Energy Agency's assessment of oil, condensate and gas reserves, broken down by field and category.

A *low, expected and high estimate of reserves* is given for each individual field, in order to illustrate the uncertainty attached to the assessment. In assessing Denmark's total reserves, it is not realistic to assume that either a high or a low figure will prove accurate for all fields. Therefore, for a large number of fields, the total assessment of reserves should be based on the expected value.

Fig. 4.1 Reserves

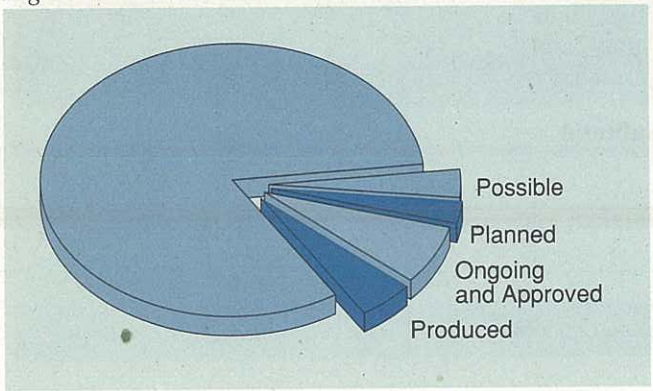


Fig. 4.2 Production and Reserves for the Categories Ongoing, Approved and Planned Recovery

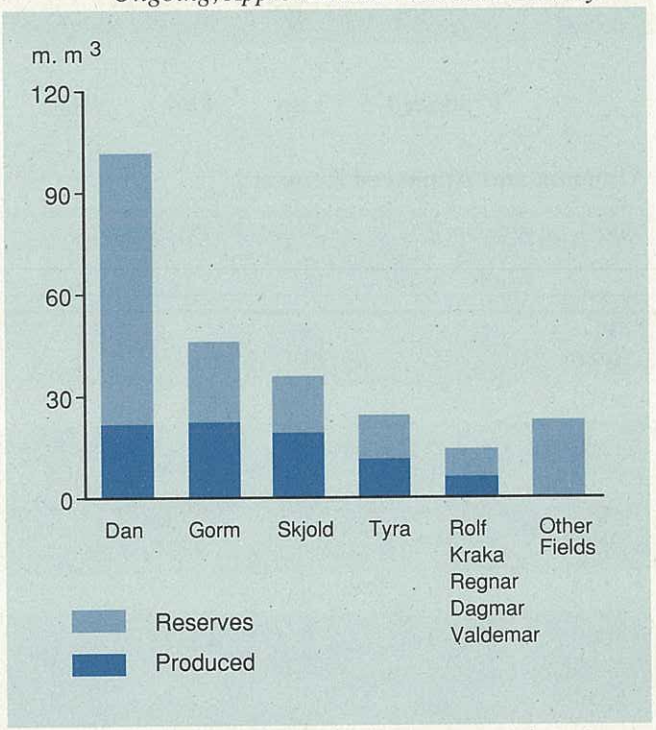


Fig. 4.2 shows the total amount of oil and condensate reserves assessed for the categories *ongoing, approved and planned recovery.* Production and reserves are shown for the nine producing fields and for the group of fields which have not yet been developed.

It appears from the figures for producing fields that between one-fourth and one-half of the total recoverable reserves has been produced. It should be noted that for some producing fields, additional reserves have been identified and included under the category *possible recovery.*

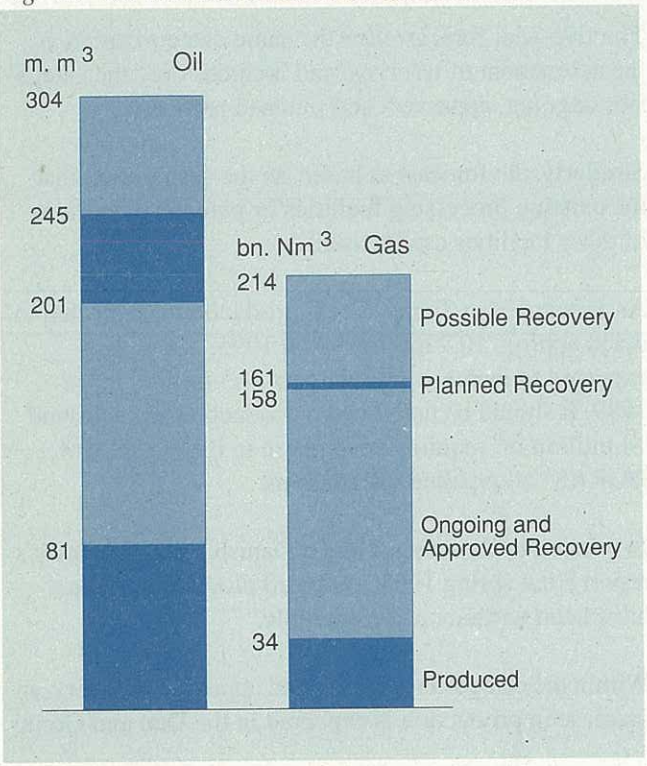
It appears from Fig. 4.3 that the total amount of oil and condensate expected to be recovered ranges from 245 to 304 million m^3. The reserves assessed for planned and possible recovery, respectively, reflect the increasing uncertainty as to whether such reserves can be exploited commercially.

Likewise, the figure illustrates that the amount of gas expected to be recovered ranges from 161 to 214 billion Nm^3. Gas production figures represent the net produc-

Table 4.1 Assessment of Reserves at January 1, 1995

	Oil and Condensate, million m^3				Gas, billion Nm^3				
	Produced	Low	Exp.	High		Produced	Low	Exp.	High
Ongoing and Approved Recovery					**Ongoing and Approved Recovery**				
Dan	22	28	42	56	Dan	9	8	13	18
Kraka	1	2	3	5	Kraka	<1	1	1	2
Regnar	1	<1	<1	<1	Regnar	<1	<1	<1	<1
Igor	-	<1	<1	<1	Igor	-	1	2	3
Alma	-	<1	1	1	Alma	-	1	1	2
Gorm	22	12	24	36	Gorm	2	3	4	6
Skjold	19	6	17	28	Skjold	2	<1	1	2
Rolf	3	<1	2	3	Rolf	<1	<1	<1	<1
Dagmar	1	<1	<1	<1	Dagmar	<1	<1	<1	<1
Tyra	11	4	13	22	Tyra	21	30	55	82
Valdemar	<1	1	2	3	Valdemar	<1	<1	1	1
Svend	-	3	5	7	Svend	-	<1	1	1
Roar	-	2	3	3	Roar	-	10	14	19
Adda	-	<1	1	2	Adda	-	<1	1	2
Elly	-	<1	1	1	Elly	-	2	5	7
Harald	-	5	7	9	Harald	-	20	25	31
Subtotal	**81**		**120**		**Subtotal**	**34**		**124**	
Planned Recovery					**Planned Recovery**				
Dan	-	27	38	49	Dan	-	1	2	2
Valdemar	-	<1	1	1	Valdemar	-	<1	<1	<1
Gert	-	1	2	3	Gert	-	<1	<1	<1
Lulita	-	3	4	5	Lulita	-	1	1	2
Subtotal			**44**		**Subtotal**			**3**	
Possible Recovery					**Possible Recovery**				
Prod. Fields	-	17	28	40	Prod. Fields	-	6	10	15
Other Fields	-	4	9	19	Other Fields	-	4	11	18
Discoveries	-	7	22	45	Discoveries	-	14	32	55
Subtotal			**59**		**Subtotal**			**53**	
Total	**81**		**223**		**Total**	**34**		**180**	
January 1994	70		208		January 1994	29		203	

Fig. 4.3 Oil and Gas Production and Reserves



tion, i.e. produced gas less reinjected gas. It should be noted that the amounts of gas stated deviate from the amounts which can be marketed as natural gas, the difference representing the amounts flared or consumed on the platforms, viz. 10% of total production.

There have been a number of revisions of the Danish Energy Agency's assessment of reserves compared to the assessment made in January 1994.

The areas where significant revisions have been made are described below.

Ongoing and Approved Recovery

Based on a substantial markup of oil-in-place and the favourable production experience to date, the reserves of the Dan Field have been written up.

Reserves have been written up for the Gorm and Skjold Fields due to the approval of a plan for establishment of wellhead compression. Further, the reserves in the western reservoir block in the Gorm Field have been reassessed based on an optimized development concept for this part of the field.

The Valdemar reserves have been written up as a consequence of favourable production experience in this field.

The Elly and Alma Fields have been included under approved recovery, as development plans for these fields were approved at the beginning of 1995.

Planned Recovery

Based on a new, extensive development plan providing for water injection in the Dan Field, substantial oil reserves have been included under planned recovery. It should be noted that although the oil reserves in the Dan Field have been written up, the gas reserves have not been written up correspondingly, as the water-injection development project involves a decline in the production of associated gas.

The Valdemar reserves have been revised on account of a change in the plans for development of the field.

The Lulita discovery has been included under planned recovery, as the discovery was declared commercial in 1994.

Possible Recovery

The Danish Energy Agency has reviewed a number of options for enhancing recovery with the use of known technology, i.e. technology which is used today under conditions comparable to those prevailing in the North Sea.

The drilling of horizontal wells is considered to further increase the production potential of the oil zone in the Tyra Field as well as that of the tight Barremian chalk reservoirs in the Kraka and Valdemar Fields.

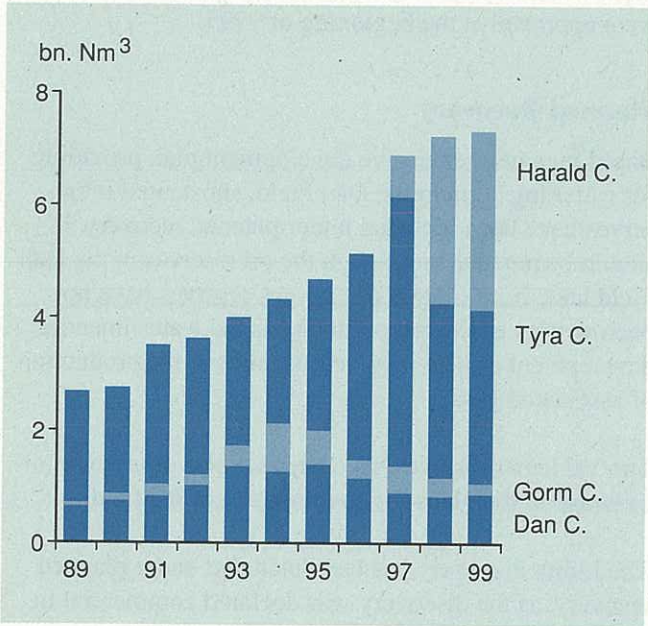
Based on reservoir calculations and rough estimates of investments, operating costs and oil price development, it is assessed that the recoverable reserves can be augmented considerably by implementing additional water-injection projects in a number of fields.

Finally, a number of discoveries that are under evaluation are included in this category. Thus, the reserves of the South Arne discovery have been included. The category also includes discoveries that have been declared non-commercial, based on current technology and prices. The reserves attributable to some of these non-commercial discoveries have been revised in the 1995 assessment.

Further Production Potential

The assessed recovery of oil and condensate, with the

Fig. 4.4 Natural Gas Sales Broken down by Processing Centre



use of known technology, corresponds to only approx. 18% of the hydrocarbons in place in the Danish area. This figure has been affected by the fairly low amount of oil reserves currently expected to be recoverable from the relatively large accumulations in the Valdemar and Tyra Fields, due to the particularly difficult recovery conditions.

In fields like the Dan, Gorm and Skjold Fields, where the production conditions are favourable, an average recovery factor of 32% of the hydrocarbons in place is expected, based on the assumption that known methods are used, including water and gas injection.

Because of these fairly low recovery factors, there is an incentive for the oil companies and authorities to develop methods to improve the recovery of oil, the so-called IOR (improved oil recovery) methods.

Production Forecasts

Based on the assessment of reserves, the Danish Energy Agency prepares production forecasts for the recovery of oil and natural gas in Denmark.

The present five-year forecast shows the Danish Energy Agency's expectations regarding activities until 1999. In addition, the twenty-year forecast shows the Danish Energy Agency's assessment of the production potential for oil and natural gas in the longer term.

Five-Year Production Forecast

The five-year forecast uses the same categorization as the assessment of reserves, and includes only the categories ongoing, approved, and planned recovery.

Similarly, the forecast in based on the assumption that the existing processing facilities or planned extensions of these facilities can be used.

As appears from Table 4.2, oil production is expected to reach approx. 10.7 million m^3 in 1995, and is then expected to increase gradually to 14.3 million m^3 in 1999. It should be noted that a production level around 14 million m^3 requires an increase in the capacity of DORAS' oil pipeline installations.

In relation to the forecast in the Danish Energy Agency's report from spring 1994, expected production figures have been written up considerably.

Within the categories ongoing and approved recovery, an increase in production is expected in the Dan and Gorm

Table 4.2 Oil and Condensate Production Forecast, million m^3

	1995	1996	1997	1998	1999
Ongoing and Approved					
Dan	3.6	3.0	2.9	2.8	2.6
Kraka	0.6	0.5	0.4	0.3	0.2
Regnar	0.1	0.0	0.0	-	-
Igor	-	-	-	-	0.0
Gorm	2.5	2.5	3.0	2.9	2.3
Skjold	1.7	1.6	1.7	1.4	1.3
Rolf	0.1	0.1	0.2	0.2	0.1
Dagmar	0.0	0.0	0.0	0.0	-
Tyra	1.7	1.5	1.5	1.1	0.9
Valdemar	0.3	0.3	0.2	0.1	0.1
Svend	-	0.6	0.7	0.6	0.5
Roar	-	0.1	0.3	0.3	0.3
Adda	-	-	-	-	0.4
Elly	-	-	-	-	0.2
Harald	-	-	0.4	1.5	1.3
Total	**10.6**	**10.3**	**11.2**	**11.2**	**10.2**
Planned	0.1	0.7	1.1	2.0	4.1
Expected	**10.7**	**11.0**	**12.3**	**13.2**	**14.3**

Fields as a consequence of favourable production experience.

Expected production for the Skjold and Gorm Fields has been written up on the basis of the approved plans for establishment of wellhead compression.

Oil production figures for the Tyra Field have been written down for the next few years, due to the most recent production experience.

The planned recovery category includes the further development of the Dan Field applied for, as well as further development of the Valdemar Field. The future development of the Gert and Lulita discoveries is also included in this category. A substantial mark-up of expected production has been made, due mainly to the further development of the Dan Field.

Expected sales of natural gas under the existing contract are shown in Fig. 4.4, broken down by four processing centres.

Twenty-Year Production Forecast

The twenty-year forecast has been prepared according to the same method as the five-year forecast, and thus uses the same categorization as the assessment of reserves. However, unlike the five-year forecast, the category possible recovery is also included.

Fig. 4.5 illustrates two oil and condensate production scenarios. The curve illustrating planned recovery is simply a continuation of the curve shown in Table 4.2, while the second curve includes possible recovery.

Planned production will increase to about 14 million m^3 in 1999, after which production is expected to decline.

Within the category possible recovery, the production potential is based on the Danish Energy Agency's assessment of possibilities for initiating further production not based on development plans submitted.

Thus, the Danish Energy Agency estimates that the increased use of water injection in certain fields represents further oil production potential, and moreover, that a potential for enhancing recovery from the oil zone in the Tyra Field as well as from the Kraka and Valdemar Fields exists. The forecast also includes potential further production from the Adda Field, as well as from discoveries that are currently being evaluated.

It appears from Fig. 4.5 that the production potential amounts to between 11 and 17 million m^3 per year until the year 2004. Production is expected to decline subsequently.

It should be noted that for a period of time, the production potential will exceed the current capacity of the oil pipeline to transport production ashore.

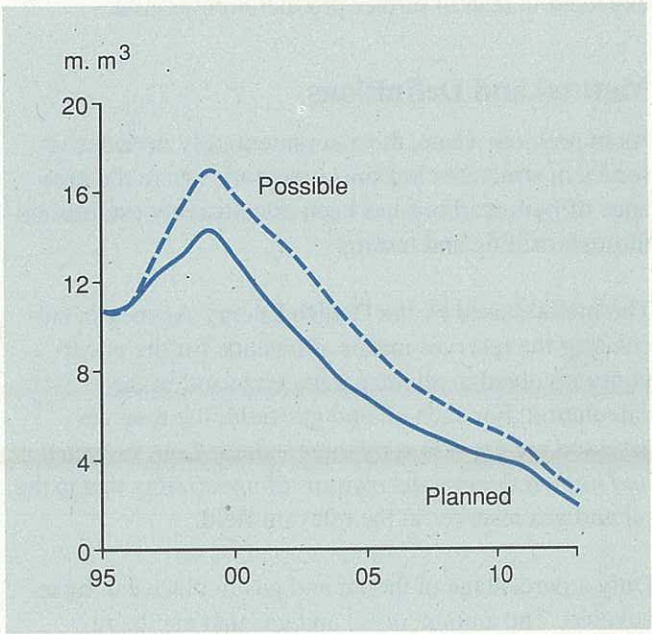
As mentioned above, the expectations for future oil production are based on the gratifying production results recorded in recent years. However, it should be emphasized that the assessment of possible recovery is subject to great uncertainty.

As opposed to the production of oil, which can always be sold at the current market price, the production of natural gas requires that sales contracts have been concluded.

Since the start of gas production in 1984, Danish natural gas has been supplied under two gas sales contracts from 1979 and 1990, respectively, providing for total supplies of 93 billion Nm^3.

In 1993, a supplementary agreement was concluded between DUC and Dansk Naturgas A/S for the sale of additional gas supplies. The new gas sales contract does not stipulate a fixed total volume, but rather a fixed

Fig. 4.5 Oil and Condensate Production



annual volume that will be supplied for as long as DUC considers it technically and financially feasible to carry on production at this level.

According to the Danish Energy Agency's forecast for the planned course of production, the gas production plateau will be maximum 7.5 billion Nm^3, and total gas supplies under the existing contracts will amount to 126 billion Nm^3.

The forecast for the possible course of production predicts total gas supplies of 144 billion Nm^3, with a plateau of 7.5 billion Nm^3.

The difference between the above-mentioned gas supplies contracted for and the corresponding figures indicated in the Danish Energy Agency's report from spring 1994 is partly attributable to the expected increase in consumption on the platforms.

Further Production Potential

The oil production scenario outlined above is not to be considered the upper limit of Danish production potential.

Further production is possible if current efforts to develop enhanced recovery methods and improve equipment are continued and intensified. Moreover, the experience gained from the current development of the fields is expected to provide new opportunities for enhancing recovery.

Finally, the results of ongoing exploration activities are expected to lead to further production potential.

Method and Definitions

As in previous years, the assessment only includes reserves in structures in Danish territory where the presence of hydrocarbons has been conclusively established through drilling and testing.

The method used by the Danish Energy Agency in calculating the reserves makes allowance for the uncertainty involved in all the parameters used in the calculation. For each oil and gas field, the reserves assessed are expressed by three values: *Low, expected and high*, reflecting the margins of uncertainty tied to the oil and gas reserves in the relevant field.

Only a percentage of the oil and gas in place can be recovered. The amount of oil and gas that can be recovered throughout the life of the field is termed the ultimate recovery. Thus, the difference between ultimate recovery and the amounts of oil and gas produced at any given time constitutes the reserves.

Categories of Reserves

The projects which are ongoing or for which the operator has submitted plans are divided into three categories: *ongoing, approved and planned recovery.*

The Danish Energy Agency assesses the reserves recoverable under *possible recovery* projects for which the operator has not submitted concrete plans to the authorities. The categories of reserves are defined as follows:

Ongoing Recovery
This category includes the reserves that are recoverable with the use of existing production facilities and wells. It is assumed that ordinary maintenance and workover operations are performed to ensure the continued functioning of the existing facilities.

Approved Recovery
If a development plan has been approved, and production has not yet been initiated, the reserves assessed to be recoverable are categorized as approved recovery.

This applies to the development of new fields as well as extensions and modifications of existing installations.

Planned Recovery
Planned recovery denotes projects described in a development plan that is being considered by the authorities. Likewise, the reserves attributable to discoveries for which a declaration of commerciality has been filed are termed planned recovery.

Possible recovery
Possible recovery denotes reserves recoverable with the use of known technology, i.e. technology which is currently used in areas where the conditions are comparable to those prevailing in the North Sea. For instance, this includes water injection on a larger scale than before or wider application of horizontal wells.

For discoveries for which a declaration of commerciality has not yet been filed, the recoverable reserves are categorized as possible recovery. This category also includes recovery from discoveries considered to be non-commercial.

5. Economy

Economic Assumptions

Crude Oil Price and Dollar Exchange Rate

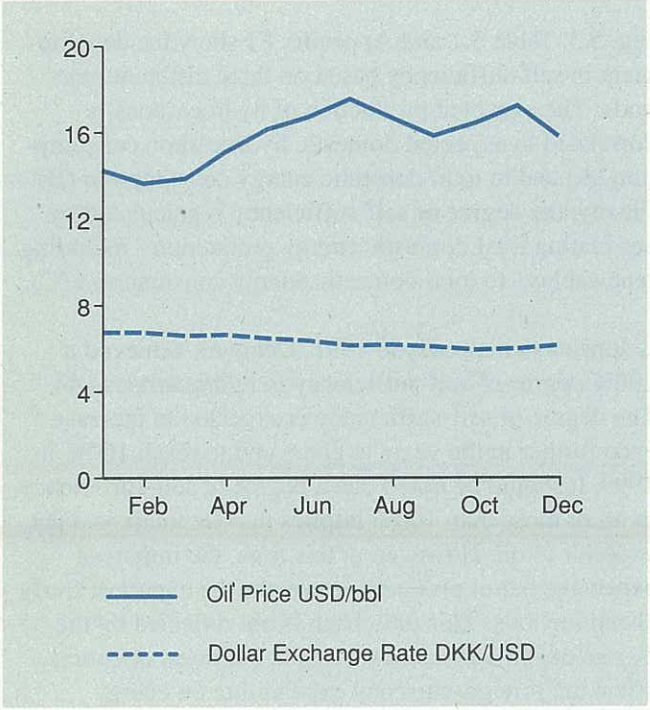
In 1994, the crude oil price continued the downward slide of previous years. The average international crude oil price (as quoted for Brent oil) in 1994 was USD 15.81 per barrel as compared to USD 17.0 per barrel in 1993.

The year began with an oil price decline to USD 13.68 per barrel, followed by an increase in the following months that culminated at a price of USD 17.58 per barrel in July. This increase was due mainly to a cold spring in the USA, the civil war in Yemen and an oil strike in Nigeria.

Later in the year, Iraq briefly mobilized its military forces near Kuwait, which also boosted oil prices. However, the relatively high oil price level could not be maintained, and the price fell during autumn, ending at USD 15.83 per barrel in December.

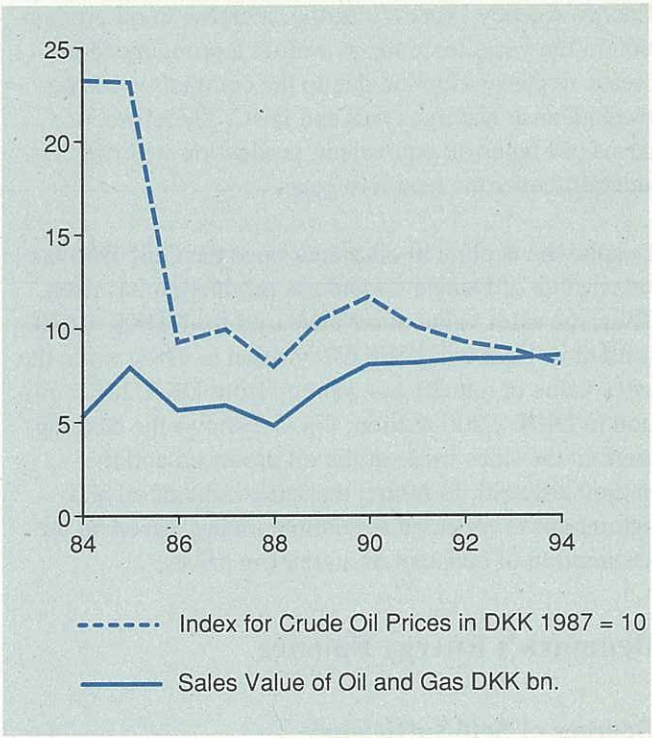
The USD exchange rate declined steadily through the major part of 1994. The exchange rate fluctuated from DKK 6.86 per USD at the beginning of the year to DKK 5.82 per USD at year-end. For the year as a whole, the average USD exchange rate was DKK 6.36 per USD.

Fig. 5.1 Oil Price and Dollar Exchange Rate, 1994



The development in oil prices and the dollar exchange rate in 1994 appears from Fig. 5.1.

Fig. 5.2 Sales Value of Oil and Gas



Future Oil Prices

This report does not contain an actual forecast of future crude oil prices. Instead, two different crude oil price scenarios have been used. One scenario assumes a constant price in real terms of USD 16 per barrel, and the other operates with an increase in oil prices from USD 18 per barrel in 1995 to USD 21 per barrel in 1996, followed by a 1% increase in real terms in each of the subsequent years. The high and the low price scenarios will be used as a basis for calculations made later in this section. In the calculations, the expected prices of natural gas and selected oil products have been based on the assumptions stated with respect to the development in the price of crude oil.

Sales Value of Danish Oil and Gas Production

In 1994, the vast increase in oil and gas production in recent years continued. Oil production went up by almost 10%, while gas sales rose by just over 8%. The Dan and Gorm Fields, in particular, contributed to the increase in 1994.

As mentioned in the section on *reserves*, the Danish Energy Agency expects a further increase in oil production in the years to come, as well as a pronounced increase in gas production due to the contracts made between Dansk Naturgas A/S and DUC. Therefore, in terms of tonnes oil equivalent, production will rise considerably over the next five years.

Despite the decline in oil prices since the Gulf War, the sales value of Danish oil and gas production has risen. Thus, the sales value of oil increased from DKK 6,620 million in 1993 to DKK 6,670 million in 1994, while the sales value of natural gas went up from DKK 2,013 million to DKK 2,200 million. Fig. 5.2 shows the development in the sales value of the oil produced and the natural gas sold. In future, the sales value of oil and natural gas is expected to continue rising, based on the assumption of constant or increasing prices.

Denmark's Energy Balance

Degrees of Self-Sufficiency

Increased oil and gas production has resulted in a constantly rising degree of self-sufficiency. Likewise, total oil and natural gas production continues to increase relative to total energy consumption. The highly favourable development in the degrees of self-sufficiency is expected to be sustained in future years. The gas sales contract concluded in 1993 between Dansk Naturgas A/S and DUC is the main reason for these favourable expectations, but the increased estimate of production from the Gorm Field and the development plan recently submitted for the water-injection project at the Dan Field (see the section on *Production*) also contribute to the appreciable increases in the degrees of self-sufficiency expected. The anticipated increase in production is expected to affect the degrees of self-sufficiency notably from 1997.

Fig. 5.3 Degrees of Self-Sufficiency

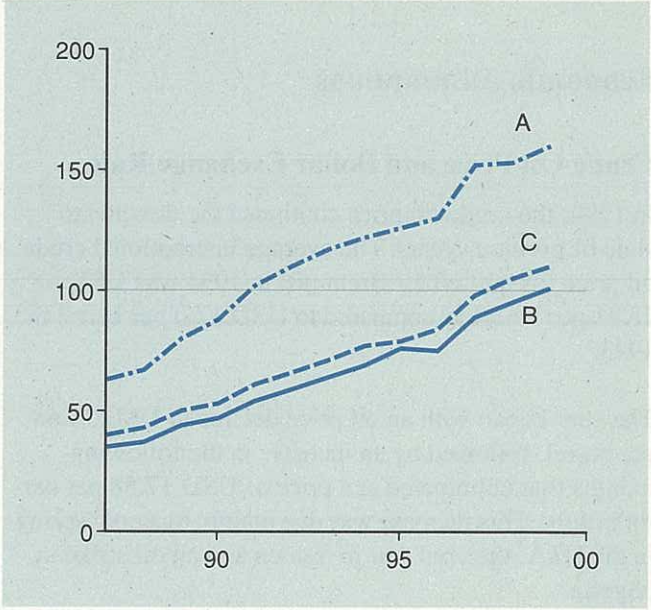


Fig. 5.3, Table 5.1 and Appendix F1 show the development in self-sufficiency based on three different methods: The expected production of hydrocarbons is correlated to expected domestic hydrocarbon consumption (A) and to total domestic energy consumption (B). Finally, the degree of self-sufficiency is calculated by correlating total domestic energy production - including renewables - to total domestic energy consumption (C).

It appears that already in 1991, Denmark achieved a 100% degree of self-sufficiency in hydrocarbons (A). The degree of self-sufficiency is expected to increase even further in the years to come and to reach 160% in 1999. It should be noted that a degree of self-sufficiency in oil of more than 100% implies that Denmark is a net exporter of oil. However, at this time, the import of expensive petrol products outweighs the export of fairly cheap fuel oils. This drawback is not reflected by the degree of self-sufficiency as such, but does, of course, affect net foreign-currency expenditure on energy.

Table 5.1 Production and Consumption

	1995	1996	1997	1998	1999
Production					
Crude Oil					
m m^3	10.70	11.00	12.30	13.20	14.30
mtoe	9.39	9.65	10.70	11.56	12.47
Natural Gas*)					
bn Nm^3	5.00	5.40	7.40	7.80	7.90
mtoe	4.63	5.00	6.90	7.28	7.38
Renewable Energy					
mtoe	1.58	1.74	1.81	1.84	1.89
Total Energy Consumption					
PJ	825	822	829	828	824
mtoe	19.70	19.63	19.80	19.78	19.68
Degree of Self-Sufficiency (%)					
A)	126	130	152	153	160
B)	71	75	89	95	101
C)	79	84	98	105	110

*) Including Fuel Consumption Offshore
A) Oil and gas production vs domestic oil and gas consumption
B) Oil and gas production vs total domestic energy consumption
C) Total energy production vs total domestic energy consumption

The increased estimates of hydrocarbon production have also had the effect that the energy content of hydrocarbons is expected to correspond to domestic energy requirements as from 1999. When the production of renewable energy is added, Denmark is assumed to be self-sufficient in energy already from 1998.

Net Foreign-Currency Expenditure

The net foreign-currency expenditure has been calculated in terms of its immediate effect on energy product items in the balance of trade, which include all forms of energy. The calculation does not take into account the cost of imports for field developments and the transfer of dividends, etc. abroad.

It appears from Fig. 5.4 that there has been a marked decline in the net foreign-currency expenditure over the past ten years. Before oil prices plummeted in 1985, the net foreign-currency expenditure on energy thus exceeded DKK 20 billion. When disregarding the brief recovery of oil prices resulting from the Gulf War, prices declined gradually in the period under review. Combined with increased Danish production, this development results in an estimated net foreign-currency expenditure on energy of about DKK 3.5 billion in 1994.

Fig. 5.4 Net Foreign-Currency Expenditure on Energy Imports

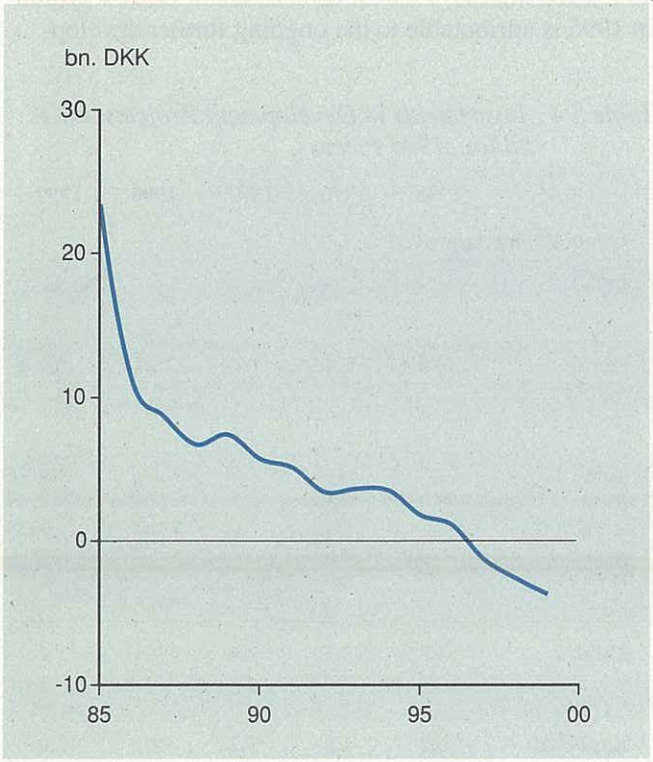


Table 5.2 Effect of Oil/Gas Activities on the Balance of Payments, DKK billion, 1994 Prices - Increasing Real Oil Prices

	1994	1995	1996	1997	1998	1999
Socio-Economic Production value	9.0	10.6	13.7	17.3	18.8	19.8
Import share	2.5	4.2	3.4	3.5	2.9	1.8
Balance of Goods and Services	6.5	6.4	10.3	13.8	15.9	18.0
Transfer of Interest and Dividends	3.3	3.6	5.1	6.7	6.6	6.7
Balance of Payments Current Account	3.2	2.8	5.2	7.1	9.3	11.3
At constant oil prices (USD 16/bbl)	3.2	2.3	3.6	4.9	6.7	8.1

Net foreign-currency expenditure for the subsequent years has been calculated on the basis of the assumptions stated with respect to the development in the gross consumption of energy and in the production of oil and gas. One calculation, based on the scenario with increasing crude oil prices outlined above, shows net earnings from energy exports as from 1997. These net earnings are anticipated to rise further in the following years. The development will be less conspicuous based on a low oil price scenario. Historical net foreign-currency expenditure is shown in Appendix F2.

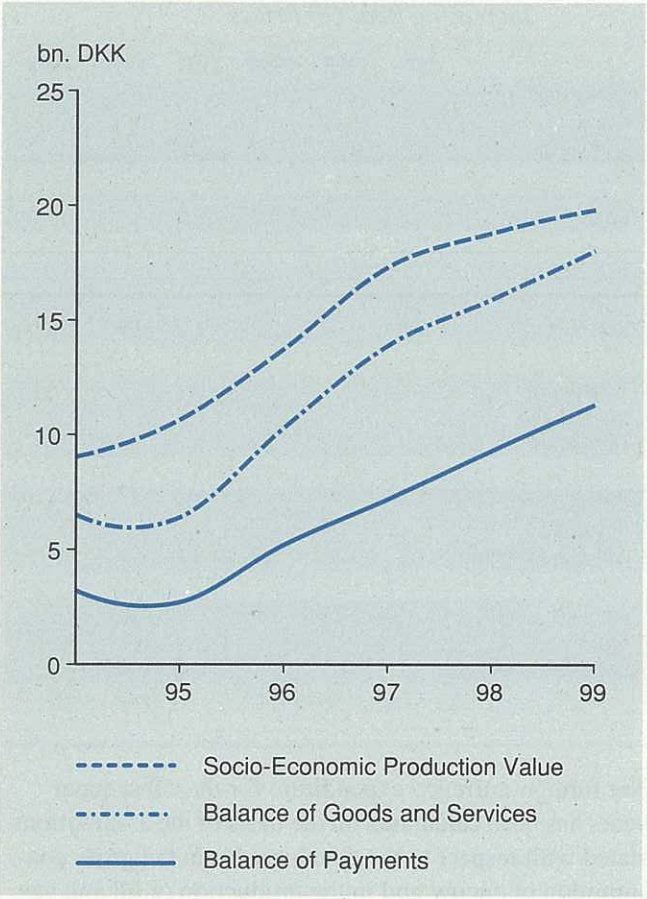
Effect on Balance of Payments

The expected future effect of oil and gas production on the balance of payments has been evaluated to supplement the calculations of net foreign-currency expenditure on energy, which is affected by energy prices as well as Danish production.

The Danish Energy Agency estimates that the increased oil and gas production in recent years has favourably affected the balance of payments on current account in the amount of DKK 3-4 billion a year. This trend is expected to become more pronounced in the years to come.

The production of oil and natural gas improves the balance of payments, due partly to the direct earnings

Fig. 5.5 Effect of Oil/Gas Activities on the Balance of Payments



derived from exporting part of the production, and partly to the foreign-currency expenditure saved, in that a share of production is used for domestic consumption, thus eliminating the need for energy imports otherwise required. Accordingly, the development in the socio-economic value of production shown in Fig. 5.5 and Table 5.2 reflects the value of direct export revenue and the cost of imports saved.

When the import share of investments and operating costs is subtracted, the effect on the balance of goods and services results. In turn, the direct effect on the balance of payments on current account can be calculated when interest and dividends transferred abroad are deducted.

The effect on the balance of payments is very sensitive to fluctuations in the price of crude oil. Not surprisingly, the calculations based on constant prices and those based on increasing real prices show that the effect is greatest when using the second price scenario. The calculations based on an increasing real price show that the net effect on the balance of payments increases to about DKK 11 billion in 1999.

Table 5.3 DUC's Investments in Development Projects, DKK million, Nominal Prices

	1990	1991	1992	1993	1994*)
Dan	297	915	1,244	1,081	410
Kraka	227	87	97	79	175
Regnar	1	-	21	168	-
Gorm	563	409	411	722	515
Skjold	105	297	196	453	560
Rolf	1	50	-	-	-
Dagmar	246	77	2	-	-
Tyra	121	274	372	380	1,160
Valdemar	123	21	27	375	110
Roar	-	-	-	2	25
Svend	-	-	-	5	55
Harald	-	-	-	6	150
Not allocated	69	134	42	98	20
Total	**1,736**	**2,260**	**2,412**	**3,369**	**3,180**

*) Estimate

The Finances of the Licensees

Costs of Exploration, Development and Operation

The expected sustained increase in oil and gas production is reflected mainly by the investment activity, which has been on the rise since the end of the 1980s, and which is expected to reach a particularly high level in 1995. The high investment level of about DKK 6 billion in 1995 is attributable to the ongoing further develop-

Table 5.4 Investments in Development Projects, DKK billion, 1994 Prices

	1995	1996	1997	1998	1999
Ongoing and Approved					
Igor	-	-	-	-	0.2
Gorm	0.8	0.4	0.6	-	0.1
Skjold	0.5	-	-	-	-
Tyra	1.7	0.9	0.7	1.1	1.4
Roar	0.4	0.5	-	-	-
Adda	-	-	-	0.4	-
Svend	0.4	0.5	-	-	-
Harald	1.0	0.9	0.9	1.0	-
Elly	-	-	0.4	0.4	-
Total	**4.8**	**3.2**	**2.6**	**2.9**	**1.7**
Planned	1.4	1.6	2.6	1.3	0.3
Expected	**6.2**	**4.8**	**5.2**	**4.2**	**2.0**

ment of the producing fields Gorm, Skjold and Tyra, as well as the development of the new fields Roar, Svend and Harald, to be brought on stream in the course of 1996 and 1997. The planned expansion of the water-injection project at the Dan Field, representing an investment of about DKK 6 billion until 1999, is expected to be initiated already in 1995, when extensive drilling operations will commence.

Investments are expected to stabilize at a level of about DKK 5 billion in 1996 and 1997, when the principal activities are anticipated to converge on the further development of the Tyra, Gorm and Dan Fields as well as the development of the Harald Field.

Based on the current knowledge of investment activities, the scope of investment is expected to narrow in the longer term and to stabilize around DKK 1 billion from the turn of the century. Historical investments are reflected by Table 5.3, while future investments are shown in Table 5.4.

As mentioned in the section on *exploration*, exploration activity has been low in recent years due to the impending completion of the work programmes from the Third Licensing Round. Based on the new licences granted in the Fourth Licensing Round and the encouraging results from the Rigs-1 well drilled by Amerada Hess, exploration activity is expected to rise again in future years, however. Thus, exploration costs of about DKK 200-300 million a year are anticipated for the years ahead. Fig. 5.6 shows the development in exploration costs over the past ten years.

Fig. 5.6 Costs of Exploration, DKK million, Nominal Prices

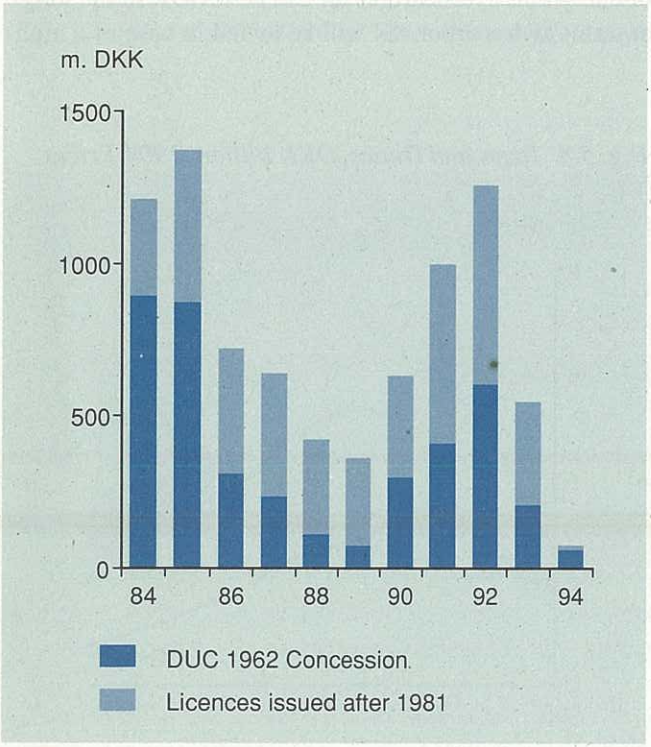
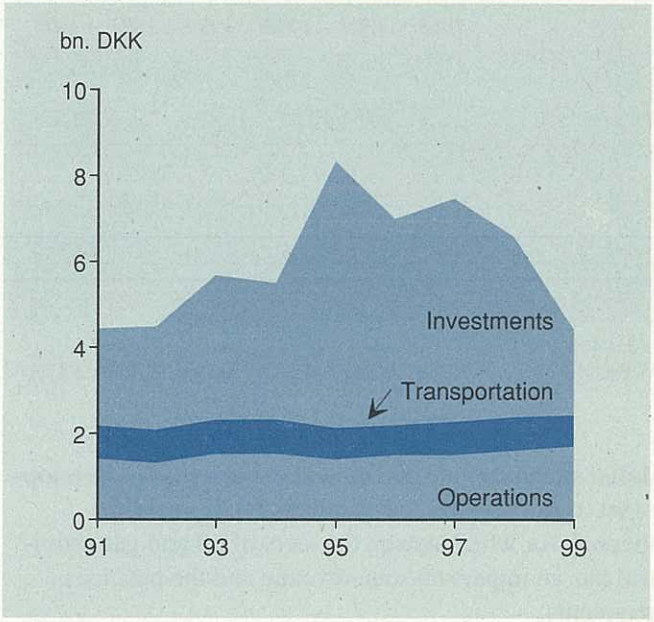


Fig. 5.7 Investments in Fields, Operations and Transportation, DKK billion, Nominal Prices



The costs of operating oil and gas production facilities have remained at a fairly constant level since 1991, viz. about DKK 1.5 billion annually. In light of the planned and approved development of production facilities, an additional increase in operating costs is expected.

With regard to transportation costs, the payments towards the capital cost and operating costs of the oil pipeline have declined slightly, while payments of the profit element in the pipeline tariff have gone up. The capital cost and operating costs are expected to fall in the next few years, while payments of the profit element are expected to increase, see below. Fig. 5.7 shows the historical development in investments, operating costs and transportation costs, as well as the costs projected for the future.

Financial Results of the DUC Companies

The development in oil and gas production is highly dependent on the level of investments, which, in turn, is influenced by the past and future development in the

Table 5.5 Pretax Results of the DUC Companies, DKK million, Nominal Prices

	1988	1989	1990	1991	1992	1993
Income	5,103	6,716	7,692	8,446	8,467	8,741
Op. Costs	1,569	1,654	1,858	2,070	2,022	2,478
Interest Exp.	628	680	234	336	263	297
Exc.-Rate Ad.	-324	+85	+282	-182	-171	-408
Gross Income	2,582	4,468	5,882	5,858	6,011	5,558
Depreciation	1,495	1,553	1,600	2,373	2,126	2,385
Pretax Result	**1,088**	**2,915**	**4,282**	**3,485**	**3,885**	**3,173**

Table 5.6 State Revenue from Oil/Gas Production, DKK million, Nominal Prices

	1990	1991	1992	1993	1994*)
Hydrocarbon Tax	0	0	0	0	0
Corporate Tax	1,314	990	1,002	866	833
Royalty	633	639	666	664	690
Profit Element	257	264	274	277	286
Total	**2,204**	**1,893**	**1,942**	**1,807**	**1,809**

*) Estimate

dollar exchange rate and oil and gas prices. The development in earnings and costs affects DUC's taxable income, for which reason the level of oil and gas activities has an impact on state revenue and the balance of payments.

Since being awarded the Sole Concession in 1962, DUC has incurred investment costs of about DKK 44 billion and operating and transportation costs of about DKK 25 billion. At the same time, DUC has recorded income of about DKK 110 billion. Total taxes paid amount to about DKK 21 billion. The above amounts are expressed in current Danish kroner.

The increased value of production and the growth in investments in recent years are reflected by DUC's pretax results. It appears from Table 5.5 that income and depreciation have increased somewhat, and that the pretax result recorded for 1993 declined slightly as compared to previous years.

State Revenue

The state revenue derived from oil and gas production consists of four elements: *corporate tax, royalty, the profit element of the oil pipeline tariff and hydrocarbon tax.*

Corporate tax and hydrocarbon tax are assessed and collected by the Danish Ministry of Taxation, Central Customs and Tax Administration. The assessment and collection of royalty and the profit element of the pipeline tariff are handled by the Danish Energy Agency, and 95% of the profit element payments is retained by the Agency.

Corporate tax

The DUC companies did not become liable to pay corporate tax until the beginning of the 1980s. At end-1994, the aggregate corporate tax paid totalled about DKK 8 billion. In recent years, the corporate tax paid has stabilized at a level of about DKK 1 billion a year. Depreciation charges are expected to increase in the next few years, for one thing because of the Dan Field development. However, as a marked increase in income from production is foreseen from 1996, corporate tax payments are expected to increase sharply from 1996 and onwards.

Hydrocarbon tax

As the objective of the hydrocarbon tax is to levy a special tax on very high profits, e.g. attributable to high oil prices, hydrocarbon tax only became payable for a few years at the beginning of the 1980s. Total hydrocarbon tax payments amount to just under DKK 1 billion in 1995 prices. In light of the investments and prices expected for the next few years, it must be considered unlikely that hydrocarbon tax can be levied. In the longer term, hydrocarbon tax will be levied in case of a high

Fig. 5.8 Taxes and Duties, DKK billion, 1994 Prices

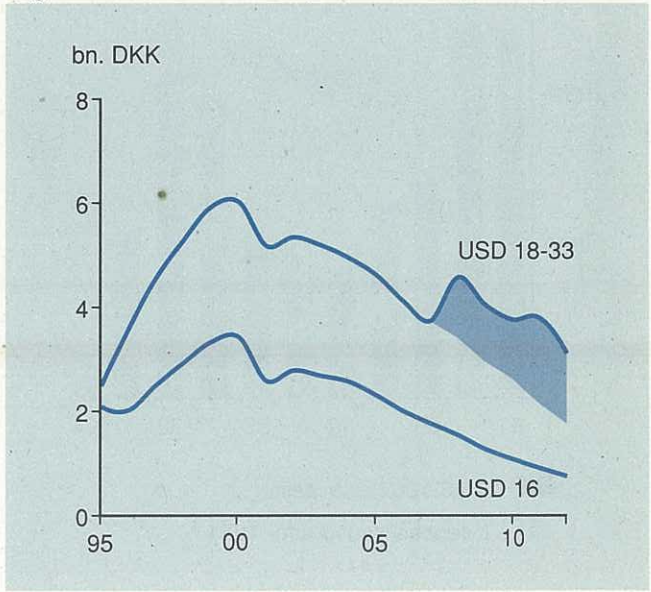


*Table 5.7 State Revenue from Oil/Gas Production, DKK billion, 1994 Prices *)*

	1995	1996	1997	1998	1999
Hydrocarbon Tax	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Corporate Tax	1.4 (1.1)	2.1 (1.0)	2.7 (1.2)	3.2 (1.5)	3.7 (1.9)
Royalty	0.8 (0.7)	1.1 (0.8)	1.4 (0.9)	1.5 (1.0)	1.6 (1.1)
Profit Element	0.3 (0.3)	0.4 (0.3)	0.5 (0.4)	0.6 (0.4)	0.6 (0.4)
Total	**2.5 (2.1)**	**3.6 (2.1)**	**4.6 (2.5)**	**5.3 (2.9)**	**5.9 (3.4)**

*) Assessed amounts
( ) Based on constant oil prices

oil price scenario. Fig. 5.8 shows the expected development in the hydrocarbon tax levied in the case of a high and a low price scenario.

Profit element of the pipeline tariff
The users of the oil pipeline are obliged to pay the costs relating to its operation. In addition, the pipeline tariff incorporates a profit element of 5% of the value of the crude oil transported. This 5% is payable to the owner of the pipeline, Dansk Olierør A/S, which passes on 95% of the profit element to the state. So far, DUC is the only user of the pipeline, and is thus liable to pay all transportation costs. Up to and including 1994, the state's revenue from the profit element amounted to about DKK 3 billion. Despite declining oil prices, the profit element has yielded an increasing revenue for the state in recent years. As the profit element is highly dependent on production and associated prices, the revenue from this source is expected to grow further for the next decade, provided that prices do not drop.

Royalty
Royalty is currently only paid by DUC. The royalty payable by DUC is levied as 8.5% of the value of oil and gas produced, after deducting the oil pipeline tariff. Since 1972, total royalties of just under DKK 9 billion have been paid.

In the past few years, the amounts of royalty paid have remained at a fairly constant level between DKK 600 and 700 million. As is the case for the pipeline tariff, the revenue derived from royalty is expected to increase in the years to come, provided that oil prices do not drop. The historical figures for state revenue are indicated in Table 5.6, while the revenue expected for the future is shown by Table 5.7.

Metering Oil and Gas Production

In order to ensure a correct assessment of the various taxes, the amount of oil and gas produced is metered according to specific guidelines.

The total amount of gas produced is metered at the Tyra East metering station, while the oil produced is metered at Dansk Olierør A/S' terminal facilities in Fredericia in connection with the lifting of the oil. The figures obtained upon metering sold gas at Tyra East are used as a basis for calculating the royalty payable. Likewise, the amounts of oil metered upon lifting from Fredericia are used to calculate royalty and the profit element of the pipeline tariff.

Further, the allocation of production to individual fields and their satellites is made on the basis of measurements at the individual processing centres and test separator measurements for each well.

In future fields, it is planned to introduce a new generation of metering systems - the so-called multiphase meters - which makes it possible to meter water, oil and gas directly, at lower cost and without prior separation in a test separator.

6. Health and Safety

The Danish Energy Agency supervises health, safety, working environment and environmental matters in connection with the exploration and production of oil and natural gas in the Danish part of the North Sea.

Environmental matters are supervised in cooperation with the National Agency of Environmental Protection, while safety matters relating to mobile offshore installations are supervised in cooperation with the Danish Maritime Authority.

Environmental matters are dealt with in a separate section of the report entitled *Environment*.

Fixed Offshore Installations

1994 was characterized by major development activities, the result of the approval of the development plans for the Tyra, Harald, Svend, Roar and Skjold Fields in 1993.

Further, the safety aspects of the development plan for the Gorm Field were dealt with, as mentioned, in the section on *Production* .

In connection with the implementation of the approved development plans, the Danish Energy Agency considered and approved several applications for building and installation permits as well as permissions for use.

As in previous years, the Danish Energy Agency's focus in granting approvals was placed on the safety cases for the individual fields submitted with the applications, as well as the companies' safety management systems and the noise evaluations prepared by the applicants.

Moreover, health and safety aspects were important considerations in the work involved in granting permits.

As in previous years, the Danish Energy Agency has currently monitored the operation and maintenance of existing installations.

In connection with inspections made on the individual offshore installations, special emphasis was placed on working environment, including dangerous noise levels.

Finally, an audit has been performed of the classification society Det norske Veritas, which forms part of Mærsk Olie og Gas AS' safety management system.

Mobile Offshore Installations

As in previous years, 1994 was a year of considerable development activity, where the implementation of the approved development plans involved a number of different mobile offshore installations, such as drilling rigs, pipe-laying barges, flotels and crane vessels.

Thus, Mærsk Olie og Gas AS employed five drilling rigs to drill a number of production wells, two owned by A. P. Møller, viz. the *Maersk Exerter* and *Mærsk Endeavour*, the *Shelf Explorer* contracted from the UK company, Transocean Drilling Ltd., the *West Kappa* from Smedvig Ltd., also a UK company, and the *Neddrill Trigon* from the Dutch company, Neddrill.

At end-1994, Amerada Hess spudded the exploration well Rigs-1 (South Arne) with the drilling rig *Mærsk Giant*, with Maersk Drilling Norge as the drilling contractor.

In the course of the year, the pipe-laying barges *Stena Apache* (Stena Offshore) and *Lorelay* (Allseas) were also employed to lay pipelines in connection with the expansion of the production facilities.

Lifting operations associated with expanding the production facilities were carried out by the crane barge *DB102* contracted from Heeremac, a Dutch company.

In a number of instances, the development activities necessitated more offshore accommodation facilities. In this connection, Mærsk Olie og Gas AS employed three flotels in 1994 in addition to A.P. Møller's *Mærsk Explorer*. Two of these flotels were the drilling rigs *Neddrill Trigon* and *Mærsk Guardian*. Moreover, at end-1994, the *Neddrill Kolskaya* was contracted from the Dutch company Neddrill.

In cooperation with the Danish Maritime Authority, the Danish Energy Agency issued permissions for use for the relevant drilling rigs and vessels, and approved manning tables and organizational charts for the individual installations. Further, the Danish Energy Agency currently supervised the operation of the mobile installations with respect to safety and working environment aspects.

In addition to the layout of living quarters on mobile offshore installations, which were upgraded substantially in several instances, the work related to working environment matters focused on noise and the use of chemicals, as in previous years. On drilling rigs, super-

vision also centred on ergonomic problems and the risk of industrial injuries related to handling drill pipe, etc.

On pipe-laying barges where the pipe is welded and pipeline is laid in the conventional way, emphasis was placed on the working environment problems associated with surface treatment of the pipe with asphalt products and the problems associated with welding.

Notification of Industrial Injuries

As in previous years, the statistics of industrial injuries reported to the Danish Energy Agency in 1994 fall into two categories: Statistics of work-related accidents reported and statistics of presumed or recognized work-induced conditions reported.

Work-Related Accidents

The criterion for reporting a work-related accident is that the injured person is unfit for work for one day or more in addition to the day of the accident. In 1994, the Danish Energy Agency received 27 reports on accidents offshore, broken down as 11 accidents on fixed offshore installations together with flotels, and 16 on other mobile offshore installations. None of the accidents resulted in death or serious personal injury.

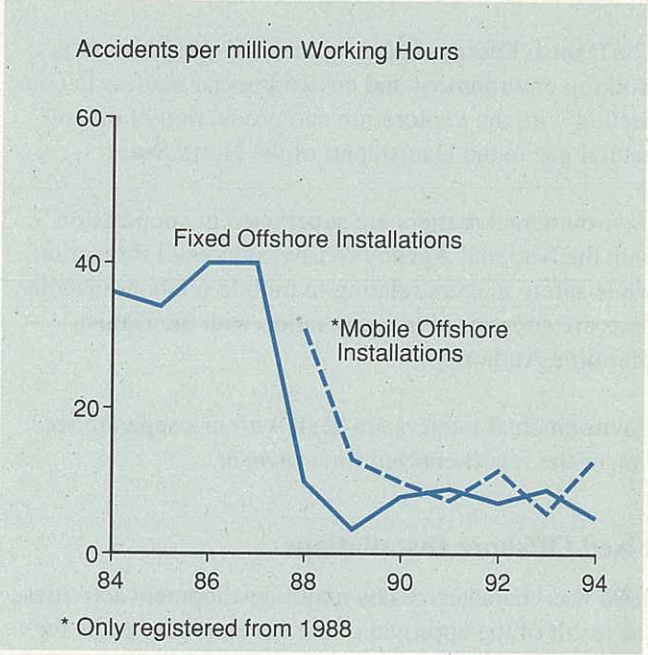
When the 11 reported work-related accidents on fixed offshore installations are related to the number of hours worked (2,2 million hrs.), it yields an accident frequency of 5.0 per million working hours. Moreover, when the 16 work-related accidents on mobile offshore installations, excluding flotels, reported in 1994 are related to the number of hours worked on these installations (1.2 million hrs.), it yields an accident frequency of 13.2 per million working hours.

Table 6.1 Accidents per million Working Hours

Year	Fixed	Mobile
1987	40	-
1988	10.3	*31.0
1989	3.4	12.7
1990	7.9	9.9
1991	9.0	7.4
1992	7.1	11.5
1993	8.9	5.7
1994	5.0	13.2

*Only registered from 1988

Fig. 6.1 Work-Related Accidents



The number of working hours is calculated on the basis of information received from the companies and the person-on-board lists, based on an average workday of 13 hours.

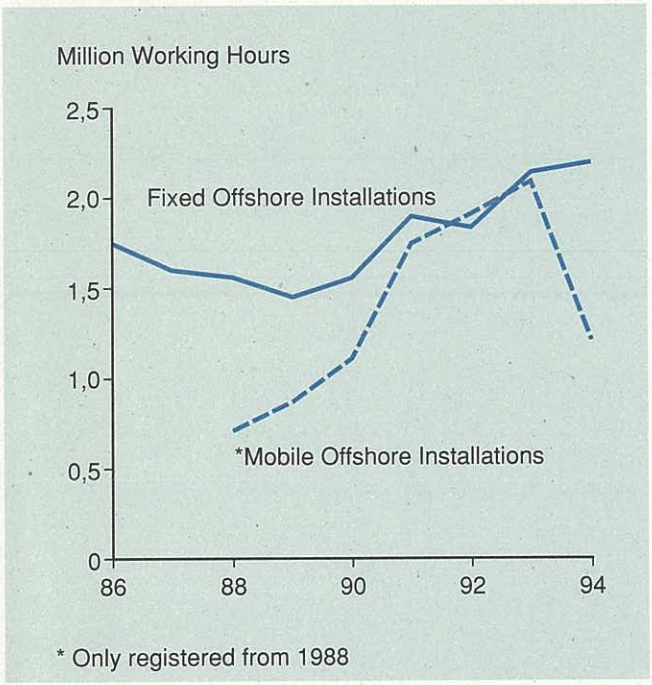
Fig. 6.1 and Table 6.1 show the number of accidents reported per million working hours for mobile and fixed offshore installations as well as flotels in the period from 1987 to 1993. The figures shown comprise all accidents related to the installation, operation and extension of the above-mentioned facilities.

Thus, the low accident frequency of previous years has been maintained for both fixed and mobile offshore installations.

By way of comparison, the accident frequency for Danish onshore industries since 1987 hovered around 50 per million working hours. In 1993, the frequency was 52.6 per million working hours. *The Danish Employers' Confederation, Work-Related Accidents 1993.*

Fig. 6.2 shows the number of working hours on fixed and mobile offshore installations. The number of hours worked on fixed offshore installations increased somewhat in 1994 as compared to 1993. For mobile offshore installations, the number of working hours declined in 1994 by about 40% in relation to the number of working hours in 1992 and 1993, when the drilling activity in the Danish sector was particularly high.

Fig. 6.2 Number of Working Hours on Offshore Installations



Presumed or Recognized Work-Induced Conditions

If a doctor suspects or ascertains that a condition has been induced by work on offshore installations, the Danish Energy Agency must be notified.

As in previous years, notification was made via the Directorate of National Labour Inspection in 1994. In 1995, the Danish Energy Agency plans to launch an information campaign regarding the duty to report work-induced conditions, so that notification is made direct to the Danish Energy Agency.

In 1993 and 1994, the Danish Energy Agency was notified of eight presumed or recognized work-induced conditions. These conditions are distributed on the following main diagnostic groups: Muscle-skeletal conditions, ear conditions, skin diseases and other conditions.

Table 6.2 Number of Presumed or Recognized Work-Induced Conditions Reported

Diagnosis	1993	1994
Muscle-skeletal conditions	1	1
Ear conditions	2	1
Skin diseases	1	0
Other conditions	2	0
Total	**6**	**2**

Muscle-skeletal conditions denote conditions in the back, shoulders, arms or legs. Table 6.2 illustrates the distribution of the conditions reported on diagnostic groups in 1994, while Fig. 6.3 shows the distribution in the period from 1985 to 1994.

Notifications were made by contractors as well as operators.

For some of the notifications, work performed onshore may have contributed to the condition.

Not all of the notifications received can be attributed directly to fixed or mobile offshore installations. Consequently, a joint survey has been made for the two types of installations.

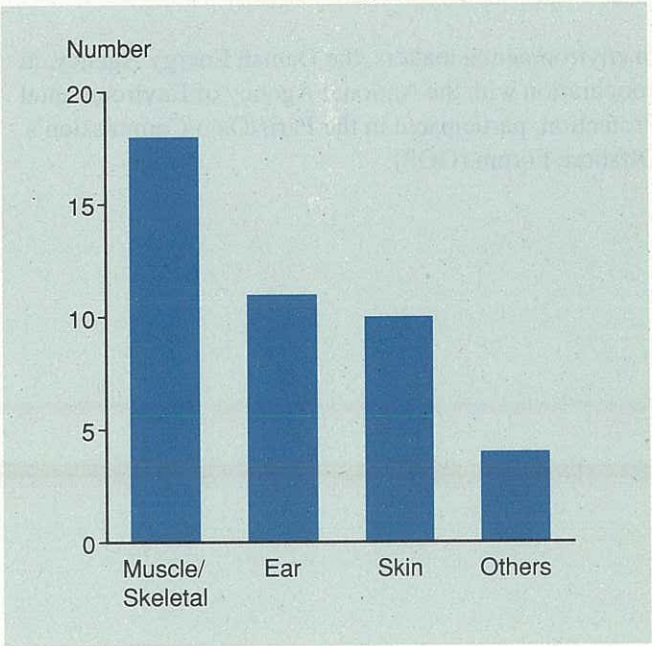
New Regulations

As before, new regulations within the oil and gas sector were drafted in cooperation with the parties involved in 1994.

In 1994, the Danish Energy Agency issued the following Executive Orders to implement EU Directives:

- Executive Order No. 540 of June 22, 1994 on safety signs and other forms of signalling on offshore installations.

Fig. 6.3 Number of Presumed or Recognized Work-Induced Conditions Reported, 1985-94



- Executive Order No. 670 of July 14, 1994 on biological agents and the working environment on offshore installations.
- Executive Order No. 798 of August 30, 1994 on threshold limit values for substances and materials on offshore installations.
- Executive Order No. 855 of October 6, 1994 on use, etc. of asbestos on offshore installations.

Further, in 1994, the Danish Energy Agency published guidelines regarding control systems on mobile offshore installations that are not drilling rigs.

International Cooperation

As in previous years, the Danish Energy Agency placed great emphasis on international cooperation with the supervisory authorities of other countries in the North Sea area in safety and working environment matters. Thus, in 1994, the Danish Energy Agency held meetings with the supervisory authorities of the individual countries and participated in cooperation within the North Sea Offshore Authorities Forum (NSOAF) on safety training and safety cases, among other things.

In 1994/95, the chairmanship of NSOAF rests with the Danish Energy Agency, which is also in charge of the annual meeting in May 1995.

Throughout 1994, the Danish Energy Agency also continued its work under the auspices of the Safety and Health Commission for the Mining and other Extractive Industries under the EU Commission.

In environmental matters, the Danish Energy Agency, in cooperation with the National Agency of Environmental Protection, participated in the Paris/Oslo Commission's Offshore Forum (GOP).

7. Environment

Environmental considerations have had an increasing impact on society in recent years. This has also led to more focus on protecting the environment in connection with the location, design and operation of offshore installations.

In Denmark, the environmental matters relating to offshore installations are regulated primarily by the Act on the Marine Environment and the Act on Certain Marine Installations. Danish legislation imposes obligations on both the National Agency of Environmental Protection and the Danish Energy Agency for protection of the environment.

The obligations of the National Agency of Environmental Protection relate primarily to discharges from platforms and their effect on the surrounding environment, as well as the preparedness to contain oil spills. The obligations of the Danish Energy Agency relate mainly to the design, equipment and operation of platforms. Cooperation between the two agencies ensures coordinated efforts.

The increased interest in the environmental aspect of activities in the North Sea is not exclusive to Denmark. Internationally, greater efforts have been made to control the marine environment in the past few years, and consequently to limit the environmental impact of offshore installations.

The Danish contribution in this context is made in cooperation among several institutions, coordinated by the National Agency of Environmental Protection. The Danish Energy Agency assists within its spheres of responsibility and participates in the international fora that are most relevant to Danish oil and gas activities.

The Danish Energy Agency bases its approach on the premise that integrated protection of environmental and safety matters will optimize results in both areas.

General

Prior to awarding the most recent licences, an evaluation of the special environmental vulnerability of the areas offered for licensing was made. Against this background, the licensees have been subjected to special obligations with regard to protecting the environment, where relevant. Likewise, environmental evaluations are made prior to the construction of production facilities, followed by environmental monitoring of the surroundings during operations.

The environmental impact from offshore installations may be a result of the presence of such installations, their normal operation or accidents, which could, for instance, lead to uncontrolled discharges.

The National Agency of Environmental Protection sets limits as to which substances and which quantities may be discharged into the sea during normal operations, and lays down requirements for environmental contingency plans.

The Danish Energy Agency regulates the location, design and operation of offshore installations with a view to avoiding accidents and associated discharges. In addition, the Danish Energy Agency has stipulated limits for the amounts of gas that may be flared without utilizing the energy released.

In keeping with the development in other areas of society, the methods used to regulate environmental matters are changing. Whereas regulation was handled previously by setting specific limits for the type and quantity of discharges, in future the focus will increasingly be placed on reducing the environmental impact by having the companies involved use the best possible technology and working methods in terms of environmental protection.

In this connection, the focus will increasingly shift to the operators' assessment of the consequences of the activity for the surrounding environment and the associated control procedures.

Reduction of CO_2 emissions

Large amounts of energy are used in the production and transportation of oil and natural gas, and it is also necessary to flare gas on offshore installations, to the extent that such gas cannot be utilized for safety or technical reasons. Therefore, offshore installations emit CO_2 in quantities that depend on the scope of production and geological, geographical and technical conditions related to the installations.

Compared to size of production, Denmark has many production facilities. This limits the possibilities of utilizing the energy effectively. Vast amounts of natural gas are produced, and transporting gas to shore consumes great amounts of energy. At the same time, Danish oil accumulations are found mainly in reservoirs with difficult

production properties, so that extraction is only possible by means of water injection or other techniques that require large amounts of energy.

'Energy 2000, a Plan of Action for Sustainable Development' set up the first Danish objective for reducing CO_2 emissions from total Danish energy consumption, including from energy production on offshore installations, but the plan did not specify any targets for reducing CO_2 emissions on offshore installations.

In 1993, Denmark acceded to the Climate Convention, which encompasses all CO_2 emissions in the territories of the countries acceding to the Convention, and thus also emissions from the offshore sector, including the flaring of gas. Therefore, total emissions from the offshore sector are included in the Danish report for 1994 made under the Climate Convention.

When 'Energy 2000, a Plan of Action for Sustainable Development' was prepared in 1988, it was assumed that the offshore sector would have a stable consumption of energy, and the specific national objectives for other sectors were set up against this background. However, the subsequent development of production technology has resulted in a substantial increase in the level of offshore activities, and thus an increase in CO_2 emissions.

However, natural gas production provides a basis for improving energy supply systems onshore, in terms of CO_2 emissions, as natural gas has replaced coal in power and heat production. The CO_2 emission per GJ is 95, 74 and 57 kg of CO_2 for coal, oil and natural gas, respectively. In other words, one m^3 of natural gas releases 2.35 kg of CO_2, while a corresponding amount of coal, measured in terms of energy, releases 3.90 kg of CO_2. For each billion m^3 of natural gas used instead of coal, onshore CO_2 emissions are therefore reduced by about 1.5 million tonnes of CO_2 or more, when considering that natural gas gives higher efficiency than coal. Likewise, the switch from oil to natural gas reduces CO_2 emissions, thus eliminating the emission of at least 0.7 kg of CO_2 per m^3 of natural gas.

The emission of CO_2 resulting from the production and transportation of oil and natural gas from existing and planned offshore installations is expected to be about 2 million tonnes of CO_2 in 1998, assuming that 7 billion m^3 of natural gas is transported to shore. Thus, the switch in Danish energy supplies makes it possible to reduce onshore CO_2 emissions, which greatly exceed total CO_2 emissions from Danish offshore installations. The domestic emissions eliminated depend on how much natural gas is exported and which fuels are replaced by natural gas in Denmark.

In cooperation with the offshore industry, the Danish Energy Agency is mapping expectations of future emissions of greenhouse gases from the production facilities, as well as the potential for reducing such emissions.

These studies verify that emissions will rise considerably in the years to come. The main reasons are that very substantial energy supplies are required to exploit the remaining reserves in the fields efficiently, and that the transportation of natural gas to shore will be increased. This increase in emissions will occur, even though the equipment used has been rendered more efficient in recent years in terms of energy consumption, and even though further improvements have been planned for the future.

Generally, it is expected that the offshore sector, like other Danish industries, will invest reasonable amounts in limiting emissions of greenhouse gases, but the special conditions prevailing in the offshore sector and the increased consumption of energy required for extraction may make reduction initiatives highly costly.

In the near future, the Danish Energy Agency will review the potential for eliminating emissions with a view to assessing whether any options exist, as yet unused, for introducing financially reasonable measures to reduce emissions over and above the reductions already planned.

Assessment of Effects on the Environment

In connection with approving the design, construction, installation and commissioning of offshore installations, a number of environmental aspects are already taken into account, as the protection of safety interests automatically involves the protection of various environmental interests.

However, it follows from the Council Directive on the assessment of the effects of certain public and private projects on the environment that the member states are to ensure, prior to establishing specific installations described in more detail, that the environmental impact of the installations is evaluated and that the general public affected is heard.

The extractive industry is comprised by Annex 2 of the Directive, which sets up various categories of projects that are exempt from an obligatory assessment proce-

dure. Accordingly, the member states may designate certain types of projects to be evaluated, or may set up criteria and/or threshold values to determine which categories of projects are to be evaluated.

Against this background, the Danish Energy Agency has drafted a proposal for the statutory provisions required to implement the Directive, in addition to the other proposed amendments to the Danish Subsoil Act, as part of implementing the Licensing Directive.

Following the adoption of the proposed amendments to the Danish Subsoil Act, the intention is now to prepare more detailed regulations to implement the Directive. These regulations will be drawn up in cooperation with the parties involved.

In drafting the more specific regulations regarding assessments of the environmental impact, the projects to be subjected to the above-mentioned obligatory assessment procedure will be specified, and attempts will be made to establish a more well-defined framework for environmental evaluations and the procedure for public hearings.

8. Research

Energy Research Programme 1995 (ERP 95)

In 1994, funding in the amount of DKK 22 million was granted for 11 proposed projects, with budgeted costs totalling DKK 40 million. The Energy Research Programme is financed by funds provided for in the Danish Finance Act.

The Danish Energy Agency has the administrative and professional responsibility for considering and evaluating project applications submitted. The Danish Energy Agency bases its undertakings to fund projects on an evaluation made by the Advisory Oil and Natural Gas Research Committee.

As last year, the principal criterion for funding is the importance of the projects to society and their relevance in terms of energy. Priority has been accorded to the following four areas of research: *exploration, recovery, equipment and installations as well as arctic oil and gas projects.*

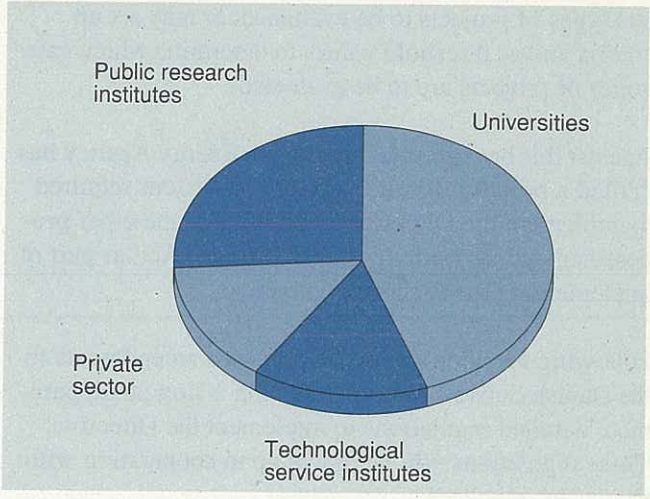
Generally, high priority is given to the following studies:

- Finding reservoir rock in the Central Graben.
- Finding source rock outside the Central Graben.
- Improving the measuring technique for testing enhanced recovery methods.
- Proceeding with the stochastic reservoir modelling technique.
- Basic scientific aspects regarding pipeline flow of relevance to flexible satellite developments, the precipitation of solid phases and extending the life of installations.
- Projects to catalyze the interest in exploration in Greenland.

Cooperation with Eastern European and Developing Countries

In connection with implementing 'Energy 2000, a Plan of Action for Sustainable Development', funds of up to DKK 10 million a year have been earmarked as from 1994 for energy research cooperation with the Eastern European and developing countries. Within the area of oil and gas activities, funds were granted for three such proposed projects in 1994 in connection with the round of applications for ERP 95.

Fig. 8.1 Distribution of ERP Funding



Licences

Certain exploration licences incorporate agreements on the provision of funds for research and development within activities which relate to exploration, production and development.

Such research and development projects were initiated in 1984, and at end-1994, projects worth approx. DKK 83 million had been completed or initiated.

Funds have been targeted at projects with the following objectives:

- To increase knowledge about geological and geophysical conditions in the subsurface that determine the formation and accumulation of oil and natural gas.
- To reduce costs of offshore structures and to develop installations and platforms for marginal fields, as well as exploration/production under extreme conditions.
- To limit and prevent impact on and damage to the environment.

International Relations

In recent years, international energy research has become closely coordinated. Through the projects selected, the Danish Energy Agency endeavours to promote coordinated research, both through its representation on international committees and by supporting the integration of national projects into major international projects.

Chalk Research Programme

This research programme was started in 1982 on the initiative of Norwegian and Danish authorities. The objective of this research programme is to enhance recovery from chalk formations. The expenses for the programme are shared between seven oil companies, including Mærsk Olie og Gas AS.

The research programme consists of four phases, of which the third phase was completed in 1992. The fourth phase, which was initiated at the beginning of 1994, is expected to have a duration of about three years.

In the fourth phase, research on the following topics was carried on:

- Characterizing chalk
- Effect of water injection
- Mechanical properties of chalk

A total of DKK 43 million was invested in this research in the three initial stages, and the budgeted cost of the fourth phase is about DKK 18 million.

EU Research and Development Programmes

The fourth EU framework programme for research, technological development and demonstration was finally adopted at the end of 1994, and the non-nuclear energy research programme was announced later in mid-December 1994.

Within the energy area, the new programme for research and development, *Joule*, and the demonstration programme, *Thermie*, have been combined within a joint framework, but with a clear distinction between the two programme areas, as well as their administration. The Joule programme is administered by DG XII and the Thermie programme by DG XVII.

The budget for the combined programme totals about ECU 1 billion, equal to about DKK 8 billion. Oil and gas research has been given high priority in the programme, for both Joule and Thermie. The first results of the initial rounds of applications are expected to be made known at end-1995.

A special Thermie II programme concerning the dissemination of energy technology is expected to be finally adopted in mid-1995. This programme will have a total budget of approx. DKK 220 million a year.

The 1994 results for the Thermie I round most recently held are now available in their entirety. The result for the oil and gas area was quite satisfactory from a Danish point of view, as two Danish projects were awarded just over ECU 1.6 million (approx. DKK 12.5 million).

The Nordic Energy Research Programme

Under the Nordic Energy Research Programme, funds are allocated to senior researchers and students carrying on research, who participate in inter-Nordic research cooperation at Nordic universities. The Danish participation in this cooperation is financed by the Energy Research Programme, and the Danish Energy Agency is represented on the executive research committee in charge of the programme.

This cooperation is administered by a number of expert committees. The Petroleum Technology Expert Committee considers applications for funding within the area of oil and gas activities. In 1994, the Expert Committee awarded grants to 13 senior researchers and recipients of PhD scholarships.

Appendix A

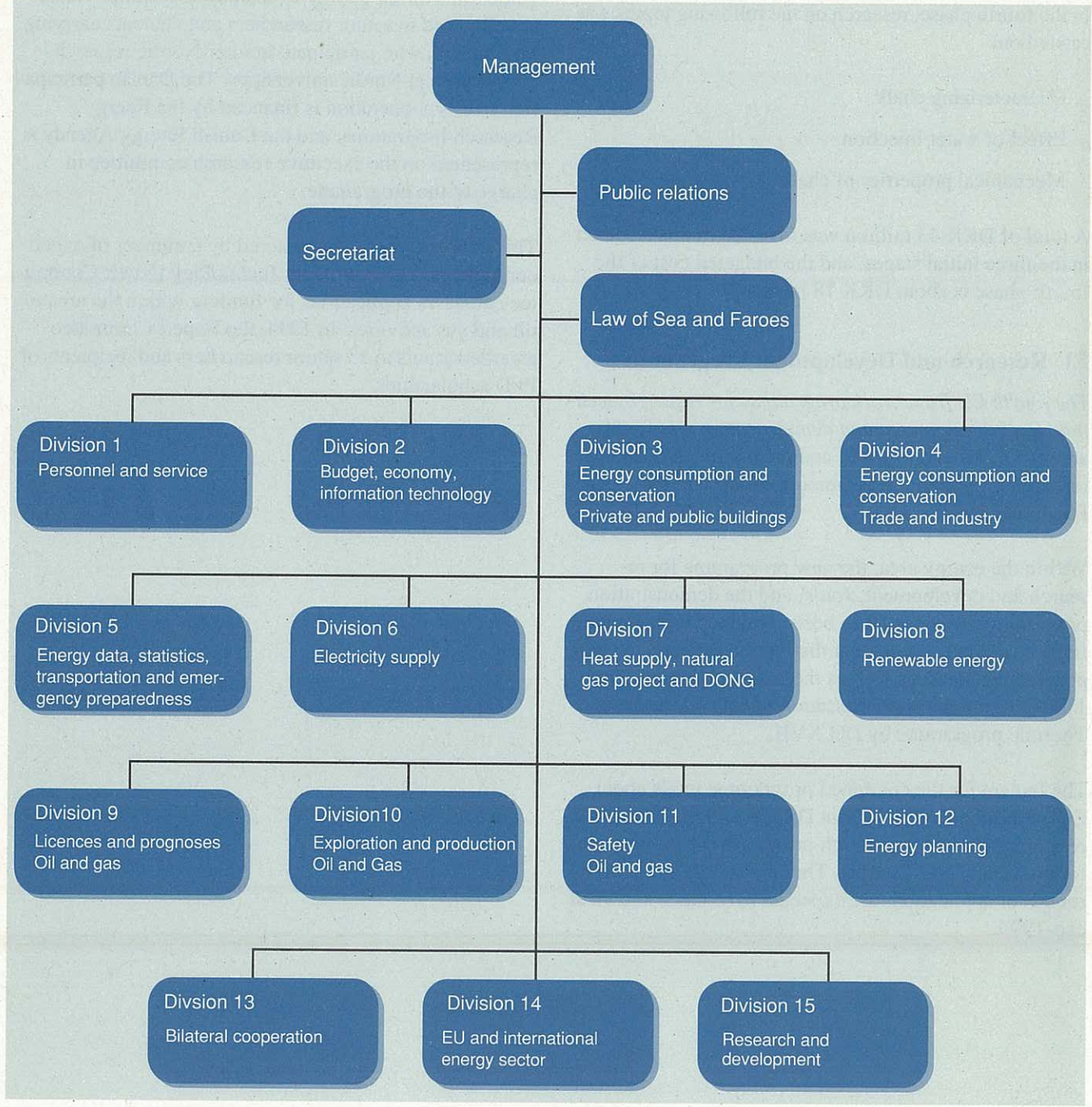
Organization

The merger between the Ministry of Energy and the Ministry of the Environment in October 1994 led to changes in the Danish Energy Agency's sphere of activity, structure and staffing.

The energy-related tasks undertaken by the former department of the Ministry of Energy have been transferred to the Danish Energy Agency. Likewise, the unit dealing with the law of the sea and the Faroe Islands is part of the Danish Energy Agency today. The Mineral Resources Administration for Greenland has been placed in the vicinity of the Danish Energy Agency, from where its secretariat functions are handled.

The Danish Energy Agency handles all technical matters and case administration within the energy area for the Ministry of Environment and Energy. In this connection, the Agency undertakes the complete processing of all energy-related matters to be submitted to the Minister, and handles relations and coordination with external parties.

Fig. A1 Organizational Chart of the Danish Energy Agency



The new organization of the Danish Energy Agency is shown by Fig. A1. The Danish Energy Agency has 15 divisions, in addition to the special unit responsible for matters relating to the law of the sea and advising the Faroese Home Rule authorities.

At the turn of the year 1994/95, the Agency employed the equivalent of about 250 full-time employees, about 40 of whom are involved in the administration of oil and gas activities.

Accordingly, the responsibilities of the Danish Energy Agency within the area of oil and gas include those previously allocated to the department, including matters concerning licensing, the approval of development plans and general issues relating to the DONG group.

Thus, the administration of oil and gas activities are handled by the 9th, 10th and 11th divisions of the Danish Energy Agency, assisted by the 7th and 15th divisions and the Law of the Sea Unit to some extent. How responsibilities between the oil and gas divisions are divided is dealt with in more detail below.

The Ninth Division. Licences and Forecasts, Oil and Gas

Licensing policy and administration, licensing rounds and the awarding of licences. Preparing analyses, evaluating the potential and making forecasts of Danish oil and gas reserves. Evaluating commercial viability within the oil and gas sector. The Licensing Directive, oil and gas issues relating to the European Energy Charter. The legal and financial supervision of the licensees' activities. The Danish Subsoil Act, the Oil Pipeline Act and the Act on the Continental Shelf. DOPAS and DORAS.

The Tenth Division. Exploration and Production of Oil and Gas

Supervising exploration and production activities in terms of resources. Approving appraisal programmes and work programmes. Evaluating declarations of commerciality. Approving development plans and production profiles. Matters concerning unitization and safe production. Geological evaluations and reservoir engineering.

The Eleventh Division. Safety and Working Environment in the Oil/Gas Sector

Activities concerning safety, working environment and other environmental issues under the provisions of the Danish Act on Certain Marine Installations and the Subsoil Act. Approving mobile and fixed installations as well as pipelines. Supervising the safety, working environment and other environmental aspects of offshore installations and pipelines, as well as monitoring drilling operations in terms of safety. Approving and supervising manning tables and organizational charts, as well as undertaking the tasks related to membership of the Action Committee, the Coordination Committee and the Average Commission for Offshore Installations. Supervising supplies conveyed through DONG's transmission system and supervising the technical safety aspects of DONG's storage facilities. Drawing up regulations in this area.

The Seventh Division. Heat Supply, the Natural Gas Project and DONG

Activities under the provisions of the Danish Heat Supply Act, expanding decentralized heat and power systems and using environmentally friendly energy sources. Legal/administrative and financial issues. Approving projects and hearing appeals under the Heat Supply Act. Agenda 21 planning and work on the 'Brundtlandby' project. Act on Subsidies to Promote Connection to Coal-Fired Combined Heat and Power Systems. Matters concerning the DONG group and the regional natural gas companies. The financial, legal, technical and organizational matters related to the implementation of the natural gas project. The Danish Act on Natural Gas Supplies and matters concerning the purchase and export of natural gas.

The Fifteenth Division. Research and Development

National and international activities regarding energy research. The national activities include administering energy research programmes, research policy proposals and statements, as well as acting as the secretariat of the Advisory Oil and Natural Gas Research Committee. The international activities relate mainly to the EU research programmes, the IEA and the Nordic Energy Research Programme.

The Law of the Sea Unit

Issues relating to the Convention on the Law of the Sea, the delimitation of the continental shelf, as well as advising the Faroese Home Rule authorities.

Appendix B

Licences in Denmark

Group	Share
Dansk Undergrunds Consortium (DUC):	
The Sole Concession of July 8, 1962	
Blocks: 5504/5 and 6 (Elly)	
Blocks: 5603/27 and 28 (Gert)	
Blocks: 5504/10 and 14 (Rolf)	
Block: 5604/25 (Svend)	
Blocks: 5604/21 and 22 (Harald)	
Blocks: 5504/7, 8, 11, 12, 15 and 16 5505/13, 17 and 18 (Contiguous Area)	
A.P. Møller (Concessionaires)	39.00%
Shell Olie- og Gasudvinding Danmark BV	46.00%
Texaco Denmark Inc.	15.00%
Mærsk Olie og Gas AS is operator	
2nd and 3rd Round Groups:	
Licence 7/86	
Blocks: 5604/22 and 26	
Statoil Efterforskning og Produktion A/S	33.54%
Total Marine Danmark	15.19%
LD Energi A/S	9.49%
EAC Energy A/S	5.06%
DENERCO K/S	11.39%
DOPAS	25.32%
Statoil is operator and DANOP will be operator in a development phase	
Licence 1/89, 2/89	
Blocks: 5504/6 and 10 (1/89)	
Block: 5603/26 (2/89)	
Amoco Denmark Exploration Co.	70.00%
FLS-Energy A/S	5.00%
DENERCO K/S	5.00%
DOPAS	20.00%
Amoco is operator	
Licence 3/89	
Blocks: 5606/13, 14, 15, 17 and 18	
Amoco Denmark Exploration Co.	80.00%
FLS-Energy A/S	5.00%
DENERCO K/S	5.00%
DOPAS	10.00%
Amoco is operator	
Licence 7/89	
Block: 5504/2	
Blocks: 5604/25, 29 and 30	
Amerada Hess (Denmark) A/S	65.69%
Danoil Exploration A/S	1.81%
DENERCO K/S	7.50%
DOPAS	25.00%
Amerada Hess is operator	

Group	Share
Licence 8/89	
Block: 5603/32	
Block: 5604/29	
Amerada Hess (Denmark) A/S	58.72%
Danoil Exploration A/S	2.55%
DENERCO K/S	10.56%
DOPAS	28.17%
DANOP is operator	
Licence 10/89	
Blocks: 5603/27 and 31	
A.P. Møller	26.67%
Shell Olie- og Gasudvinding Danmark BV	26.67%
Texaco Denmark Inc.	26.67%
DOPAS	20.00%
Mærsk Olie og Gas AS is operator	
Licences awarded in 1990 and 1992:	
Licence 1/90	
Block: 5604/18	
Statoil Efterforskning og Produktion A/S	33.54%
Total Marine Danmark	15.19%
LD Energi A/S	9.49%
EAC Energy A/S	5.06%
DENERCO K/S	11.39%
DOPAS	25.32%
Statoil is operator and DANOP is co-operator	
Licence 2/90	
Blocks: 5604/23 and 24	
Statoil Efterforskning og Produktion A/S	40.42%
Total Marine Danmark	18.31%
LD Energi A/S	11.44%
EAC Energy A/S	6.10%
DENERCO K/S	13.73%
DOPAS	10.00%
DANOP is operator	
Licence 3/90	
Block: 5603/28	
A.P. Møller	31.20%
Shell Olie- og Gasudvinding Danmark BV	36.80%
Texaco Denmark Inc.	12.00%
DOPAS	20.00%
Mærsk Olie og Gas AS is operator	

Group	Share
Licence 1/92	
Blocks: 5508/27, 28 and 32	
DOPAS	50.00%
RWE-DEA Denmark Oil GmbH	35.00%
Ruhrgas AG	10.00%
DENERCO K/S	5.00%
DANOP is operator	

4th Round Groups:

Group	Share
Licence 1/95	
Blocks: 5503/2 and 3	
Blocks: 5603/30 and 31	
Amerada Hess (Denmark) A/S	40.00%
Premier Oil BV	20.00%
DENERCO K/S	20.00%
DOPAS	20.00%
Amerada Hess is operator, DANOP is co-operator	
Licence 2/95	
Blocks: 5503/3 and 4	
Block: 5603/31	
Block: 5604/29	
Amerada Hess (Denmark) A/S	69.44%
DOPAS	20.00%
DENERCO K/S	10.56%
DANOP is operator, Amerada Hess is co-operator	
Licence 3/95	
Blocks: 5604/19 and 20	
Block: 5605/21	
Statoil Efterforskning og Produktion A/S	56.60%
DOPAS	20.00%
DENERCO K/S	13.23%
LD Energi A/S	10.17%
DANOP is operator, Statoil is co-operator	
Licence 4/95	
Block: 5604/20	
Blocks: 5605/4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17	
Blocks: 5606/1, 5 and 9	
Mobil Erdgas-Erdöl GmbH	27.50%
RWE-DEA AG	20.00%
Wintershall AG	20.00%
DOPAS	20.00%
EWE AG	12.50%
DANOP is operator	

Group	Share
Licence 5/95	
Blocks: 5603/30 and 31	
Phillips Petroleum Int. Corp. Denmark	35.00%
Amerada Hess (Denmark) A/S	20.00%
DOPAS	20.00%
AS Pelican	15.00%
DENERCO K/S	5.00%
Premier Oil BV	5.00%
Phillips is operator	
Licence 6/95	
Blocks: 5604/16 and 20	
Blocks: 5605/13 and 17	
Statoil Efterforskning og Produktion A/S	50.00%
Enterprise Oil Exploration Ltd.	20.00%
DOPAS	20.00%
DENERCO K/S	10.00%
Statoil is operator and DANOP is co-operator	
Licence 7/95	
Block: 5505/22	
A.P. Møller	26.67%
Shell Olie- og Gasudvinding Danmark BV	26.67%
Texaco Denmark Inc.	26.67%
DOPAS	20.00%
Mærsk Olie og Gas AS is operator	
Licence 8/95	
Blocks: 5504/3 and 4	
Shell Olie- og Gasudvinding Danmark BV	36.80%
A.P. Møller	31.20%
DOPAS	20.00%
Texaco Denmark Inc.	12.00%
Mærsk Olie og Gas AS is operator	
Licence 9/95	
Blocks: 5604/21, 22, 25 and 26	
Shell Olie- og Gasudvinding Danmark BV	36.80%
A.P. Møller	31.20%
DOPAS	20.00%
Texaco Denmark Inc.	12.00%
Mærsk Olie og Gas AS is operator	

Appendix C

Exploration and Appraisal Wells, 1986-1994

Well Number	Operator Drilling Rig	Lat. North Long. East	Total Depth Formation	Spudded Completed
Lulu-2	Mærsk Olie og Gas AS	56°19'06"	3603 metres	1985-12-15
5604/22-2	Mærsk Endeavour	04°17'31"	U. Permian	1986-03-18
Diamant-1	Phillips	56°00'23"	4204 metres	1986-01-11
5603/32-2	Glomar Labrador 1	03°53'44"	L. Permian	1986-03-18
East Rosa-3	Mærsk Olie og Gas AS	55°35'37"	1569 metres	1986-01-20
5504/15-5	Dyvi Epsilon	04°36'31"	U. Permian	1986-03-19
East Rosa Fl.-1	Mærsk Olie og Gas AS	55°33'51"	3037 metres	1986-03-24
5504/15-6	Mærsk Endeavour	04°37'54"	U. Jurassic	1986-04-30
Ravn-1	Amoco	55°52'36"	4968 metres	1986-03-24
5504/01-2	Dyvi Epsilon	04°13'52"	L. Permian	1986-07-21
Mi. Rosa Fl.-1	Mærsk Olie og Gas AS	55°35'27"	3035 metres	1986-05-04
5504/15-7	Mærsk Endeavour	04°31'33"	L. Cretaceous	1986-06-11
West Lulu-4	Mærsk Olie og Gas AS	56°19'05"	3814 metres	1986-07-28
5604/21-6	Mærsk Endeavour	04°10'17"	L. Triassic	1986-09-13
Gwen-2	Mærsk Olie og Gas AS	56°06'52"	4363 metres	1986-09-30
5604/29-3	Mærsk Endevour	04°04'10"	L. Triassic	1986-12-15
Mejrup-1	Phillips	56°22'39"	2481 metres	1987-03-22
5608/19-1	Kenting 36	08°40'36"	U. Triassic	1987-04-29
Felicia-1	Statoil	57°26'18"	5280 metres	1987-07-04
5708/18-1	Mærsk Guardian	08°18'41"	L. Permian	1987-12-03
Gert-3	Mærsk Olie og Gas AS	56°12'43"	5003 metres	1987-07-21
5603/28-2	Mærsk Endeavour	03°45'49"	Palaeozoic	1987-10-28
Ibenholt-1	Phillips	56°23'26"	2558 metres	1987-08-11
5605/20-1	Dyvi Sigma	05°58'29"	Precambrian	1987-09-24
Deep Gorm-1	Mærsk Olie og Gas AS	55°34'04"	3823 metres	1987-08-18
5504/16-5	Zapata Scotian	04°45'50"	Triassic	1987-12-04
Ravn-2	Amoco	55°50'34"	4466 metres	1987-09-16
5504/05-1	Dan Earl	04°13'40"	Triassic	1987-11-17
Elly-2	Mærsk Olie og Gas AS	55°47'19"	4104 metres	1987-11-15
5504/06-2	Neddrill Trigon	04°19'04"	Triassic	1988-05-31
Jeppe-1	Norsk Hydro	56°11'04"	5047 metres	1987-12-10
5603/28-3	Mærsk Guardian	03°54'36"	L. Permian	1988-03-02
Borg-1	Danop	55°02'57"	3063 metres	1988-04-18
5508/32-2	Kenting 34	08°48'23"	Palaeozoic	1988-05-29
Gulnare-1	Statoil	56°10'13"	4735 metres	1988-06-04
5604/26-1	Mærsk Endeavour	04°26'41"	U. Jurassic	1988-09-19
Tordenskjold-1	Danop	55°56'19"	3702 metres	1988-12-14
5503/03-2	Neddrill Trigon	03°32'31"	L. Permian	1989-02-04
Pernille-1	Norsk Hydro	55°00'54"	3589 metres	1989-04-09
5514/30-1	Glomar Moray Firth	14°18'43"	Silurian	1989-06-06
Stina-1	Amoco	54°47'20"	2482 metres	1989-06-12
5414/07-1	Glomar Moray Firth	14°37'44"	Silurian	1989-07-11
Falk-1	Amoco	55°50'01"	4200 metres	1989-07-24
5504/06-3	Glomar Moray Firth	04°18'50"	U. Triassic	1989-09-05
Gert-4	Mærsk Olie og Gas AS	56°13'18"		1989-11-02
5603/27-4	Mærsk Endeavour	03°43'48"		1990-05-16
Alma-1	Mærsk Olie og Gas AS	55°28'58"		1990-03-18
5505/17-10	Mærsk Giant	05°12'33"		1990-08-16
Amalie-1	Statoil	56°14'39"	5320 metres	1990-08-01
5604/26-2	Neddrill Trigon	04°22'02"	Jurassic	1991-06-17
E-5	Mærsk Olie og Gas AS	55°40'25"		1991-02-05
5504/12-4	West Sigma	04°53'11"		1991-05-11
Skjold Fl.-1	Mærsk Olie og Gas AS	55°33'23"		1991-05-10
5504/16-6	West Kappa	04°53'51"		1991-09-22
Eg-1	Agip	55°57'09"	4500 metres	1991-06-24
5503/04-2	Neddrill Trigon	03°58'25"	Permian	1991-09-23
Baron-1	Norsk Hydro	56°01'44"	999 metres	1991-07-25
5604/30-2	Mærsk Jutlander	04°15'29"		1991-08-01
Baron-2	Norsk Hydro	56°01'44"	5100 metres	1991-08-01
5604/30-3	Mærsk Jutlander	04°15'29"	U. Jurassic	1992-01-13
Elly-3	Mærsk Olie og Gas AS	55°47'19"		1991-09-12
5504/06-5	Mærsk Endeavour	04°22'02"		1992-02-12
TWC-3P	Mærsk Olie og Gas AS	55°42'56"		1991-09-14
5504/11-3	Mærsk Giant	04°44'56"		1991-11-24
S.E.Adda-1	Mærsk Olie og Gas AS	55°47'56"		1992-01-26
5504/08-5	Mærsk Giant	04°55'07"		1992-03-05
Dagmar-6	Mærsk Olie og Gas AS	55°35'04"		1992-02-22
5504/15-8	Mærsk Endeavour	04°35'50"		1992-04-11
E-6	Mærsk Olie og Gas AS	55°40'29"		1992-03-12
5504/12-5	Mærsk Giant	04°53'22"		1992-05-12
Lulita-1	Mærsk Olie og Gas AS	56°20'46"	3749 metres	1992-05-17
5604/22-3	Mærsk Giant	04°16'24"	M. Jurassic	1992-12-20
E-7	Mærsk Olie og Gas AS	55°40'43"		1992-06-11
5504/12-6	West Sigma	04°49'24"		1992-07-18
Bertel-1	Danop	56°02'12"	4810 metres	1992-06-27
5603/32-3	West Omikron	03°58'03"	Triassic	1992-10-07
Ida-1	Amoco	56°32'11"	1663 metres	1992-09-14
5606/13-1	Ross Explorer	06°06'58"	Triassic	1992-09-30
Rita-1	Mærsk Olie og Gas AS	56°09'09"	4758 metres	1992-09-18
5603/27-5	Mærsk Endeavour	03°34'13"	Triassic	1993-03-03
Skarv-1	Amoco	55°43'14"	3935 metres	1992-10-04
5504/10-2	Ross Explorer	04°24'58"	Triassic	1992-11-17
Jelling-1	Danop	55°44'22"	1933 metres	1992-10-05
5509/10-1	Kenting 31	09°22'33"	Precambrian	1992-10-24
Alma-2	Mærsk Olie og Gas AS	55°29'50"		1992-10-18
5505/17-11	Shelf Explorer	05°13'37"		1993-02-06
Løgumkloster-2	Danop	55°02'00"	2768 metres	1993-09-01
5508/32-3	Kenting 31	08°56'32"	L. Permian?	1993-10-17
Tabita-1	Statoil	56°13'37"	4313 metres	1993-09-13
5604/26-3	Glomar Moray Firth	04°23'47"	U. Jurassic	1993-12-10
E-8	Mærsk Olie og Gas AS	55°05'22"		1994-04-10
5504/12-7	West Kappa	04°59'12"		1994-06-06
Rigs-1	Amerada Hess	56°05'22"	3050 metres	1994-12-26
5604/29-4	Mærsk Giant	04°12'53"	L. Cretaceous	1995-02-25

Exploratory Surveys 1994

Survey	Operator Contractor	Type	Initiated Completed	Area	Collected in 1994
AH94C	Amerada Hess Limited Horizon Exploration Ltd.	Offshore 2D	1994-08-23 1994-08-27	Central Graben 5503,5603	223.7 km
DN94I	Dansk Naturgas A/S CGG	Onshore 2D	1994-05-10 1994-06-07	Zealand Stenlille	64.5 km
DN94T	Dansk Naturgas A/S CGG	Onshore 2D	1994-06-08 1994-06-12	Southern Jutland Tønder	3.3 km
CG94N	CGG Norge CGG Norge	Offshore 2D	1994-02-20 1994-03-20	The North Sea 5604, 5605	403.1 km
DN94N	Dansk Operatørselskab i-s Geoteam A/S	Offshore 2D	1994-05-17 1994-05-26	The North Sea Frida	657.6 km

Appendix E1

Danish Oil Production 1972-1994, million m^3

Year	Dan	Gorm	Skjold	Tyra	Rolf	Kraka	Dagmar	Regnar	Valdemar	Total
1972	0.11									**0.11**
1973	0.15									**0.15**
1974	0.10									**0.10**
1975	0.19									**0.19**
1976	0.23									**0.23**
1977	0.58									**0.58**
1978	0.49									**0.49**
1979	0.49									**0.49**
1980	0.34									**0.34**
1981	0.34	0.53								**0.87**
1982	0.31	1.64	0.02							**1.97**
1983	0.27	1.84	0.40							**2.51**
1984	0.36	1.62	0.65	0.07						**2.70**
1985	0.45	1.80	0.85	0.35						**3.45**
1986	0.47	1.72	1.07	0.57	0.47					**4.30**
1987	1.23	1.50	1.21	0.84	0.63					**5.41**
1988	1.50	1.35	1.37	0.95	0.40					**5.57**
1989	1.47	1.35	2.21	1.05	0.39					**6.47**
1990	1.58	1.44	2.63	1.08	0.27					**7.00**
1991	1.72	1.50	2.73	1.39	0.29	0.14	0.47			**8.24**
1992	2.70	1.66	2.28	1.67	0.30	0.21	0.31			**9.13**
1993	3.26	1.89	2.10	1.64	0.18	0.39	0.07	0.15	0.05	**9.73**
1994	3.50	2.42	1.72	1.75	0.09	0.49	0.03	0.43	0.30	**10.73**
Total	**21.84**	**22.26**	**19.24**	**11.36**	**3.02**	**1.23**	**0.88**	**0.58**	**0.35**	**80.76**

Danish Gas Production 1972-1994, billion Nm^3

Year	Dan	Gorm	Skjold	Tyra	Rolf	Kraka	Dagmar	Regnar	Valdemar	Total	Sold
1972	0.02									**0.02**	
1973	0.03									**0.03**	
1974	0.03									**0.03**	
1975	0.06									**0.06**	
1976	0.07									**0.07**	
1977	0.17									**0.17**	
1978	0.16									**0.16**	
1979	0.16									**0.16**	
1980	0.07									**0.07**	
1981	0.08	0.08								**0.16**	
1982	0.08	0.27	0.00							**0.35**	
1983	0.08	0.43	0.04							**0.55**	
1984	0.13	0.51	0.06	0.26						**0.96**	**0.22**
1985	0.21	0.64	0.07	1.11						**2.03**	**1.06**
1986	0.24	0.78	0.10	1.63	0.02					**2.77**	**1.80**
1987	0.44	0.88	0.10	2.65	0.03					**4.10**	**2.30**
1988	0.60	0.98	0.11	3.36	0.02					**5.07**	**2.27**
1989	0.71	0.89	0.19	3.52	0.02					**5.33**	**2.68**
1990	0.80	0.81	0.22	3.30	0.01					**5.14**	**2.75**
1991	0.88	0.84	0.23	3.67	0.01	0.06	0.07			**5.76**	**3.52**
1992	1.06	0.84	0.21	3.94	0.01	0.09	0.05			**6.20**	**3.63**
1993	1.34	0.78	0.19	3.85	0.01	0.13	0.01	0.01	0.03	**6.35**	**4.00**
1994	1.26	0.92	0.19	3.65	<0.01	0.12	0.01	0.03	0.10	**6.27**	**4.33**
Total	**8.68**	**9.65**	**1.71**	**30.94**	**0.13**	**0.40**	**0.14**	**0.04**	**0.13**	51.82	28.57

A large amount of gas has been reinjected

Natural Gas Supplies from Danish Fields 1984-1994, million Nm^3

Year	Dan	Kraka	Regnar	Gorm	Skjold	Rolf	Dagmar	Tyra	Valdemar	Total
1984	7	-	-	19	2	-	-	192	-	**220**
1985	49	-	-	0	0	-	-	1015	-	**1064**
1986	211	-	-	116	14	3	-	1460	-	**1804**
1987	378	-	-	21	2	1	-	1898	-	**2300**
1988	534	-	-	96	11	1	-	1629	-	**2271**
1989	639	-	-	55	12	1	-	1977	-	**2684**
1990	737	-	-	99	27	1	-	1889	-	**2753**
1991	769	49	-	167	46	2	-	2484	-	**3517**
1992	932	78	-	151	38	2	-	2427	-	**3628**
1993	1228	115	7	298	75	3	-	2262	17	**4005**
1994	1128	104	24	715	145	3	-	2149	59	**4327**
Total	**6612**	**346**	**31**	**1737**	**372**	**17**	**-**	**19383**	**76**	**28573**

Monthly Oil and Condensate Production 1994, thousand m^3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1994
Dan	283	231	278	288	310	291	306	297	289	309	296	318	**3496**
Kraka	36	30	33	31	34	34	48	48	38	53	51	55	**490**
Regnar	76	74	71	54	36	26	21	18	15	14	12	11	**429**
Gorm	201	186	203	200	195	209	212	205	205	203	201	198	**2421**
Skjold	158	141	153	138	138	141	145	136	130	144	146	145	**1715**
Rolf	13	11	8	10	11	7	7	8	9	5	4	<1	**92**
Dagmar	4	3	4	4	3	3	3	2	3	3	0	1	**33**
Tyra	172	147	176	171	144	133	116	103	126	156	151	152	**1748**
Valdemar	24	21	23	24	28	15	32	27	25	30	29	26	**304**
Total	**968**	**843**	**949**	**920**	**901**	**860**	**891**	**845**	**839**	**914**	**890**	**908**	**10727**

Monthly Gas Production 1994, million Nm^3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1994
Dan	112	94	98	101	107	106	104	105	103	112	111	111	**1263**
Kraka	11	8	8	8	9	9	10	10	10	11	12	13	**119**
Regnar	4	4	4	3	2	2	2	1	1	1	1	1	**25**
Gorm	82	77	79	79	74	77	78	74	80	75	73	74	**922**
Skjold	18	16	17	14	15	16	17	15	14	16	14	14	**185**
Rolf	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	**4**
Dagmar	1	1	1	1	1	1	1	1	1	1	0	<1	**8**
Tyra	394	282	376	340	243	218	186	170	247	396	388	407	**3646**
Valdemar	14	12	8	6	7	5	8	7	7	8	8	7	**96**
Total	**636**	**493**	**593**	**553**	**459**	**434**	**405**	**383**	**463**	**619**	**605**	**626**	**6269**

Appendix F1

Domestic Energy Supplies 1972-1994, Distributed on Fuels, as well as Energy Production (million t.o.e.) and Degree of Self-Sufficiency (per cent)

	Oil	Natural Gas[1])	Coal	Renewable Energy, etc.	Total	Energy Production	Self-Sufficiency A	B	C
1972	17.9	-	1.2	0.3	**19.4**	0.4	<1	<1	2
1973*)	17.4	-	1.9	0.2	**19.5**	0.3	<1	<1	2
1974*)	15.9	-	1.7	0.2	**17.8**	0.3	<1	<1	2
1975	15.2	-	2.0	0.3	**17.6**	0.5	1	1	3
1976	16.0	-	2.9	0.4	**19.2**	0.6	1	1	3
1977	16.0	-	3.3	0.4	**19.6**	0.9	3	3	4
1978	16.0	-	4.0	0.4	**20.5**	0.9	3	2	4
1979	15.9	-	4.8	0.5	**21.2**	0.9	3	2	4
1980	13.2	-	5.7	0.6	**19.5**	0.9	2	2	5
1981	11.6	0.0	6.0	0.7	**18.3**	1.5	7	4	8
1982	10.8	0.0	6.2	0.8	**17.9**	2.5	16	10	14
1983	10.2	0.1	6.6	0.8	**17.8**	3.1	22	13	17
1984	10.2	0.2	7.1	0.9	**18.3**	3.5	25	14	19
1985	10.4	0.7	7.4	0.9	**19.3**	4.9	36	21	25
1986	10.2	1.2	7.4	1.0	**19.7**	6.5	48	28	33
1987	9.7	1.5	7.7	1.1	**20.0**	8.0	63	35	40
1988	9.0	1.6	7.7	1.1	**19.4**	8.3	67	37	43
1989	8.6	1.8	7.6	1.2	**19.1**	9.6	80	44	50
1990	8.3	1.9	7.6	1.2	**18.9**	10.2	88	47	53
1991	8.3	2.1	7.8	1.3	**19.5**	12.0	102	54	61
1992	8.3	2.2	7.7	1.5	**19.6**	13.0	110	59	66
1993	8.1	2.5	7.5	1.5	**19.5**	14.0	117	64	71
1994*)	8.5	2.7	7.0	1.6	**19.7**	15.2	122	69	77

Climatic correction has not been applied, as opposed to other surveys of consumption

A) Oil and gas production vs domestic oil and gas consumption
B) Oil and gas production vs domestic energy consumption
C) Total energy production vs domestic energy consumption
*) Estimate
[1]) Including fuel consumption offshore

Financial Key Figures

	Investments in Field Development DKK million	Operating Costs for Fields [1] DKK million	Exploration Costs [2] DKK million	Crude Oil Price [3] USD/bbl	Exchange Rate DKK/USD	Inflation Rate [4] per cent	Net Foreign-Currency Expenditure on Energy Import DKK million
1972	105	32	28	3.0	7.0	6.6	3.3
1973	9	34	83	4.6	6.1	9.3	4.3
1974	38	58	76	11.6	6.1	15.2	9.8
1975	139	64	118	12.3	5.8	19.6	9.4
1976	372	71	114	12.3	6.1	9.0	10.3
1977	64	88	176	14.0	6.0	11.2	11.4
1978	71	128	55	14.0	5.5	10.0	10.9
1979	387	146	78	20.4	5.3	9.6	15.5
1980	956	169	201	37.5	5.6	12.3	21.2
1981	1651	402	257	37.4	7.1	11.7	25.9
1982	3948	652	566	34.0	8.4	10.2	25.9
1983	3528	615	1264	30.5	9.1	6.9	21.9
1984	1596	1405	1211	28.2	10.4	6.3	22.8
1985	1956	2256	1373	27.2	10.6	4.7	23.4
1986	1694	1598	721	14.7	8.1	3.6	11.2
1987	914	1655	639	18.4	6.8	4.0	8.7
1988	897	1604	420	14.8	6.7	4.6	6.7
1989	1145	1821	300	18.0	7.3	4.8	7.4
1990	1736	1924	594	23.5	6.2	2.6	5.7
1991	2260	2173	997	20.0	6.4	2.4	5.1
1992	2412	2081	1256	18.9	6.0	2.1	3.4
1993	3369	2319	545	16.8	6.5	1.2	3.6
1994*)	3180	2320	75	15.6	6.4	2.0	3.5

Nominal Prices [1]) Including transportation costs [2]) All licences [3]) Danish crude oil [4]) Consumer prices *) Estimate

Appendix G 1

Producing Fields

The Dan Centre

Field name:	Dan
Prospect:	Abby
Location:	Block 5505/17
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1971
Year on stream:	1972
Producing wells:	58
of which horizontal:	35
Injection wells:	20
of which horizontal:	6
Water depth:	40 m (131 ft)
Acreage:	20 km^2 (5,000 acres)
Reservoir depth:	1,850 m (6,070 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous
Reserves Expectation	
Oil:	79.9 million m^3 (503 MMbbls)
Gas:	14.4 billion Nm^3 (537 BSCF)
Cumulative Production	
Oil:	21.84 million m^3 (138 MMbbls)
Gas:	8.68 billion Nm^3 (323 BSCF)
Cumulative Injection	
Water:	6.65 million m^3 (42 MMbbls)

Review of Geology

Dan is an anticlinal structure induced through salt tectonics of the Zechstein/Triassic. The chalk reservoir has adequate porosity, although strongly reduced permeability. A major fault divides the field into two independent reservoirs. There is a gas cap in the field. In 1989, water injection was initiated in the reservoir to enhance oil recovery.

Production Facilities

The field installation comprises six wellhead platforms (A, D, E, FA, FB and FE), two processing/accommodation platforms (B and FC) and two gas flare stacks (C and FD).

Processing of the produced oil and gas takes place mainly at Dan FC. The older processing facilities at Dan B have since 1987 been used for temporary, individual well production testing only. Final processing of the produced oil is performed prior to export ashore via the booster platform, Gorm E. The gas is preprocessed at Dan FC and further transported to Tyra East for final processing and export ashore.

In 1994, water-injection capacity was expanded to 8.7 million m^3 per year (150,000 bbls per day). The processing facilities at the Dan Field handle production from the Kraka and Regnar Fields.

There are accommodation facilities for 91 persons in the Dan Field, Dan FC accommodating 86 persons.

Field name:	Kraka
Prospect:	Anne
Location:	Block 5505/17
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1966
Year on stream:	1991
Producing wells:	6
of which horizontal:	6
Water depth:	45 m (148 ft)
Acreage:	20 km^2 (5,000 acres)
Reservoir depth:	1,800 m (5,900 ft)
Reservoir rock:	Chalk
Geological age:	Danian
Reserves Expectation	
Oil:	3.3 million m^3 (21 MMbbls)
Gas:	1.1 billion Nm^3 (41 BSCF)
Cumulative Production	
Oil:	1.23 million m^3 (8 MMbbls)
Gas:	0.40 billion Nm^3 (15 BSCF)

Review of Geology

Kraka is an anticlinal structure induced through Zechstein salt tectonics, which to a certain degree has caused fracturing in the chalk. The chalk reservoir has adequate porosity, although reduced permeability. The thin oil pay zone is further characterized by high water saturations. There is a small gas cap in the field.

Production Facilities

Kraka is a satellite development to Dan FC, including an unmanned production platform of the STAR type hosting six wells. The produced oil and gas are transported to Dan FC for processing and export ashore.

Field name:	**Regnar**
Prospect:	Nils
Location:	Block 5505/17
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1979
Year on stream:	1993
Producing wells:	1
Water depth:	45 m (148 ft)
Acreage:	8 km² (2,000 acres)
Reservoir depth:	1,700 m (5,600 ft)
Reservoir rock:	Chalk and Carbonates
Geological age:	Late Cretaceous and Zechstein
Reserves Expectation	
Oil:	0.2 million m³ (1 MMbbls)
Gas:	<0.1 billion Nm³ (1 BSCF)
Cumulative Production	
Oil:	0.58 million m³ (4 MMbbls)
Gas:	0.04 billion Nm³ (1 BSCF)

Review of Geology

The Regnar field is an anticlinal structure, induced through Zechstein salt tectonics. The structure is heavily fractured, resulting in favourable reservoir conductivity (compare Skjold, Rolf and Dagmar).

Production Facilities

The Regnar Field has been developed as a satellite to the Dan Field. Production takes place in a subsea-completed well. The oil and gas produced are transported through a multiphase pipeline to Dan FC for processing and export ashore.

The Gorm Centre

Field name:	**Gorm**
Prospect:	Vern
Location:	Blocks 5504/15 and 16
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1971
Year on stream:	1981
Producing wells:	27
of which horizontal:	4
Gas injection wells:	2
Water injection wells:	13
of which horizontal:	8
Water depth:	39 m (128 ft)
Acreage:	12 km² (3,000 acres)
Reservoir depth:	2,100 m (6,900 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous
Reserves Expectation	
Oil:	23.8 million m³ (150 MMbbls)
Gas:	4.4 billion Nm³ (164 BSCF)
Cumulative Production	
Oil:	22.26 million m³ (140 MMbbls)
Gas:	9.65 billion Nm³ (359 BSCF)
Net gas:	1.73 billion Nm³ (64 BSCF)
Cumulative Injection	
Gas:	7.92 billion Nm³ (295 BSCF)
Water:	10.62 million m³ (67 MMbbls)

Review of Geology

Gorm is an anticlinal structure due to Zechstein salt tectonics. A major fault extending north-south divides the field into two individual reservoirs. The western reservoir block is heavily fractured.

Initially, there was no gas cap in the Gorm Field, but since the field was brought on stream, the injection of gas has resulted in the formation of an artificial gas cap in the western block. Gas injection is being phased out. In 1989, water injection was initiated in the reservoir.

Production Facilities

The Gorm Field consists of two wellhead platforms (A and B), one processing/accommodation platform (C), one gas flare stack (D), one riser/booster platform (E) and one combined wellhead/processing/booster platform (F).

The Gorm F facilities consist of two oil stabilization plants, one receiving the sour oil and gas from the Dagmar Field, and the other supplementing the capacity of the Gorm C facilities.

The water-injection capacity at the Gorm Centre constitutes 12.2 million m^3 per year (210,000 bbls per day).

In 1995, the Gorm F platform will be extended by a third deck to accommodate the water-processing facilities, a new water-injection pump and possibly desulphurization facilities. In 1997, wellhead compression will be established on a planned fourth deck to reduce the wellhead pressure in the Gorm and Skjold wells. In addition, a new test separator will be installed on this deck.

Final processing of oil and gas takes place at Gorm C prior to export ashore via Gorm E (oil) and Tyra East (gas). The gas reinjection facilities are installed at Gorm C.

There are accommodation facilities on Gorm C for 98 persons.

Field name:	**Skjold**
Prospect:	Ruth
Location:	Block 5504/16
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977
Year on stream:	1982
Producing wells:	10
of which horizontal:	6
Water injection wells:	5
Water depth:	40 m (131 ft)
Acreage:	10 km^2 (2,500 acres)
Reservoir depth:	1,600 m (5,200 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous
Reserves Expectation	
Oil:	16.7 million m^3 (105 MMbbls)
Gas:	1.3 billion Nm^3 (48 BSCF)
Cumulative Production	
Oil:	19.24 million m^3 (121 MMbbls)
Gas:	1.71 billion Nm^3 (64 BSCF)
Cumulative Injection	
Water:	21.64 million m^3 (136 MMbbls)

Review of Geology

The Skjold Field is an anticlinal structure induced through Zechstein salt tectonics. The structure is heavily fractured, resulting in favourable reservoir conductivity, in particular within the crestal part of the structure. In 1986, water injection was initiated in the reservoir.

Production Facilities

The Skjold Field comprises a satellite development to the Gorm Field, including two wellhead platforms, Skjold A and B, as well as an accommodation platform, Skjold C. Skjold B and C, both of the STAR type, were installed in 1993/94. They are both connected by bridges to Skjold A.

In 1994, a supplementary pipeline was installed for transporting the Skjold production to the Gorm Field.

There are no processing facilities at the Skjold Field, and the production is transported to separate facilities on the Gorm F platform, which also houses facilities providing the Skjold Field with injection water and lift gas.

At Skjold C, there are accommodation facilities for 16 persons.

Field name:	**Rolf**
Prospect:	Middle Rosa
Location:	Blocks 5504/14 and 15
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS

Discovered:	1981
Year on stream:	1986
Producing wells:	2
Observation well:	1
Water depth:	34 m (112 ft)
Acreage:	8 km² (2,000 acres)
Reservoir depth:	1,800 m (5,900 ft)
Reservoir rock:	Chalk and Carbonates
Geological age:	Danian, Late Cretaceous and Zechstein
Reserves Expectation	
Oil:	1.9 million m³ (12 MMbbls)
Gas:	0.1 billion Nm³ (3 BSCF)
Cumulative Production	
Oil:	3.02 million m³ (19 MMbbls)
Gas:	0.13 billion Nm³ (5 BSCF)

Review of Geology

Rolf is an anticlinal structure created through Zechstein salt tectonics. The chalk reservoir is heavily fractured resulting in favourable reservoir conductivity (compare Skjold). The aquifer in the Rolf Field has proved highly efficient.

Production Facilities

The Rolf Field is a satellite development to the Gorm Field with an unmanned wellhead platform. The production is transported to the Gorm F platform via pipeline for stabilization together with production from the Skjold Field. Rolf is also supplied with lift gas from the Gorm Field.

Field name:	**Dagmar**
Prospect:	East Rosa
Location:	Block 5504/15
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1983
Year on stream:	1991
Producing wells:	2
Water depth:	34 m (112 ft)
Acreage:	9 km² (2,200 acres)
Reservoir depth:	1,400 m (4,600 ft)
Reservoir rock:	Chalk and Carbonates
Geological age:	Danian, Late Cretaceous and Zechstein
Reserves Expectation	
Oil:	0.1 million m³ (1 MMbbls)
Gas:	<0.1 billion Nm³ (1 BSCF)
Cumulative Production	
Oil:	0.85 million m³ (5 MMbbls)
Gas:	0.14 billion Nm³ (5 BSCF)

Review of Geology

The Dagmar field is an anticlinal structure, induced through Zechstein salt tectonics. The structure is heavily fractured, resulting in favourable reservoir conductivity (compare Skjold, Rolf and Regnar). Initially, production rates were high, but the production experience seems to indicate that the production characteristics are less favourable than in the Skjold and Rolf Fields.

Production Facilities

The Dagmar field is a satellite development to Gorm including one unmanned production platform of the STAR type. The unprocessed production is transported to Gorm F, where special facilities for handling the sour gas from the Dagmar Field have been installed. The gas from Dagmar is flared on Gorm F without being utilized due to the high content of hydrogen sulphide.

The Tyra Centre

Field name:	**Tyra**
Prospect:	Cora
Location:	Blocks 5504/11 and 12
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Year on stream:	1984
Producing wells:	42
of which horizontal:	16
Gas injection wells:	10
Water depth:	37-40 m (121-131 ft)
Acreage:	90 km² (22,000 acres)
Reservoir depth:	2,000 m (6,600 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous

Appendix G 1

Reserves Expectation	
Oil:	7.1 million m^3 (45 MMbbls)
Condensate:	5.8 million m^3 (36 MMbbls)
Gas:	55 billion Nm^3 (2.05 TSCF)
Cumulative Production	
Oil:	4.86 million m^3 (31 MMbbls)
Condensate:	6.49 million m^3 (41 MMbbls)
Gas:	30.96 billion Nm^3 (1.15 TSCF)
Net gas:	20.78 billion Nm^3 (0.77 TSCF)
Cumulative Injection	
Gas:	10.18 billion Nm^3 (0.38 TSCF)

Review of Geology

The Tyra Field is an anticlinal structure, probably related to tectonic inversion or salt tectonics or both. The accumulation consists of a gas cap containing condensate, overlying a thin black oil zone. A gas recycling project was initiated in 1987 at Tyra West in order to enhance condensate production. The newly developed horizontal drilling technique has made it possible to exploit the oil zone, as well.

Production Facilities

The production facilities include two major production complexes, Tyra West and Tyra East, each consisting of two wellhead platforms, one processing/ accommodation platform, and one gas flare stack; a riser platform has been installed at Tyra East housing the gas export outlet into the main gas pipeline.

Final processing of gas, oil, condensate and water takes place at Tyra East. The stabilized hydrocarbon liquids are transported to Gorm for export ashore. Gas recycling facilities have been installed at Tyra West for enhanced condensate recovery. There are total accommodation facilities at the Tyra Field for 176 persons (96 at Tyra East and 80 at Tyra West).

The years to come will see a major extension of the production facilities at Tyra West as well as Tyra East, including the installation of new gas processing facilities and a bridge module supported by a four-leg platform at the TWB platform. The bridge module will house new gas processing and compression facilities. At Tyra East, the extension will consist of the installation of a bridge module supported by a STAR platform at the riser platform. This bridge module will house the facilities for receiving and handling production from the future satellite fields.

The oil and condensate produced at the Tyra Centre are transported to shore via Gorm E, while gas production from the other processing centres in the Dan and Gorm Fields is conveyed to Tyra East for export ashore.

Field name:	**Valdemar**
Prospects:	Bo, Boje, North Jens
Location:	Blocks 5504/7 and 11
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977 (Bo), 1982 (Boje), and 1985 (North Jens)
Year on stream:	1993
Producing wells:	3
of which horizontal:	3
Water depth:	38 m (125 ft)
Late Cretaceous reservoir:	
Acreage:	16 km^2 (4,000 acres)
Reservoir depth:	2,000 m (6,600 ft)
Early Cretaceous reservoir:	
Acreage:	200 km^2 (50,000 acres)
Reservoir depth:	2,600 m (8,500 ft)
Reservoir rock:	Chalk
Geological age:	Danian, Late and Early Cretaceous
Reserves Expectation	
Oil:	2.6 million m^3 (17 MMbbls)
Gas:	0.9 billion Nm^3 (35 BSCF)
Cumulative Production	
Oil:	0.35 million m^3 (2 MMbbls)
Gas:	0.13 billion Nm^3 (5 BSCF)

Review of Geology

Valdemar comprises several separate reservoirs, i.e. oil and gas reservoirs in chalk of Danian/Maastrichtian and

Campanian age and oil reservoirs in chalk of Aptian/Barremian age (Tuxen formation). The properties of the Late Cretaceous reservoirs are comparable to other Danish fields like Gorm and Tyra, while the Aptian/Barremian chalk possesses very difficult production properties. The development of the recovery technique based on the drilling of long horizontal wells with sand-filled, artificial fractures has so far shown encouraging results, however.

Production Facilities

Valdemar has been developed as a satellite to Tyra, including an unmanned production platform of the STAR type. The production is transported to Tyra East for processing and export ashore.

New Field Developments

Field name:	**Svend**
Prospects:	North Arne/Otto
Location:	Block 5604/25
Concessionaireaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1975 (North Arne) and 1982 (Otto)
Dev. plan approved:	1993
Year on stream:	April 1996 (planned)
Water depth:	65 m (213 ft)
Reservoir depth:	2,500 m (8,200 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous

Field name:	**Roar**
Prospect:	Bent
Location:	Block 5504/7
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Dev. plan approved:	1993
Year on stream:	October 1996 (planned)
Water depth:	46 m (150 ft)
Reservoir depth:	2,070 m (6,800 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous

Field name:	**Harald**
Prospects:	Lulu/West Lulu
Location:	Blocks 5604/21 and 22
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1980 (Lulu) and 1983 (West Lulu)
Plan approved:	1993

Harald West:

Year on stream:	October 1997 (planned)
Water depth:	64 m (210 ft)
Reservoir depth:	3,650 m (12,000 ft)
Reservoir rock:	Sandstone
Geological age:	Middle Jurassic

Harald East:

Year on stream:	October 1998 (planned)
Water depth:	64 m (210 ft)
Reservoir depth:	2,700 m (8,900 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous

Field name:	**Adda**
Location:	Block 5504/8
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977
Dev. plan approved:	1990
Year on stream:	1999 (planned)
Water depth:	38 m (125 ft)
Late Cretaceous reservoir:	
Reservoir depth:	2,200 m (7,200 ft)
Reservoir rock:	Chalk
Early Cretaceous reservoir:	
Reservoir depth:	2,300 m (7,500 ft)
Reservoir rock:	Chalk

Appendix G 2

Field name:	**Igor**
Location:	Block 5505/13
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Dev. plan approved:	1990
Year on stream:	1999 (planned)
Water depth:	50 m (164 ft)
Reservoir depth:	2,000 m (6,600 ft)
Reservoir rock:	Chalk
Geological age:	Danian and Late Cretaceous

Field name:	**Elly**
Location:	Block 5504/6
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1984
Dev. plan approved:	1995
Year on stream:	1999 (planned)
Water depth:	40 m (131 ft)
Reservoir depth:	3,200 m and 4,000 m (10,500 ft and 13,000 ft)
Reservoir rock:	Chalk and sandstone
Geological age:	Late Cretaceous and Jurassic

Field name:	**Alma**
Location:	Block 5505/17
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1990
Dev. plan approved:	1995
Year on stream:	2003 (planned)
Water depth:	43 m (141 ft)
Reservoir depth:	3,600 m (11,800 ft)
Reservoir rock:	Sandstone
Geological age:	Middle Jurassic

Field name:	**Gert**
Location:	Blocks 5603/27 and 28
Concessionaire:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1984
Dev. plan submitted:	1991
Water depth:	70 m (230 ft)
Reservoir depth:	4,900 m (16,100 ft)
Reservoir rock:	Sandstone
Geological age:	Late Jurassic